LAMARCK, AND NEO-LAMARCKIANISM.

BY PROF. A. S. PACKARD.

WHO WAS LAMARCK, and what work did he accomplish? Was he merely a compiler like Buffon or the author of the *Vestiges of Creation*? If we look for an answer in Darwin's immortal work *The Origin of Species*, we shall find that for once this otherwise invariably candid writer, so prone to give the fullest credit for aid to his contemporaries, in referring to his great French predecessor, whose eminence as a philosopher he did not at all appreciate, sets aside his theories and speaks of "the views and erroneous grounds of opinion of Lamarck" as having been largely anticipated by his grandfather Erasmus Darwin. It is questionable whether Darwin ever carefully read through Lamarck's *Zoologie Philosophique*, or the other writings of the French zoölogist. We have heard a young but distinguished English zoölogist call Lamarck's "a bad book," probably meaning that it was not sound from the Neo-Darwinian point of view. Ray Lankester writes of Lamarck in *Nature*, as if the doctrine of the inheritance of acquired habits were the sole, or at least the most characteristic, contribution Lamarck had made to the theory of descent. It is evident that these English writers have not carefully read all that Lamarck has written, while they do not give him that credit for the clearness and fulness of his views, which Haeckel and others in Germany have done. It should be here said that Lamarck's lucubrations on chemical and physical as well as physiological subjects are worthless, and his lack of caution in publishing them is deplorable. At the same time it should be said that, when a young man, in studying the clouds he was led to believe that weather forecasts could be made, and in geology he anticipated the uniformitarian views of Hutton and of Lyell.

After thirty years experience as a systematic botanist, his *Flore*

Française being the standard French work for many years, Lamarck at an age when many other men of science cease to be productive, was transferred to the new chair of invertebrate zoölogy in the *Jardin des Plantes*. The industry, toil, and productive thought of another period of thirty years, resulted in his placing the zoölogy of the lower animals in a clearer and better defined light than ever before. This zoölogical expert wrought most important changes and reforms. He separated the Crustacea from the insects. He established the class of Arachnida, separated the Annelida from other worms, and showed the distinctness of Echinoderms from polyps, thus anticipating Leuckart, who established the groups of Cœlenterata or polyps nearly half a century later. He founded the class of Infusoria. When a boy we used to arrange our shells by the Lamarckian system, which was universally used in the second quarter of the century, and great reforms in the classification of the Molluscs were wrought by him. He was called the French Linnæus, but his work was greatly in advance over that of Linnæus, being that of a skilful, profound systematist, who based his system on the facts of anatomy and structure.

As a zoölogical philosopher no one of his time approaches Lamarck, and indeed he lived fifty years ahead of his age, as the times were not ripe for the hearty and general adoption of the theory of descent. As in the animal world we have here and there prophetic types, anticipating in their generalised, synthetic nature the incoming, ages after, of more specialised types, so Lamarck anticipated by more than a half century the principles underlying the present evolutionary views, although owing to the sneers and criticisms of Cuvier and others his views were neglected and almost forgotten for a generation.

Let us compare the factors of Lamarck and of some of his contemporaries with those of Darwinism as such. The factors of Buffon who lived from 1707 to 1788 were three: climate, food, and domestication, and he insisted that there was a balance in nature. The factors of Erasmus Darwin (1731–1802), in his poem entitled "Zoonomia," were the reactions of the organism to the action of external surroundings, while use and effect were vaguely insisted on. He suggested that all the forms of life originated from a single filament, but as he had little practical skill as a systematist he did not suggest or construct a phylum.

Let us now compare first the general principles insisted upon by Lamarck, and then enumerate the Lamarckian factors. He insisted on the great length of time during which life-forms had existed, the gradual, uniform action of physical and biological forces, and the absence of catastrophies, thus anticipating the uniformitarian views in geology of Hutton and Lyell. He claimed that the lower forms arose by spontaneous generation, and are being so produced at the present day. He believed in progressive development, also insisting that many forms, whole orders and classes, were the result of retrogressive development and degeneration. He explained rudimentary structures as remains of parts which had been actively used by the ancestors, but which have become atrophied by disuse. He very clearly states that development goes on from the simple to the complex, and that the animal kingdom is like a tree, with wide gaps between the branches. He fully appreciated the fact of variation, as what botanist or zoölogist does not,—and Lamarck worked over fifty years handling and examining the lower organisms. He intimated, for instance, that specific characters vary most, and that the peripheral parts, as the legs, mouth-parts, antennæ, etc., are first affected by the causes which produce variations, while he distinctly states that it required a longer time for variation to take place in the internal organs. He also recognises the great fact of adaptation to needs. Lamarck has given us the best definition of species we have been able to find. Unlike Buffon, he is never self-contradictory or ironical, and maintained his views without modifying them till the end of his life.

Lamarck's factors of organic evolution were seven, as follows:

1. Change of environment, both direct and indirect in its action on the organism; these include change of habitat, of climate, soil, food, temperature.

2. Needs, new desires, appetites, not so much mere mental desires as the necessities of the entire organism, physical and mental, due to changes in the surroundings. Lamarck's use of the word need or necessity (*besoin*) has been greatly misunderstood and caricatured. By such changes animals are subjected to new needs. Lamarck gives as an instance the birds driven by necessity (*besoin*) to obtain their food in the water, who gradually assumed characters adapting them for swimming, wading, or for searching for food in the shallow water, as in the case of the long-necked kinds. Snakes lost their limbs in becoming adapted for gliding through brush or grass or such places. His best examples are the giraffe, kangaroo, and the ai, the lemur of Madagascar, so wonderfully adapted for an arboreal life. The acquisition of new habits or usages through necessity (*besoin*), owing to a change in surroundings, is much dwelt upon. He claims: "*Il est facile de démontrer par l'observation que*

ce sont usages qui ont donné lieu aux formes," which is another expression for Geoffroy St. Hilaire's "*C'est la function qui crèe l'organe.*"

By many, including Wallace, Lamarck's views under this head are not fairly stated. It is evident to any one who will carefully read what he says of "*besoins*" that he does not refer so much to mental desires as to those needs thrust upon the animal by change of circumstances. Wallace in his classical essay which appeared in 1858 inaccurately states Lamarck's views when he represents Lamarck as saying that the giraffe acquired its long neck by desiring to reach the foliage of the more lofty shrubs, and constantly stretching its neck for the purpose. What Lamarck does say is that "the giraffe lives in dry, desert places, without herbage, so that it is obliged to browse on the leaves of trees, and is continually forced to reach up to them. It results from this habit, continued for a long time in all the individuals of its species, that its fore limbs have become longer than its hind ones and that its neck has become so elongated that the giraffe, without raising itself erect on its hind legs, raises its head and reaches six metres high (almost twenty feet). We submit that this mode of evolution of the giraffe is quite as reasonable as the one insisted upon by Mr. Wallace. Quatrefages has also protested against the way Lamarck's views have been caricatured, although he was not himself an evolutionist.

3. Use and disuse. While the continual use or exercise of organs develops them, as in the case of birds, giraffes, and kangaroos, the second of these principles was illustrated by the case of the mole, the spalax, the whale-bone whales, whose rudimentary teeth exist in the embryo, the ant-lion, the blind Proteus of caves, the eyeless bivalves, and the snakes, whose limbs he claimed have disappeared from disuse.

4. Lamarck frequently refers to the precautions that nature has taken to place limits to the too great increase in individuals, and consequent overcrowding of the earth. The stronger and better armed, he says, devour the weak, the large animals devour the smaller. The multiplication of the smaller species is so rapid that these smaller species render the earth inhabitable for others, but their length of life is very short, and nature always preserves them in just proportions not only for their own preservation, but also for that of other species. The larger species, however, multiply slowly, and thus is preserved the kind of equilibrium which should exist. These views are of the same general scope as Darwin's law of struggle for existence, and imply Spencer's principle of the survi-

val of the fittest. Lamarck does not, however, bring out clearly the fact of competition, a cardinal doctrine of Darwinism.

5. Lamarck's characteristic doctrine is the inheritance of characters, including those acquired during the lifetime of the individual. But this was also held by Darwin and all evolutionists until called in question by Weismann. The doctrine of heredity itself he recognised as a fundamental principle in biology.

6. The effects of crossing were considered by Lamarck, and, what has been overlooked by commentators, he clearly insists on the swamping effects of crossing, saying: "If, when any peculiarities of form or any defects whatsoever are acquired, the individuals in this case always pairing, they will reproduce the same peculiarities, and if for successive generations confined to such unions, a special and distinct race will then be found. But perpetual crosses between individuals which have not the same peculiarities of form, result in the disappearance of all the peculiarities acquired by particular circumstances." Here we have anticipated a great deal of what we find in the writings of Darwin, Romanes, and others.

7. Another principle, much insisted on by evolutionists, and especially by Wagner in 1868, is the principle of geographical isolation. It is this which underlies Gulick's principle of segregation, and Romanes's similar doctrine of physiological selection. This was anticipated by Lamarck, who at the close of the paragraph we have just quoted, and which has been overlooked by commentators, goes on to say: "Were not men separated by distances of habitation, the mixtures resulting from crossing would obliterate the general characters which distinguish different nations." (*Phil. Zool.*, p. 262.) He does not, however, specifically apply this principle to other animals than man, but the principle stated by Darwin and other writers is the same.

If we now turn to Darwin's *Origin of Species* it will be seen that the fundamental doctrine of his work is Natural Selection, based on the principle of competition. His book, however, written as it was in the fifties, and packed with facts drawn from embryology, morphology, and paleontology, those sciences having been founded and developed after Lamarck's time, accomplished the gigantic labor of convincing and converting the scientific world. Darwinism is popularly synonymous with evolution. It is, however, obvious that without the action of the Lamarckian factors, we should have had no assemblages of plants and animals to afford a field for the play of competition and natural selection. It should be borne in mind that Darwin starts with the tendency to variation, which he assumes. It is obvious that the Lamarckian factors as a whole started the ball in motion and laid the solid foundations on which natural selection rests. Meanwhile the competitive and selective principles have been operating throughout the entire period since organisms came into existence in any number or variety. It is therefore well to insist that in discussing the origin of the doctrine of evolution, due and full credit should be given to the great French naturalist and philosopher, who a half century in advance of his time very clearly and explicitly formulated the primary laws of organic evolution.

It should also be explicitly understood that natural selection is not an active factor, or a *vera causa.* It simply expresses the results of the operation of a series of factors, those factors having been previously worked out, or at least suggested and supported by a few examples, by Lamarck.

Now to this Lamarckism, as we have represented it in its modern form, supported and broadened by the facts of modern morphology, embryology, physiology, the study of geographical distribution and the facts of variation, and more especially by the wonderful genetic series revealed by the labors of paleontologists—all of which were unknown to Lamarck—to this modern phase of Lamarckism, we have given the name of Neo-Lamarckism, since it stands for Lamarckism plus the additions to our knowledge made since the date of Lamarck's works.

One of the most important treatises on these Neo-Lamarckian lines is the recent work of Prof. E. D. Cope, *The Primary Factors of Organic Evolution.*[1] In a logical way, abundant facts supporting the principles advanced, this prominent naturalist treats first of the nature of variation; second, of the causes of variation, and, in the third part, of the inheritance of variation. The whole argument and the mode of stating and illustrating it is clear, compact, and strong. It forms an admirable digest of some of the phases of the subject of organic evolution. One feature of it is the conciseness of style, being free from the verbiage which weakens much of Romanes's writings. So far as we have observed the facts are reliable, and are to be accepted as true. The force, clearness, and compactness of the style are the result of years of anatomical and systematic work plus a good deal of hard, logical thinking. It is safe to say the book and its views will never be superannuated or placed on the retired list. It may be hard reading for the layman,

[1] Chicago: The Open Court Publishing Co. 1896. 12 mo, pp. 547, cuts, 120. Price. $2.00 net.

but the working evolutionist, the student of variations and of their causes, will find it most suggestive and indispensable.

It is written, however, from the point of view of the author's own lines of study, which have been in vertebrate paleontology. So many-sided is the theory of descent that no single book presents all sides in equal proportions. Many books on evolution are written entirely from the side of Darwinism or natural selection as such; others, like Semper's *Animal Life* and Eimer's *Organic Evolution*, as well as the works of St. George Mivart, Haeckel, Perrier, and others, are cast in a broader mould and are more eclectic.

It is evident that the most productive line of investigation in the future is a study of variation and its causes, particularly the latter. Darwinians insist that variations have been indefinite, accidental. Most Neo-Lamarckians hold on the other hand that they are not fortuitous but definite, along certain lines, the proof being that evolution has proceeded along certain definite lines, ending in this or that order or class. The problem now is to ascertain the physical causes of variation, and why, for example, evolution has followed this or that definite path, tending on the whole upwards, and ending in the eight branches of the tree of animal life, with their lesser branches and twigs, the classes, orders, families, genera, and species. These lines, as regards the vertebrates, are very clearly defined by our author. The recent carefully detailed work of Bateson, *Materials for the Study of Variations*, not only makes no attempt to discover the causes, but is simply a collection of cases of abnormal sports and variations, the author actually stating that it is "hard to see how the environmental differences can thus be in any sense the directing cause of specific differences." On the contrary we hold, with Herbert Spencer: "The direct action of the medium was the primordial factor of organic evolution." And it is vastly more broadening and informing instead of merely collecting and cataloguing sports and variations at least also to attempt to examine into the changes in temperature, climate, soil, and in the biological environment, which have in many cases clearly enough produced the variations—whether useful or not to the animal. Regarding the last subject, a great deal of tedious verbiage and wearisome discussion has been going on in the English journals, with no definite results.

Concerning the causes of variation much might have been said by our author as to the effect of changes in temperature, light, food climate, but space hardly permitted, and Semper's work, to which he refers the reader, has adequately covered the ground.

Considerable space is given to the subject of parallelism. This section is interesting, since it restates in a detailed way the fact worked out by Von Baer, Agassiz, and Vogt, and brought by Profs. Hyatt and Cope into relation with the doctrine of evolution. Parallelism, however, appears to express a result and is not an active factor in evolution. Yet the general parallelism existing between taxonomy, ontogeny, and phylogeny is of great interest, and in this chapter the author shows admirable power of generalisation.

The causes of variations Cope divides into two classes: the physico-chemical (molecular), and the mechanical (molar). To these two types he gives the names Physiogenesis and Kinetogenesis. In this section also is discussed the principle of inheritance of characters. The portion on physiogenesis is short with but few cases mentioned compared with the many which might be brought forward, for which, however, he refers the readers to Semper's *Animal Life*.

To dynamic evolution or kinetogenesis the author devotes nearly a third of the book. And here Dr. Cope, who has given much time and thought to the subject, is at his best. Kinetogenesis is but a newly-coined word for a study of the effects of use and disuse of the different organs of the individual. A great deal has been said about structures or peculiarities in the organisation which are useless to their possessors. These parts are classified by Cope, who, with others, regards them as brought about by disuse. Such are the vestigial legs and digits of numerous lizards, the mammæ of male animals, and the vestigial structures found in many highly specialised animals, notably in man where some seventy such vestiges exist to prove his descent from the lower Primates. The existence of some of these has been explained by Darwin by the action of natural selection, through "his unwillingness to look to disuse as the cause of the conditions he describes." The instances Dr. Cope quotes in illustration of kinetogenesis are taken from American authors, and indeed in the labors of the late Prof. Ryder, Cope, Dall, Hyatt, Jackson, Osborne, and others in this country, and of Hütter, Henke, Reyher, Fick, Tornier, and others in Europe, including Herbert Spencer, who really was the first to start this kind of inquiry, we have the first attempts to explain by the effects of impacts, strains and stresses, and other movements of the muscles and other soft parts on the hard parts (as shells, the arthropod crust, and the teeth and bones), the origin of joints, segmental parts, and differences in form of the parts of the skeleton. There has thus been opened up a distinct department of dynamic evolution, the study of which promises the most fruitful results. Cope's discussion of this whole matter is ingenious; his arguments appear to us to be solid and logical, and the objections of the Neo-Darwinians have been amply met.

The treatment of the principle of natural selection is fair. Its inadequacy as a primary factor or as the efficient cause of all variations, so clearly proved by Herbert Spencer and others, is here fully insisted upon.

Under this head also we have a brief, terse discussion of isolation, though it was first suggested by Lamarck, as we have already seen, and is by no means a part of the theory of natural selection, and might well have been allowed more space, since it is, though a passive agent or principle, one of universal occurrence, and of no little importance in the preservation of variations and their final elaboration into specific characters.

We have never regarded protective mimicry as a genuine active factor in the production of specific characters, and with the extreme views of Wallace, Poulton, and others we have been unable to agree, and we coincide with Cope, that to ascribe such color and form-characters to natural selection as a cause, is clearly impossible. The cases of mimicry are often due to the direct or indirect action of light, and other factors, and the supposed agency of natural selection in the matter is a fallacy. Many examples are cases of convergence. Into some cases the selective principle appears to enter, but the last word, it seems to us, has not yet been spoken on this intricate subject.

No one interested in the subject of heredity—and who is not? —can well afford to pass by the third part of this book in which the inheritance of variations is discussed in a fair and comprehensive way. Because perhaps from quite independent points of view the reviewer's opinions are in harmony with those of Cope, he is led to endorse, with little fault-finding, all that is here said in favor of the principle of the inheritance of characters acquired during the life-time of the individual, and against the extremely hypothetical views of Weismann. The very strong and apparently well-proved cases, quoted from Brewer, of the inheritance of characters due to nutrition, to use, as in the example of the evolution of the trotting horse, and particularly the inheritance of characters due to mutilation and injuries and those due to regional influences appear to be strong proof that in these days such inheritances may at times occur, though in earlier geological times they must have been more frequent and normal. With little doubt in the near future this discussion, which, as Cope states, is "sometimes a logomachy dependent on the significance which one attaches to the term "acquired characters," will gradually close, by the abandonment by both parties in the controversy of extreme views on the subject.

The discussion under the head of "The Energy of Evolution" is suggestive, though there is a tendency to the multiplication of newly coined terms which may seem, for the sake of clearness, to be necessary, but which will repel the lay reader. Again, returning to the consideration of the dynamics of organic evolution, and to prove the inadequacy of the claims of natural selection, the author, probably quite unconsciously, follows in a general way the Lamarckian argument. Natural selection, Cope well maintains, "cannot be the cause of those alternatives from which it selects. The alternatives must be presented before the selection can commence." Darwinians imagine that here and there a useful variation or sport has been preserved or eliminated, and has been, so to speak, nursed and petted and cared for until it became a varietal and ultimately a specific character. But, as suggested by the *critique* in the *North British Review* for 1867 (attributed to Fleeming Jenkin), the objector to natural selection requires that useful variations should, in order to be preserved, arise in an enormous number of individuals "all having a little improvement in the same direction." And this is distinctly what Lamarck has said. In his case of the birds evolved by necessity into swimming or into wading forms, he does not intimate, as generally supposed by those who carelessly read him, that a single bird, by simply wishing or willing, gradually acquired webbed feet, or longer necks or longer legs, but he says, speaking of a supposed bird wishing to prevent its body from sinking in the water, "it makes every effort to extend and elongate its feet." "*Il en résulte que la longue habitude que cet oiseau et tous ceux de sa race contractent d'étendre et d'allonger continuellement leurs pieds,*" etc.; and in the next case of the bird wishing to fish without wetting its body and which "makes continual efforts to lengthen its neck, the necessity of adopting this new habit or means of obtaining its food, is not restricted to a single individual, but to all those of its race." In other words, we have here suggested that the variations were common to the species *en masse* and were induced by a change in the physical or biological environment which drove all or large numbers of the individuals of a species to the necessity of adopting new habits, and thus to transform from one species into another. It is the great weakness and inadequateness of Darwinism as such that individual or chance variation or sports, which the whole course of nature tends to wipe out by crossing or by the death of the unfit individual, are suffered to be the ancestors of species. This, it is true, may sometimes happen, but it is an exception which proves the rule.

Dr. Cope then enters into a discussion of the energy of growth and evolution as distinguished from that displayed by non-living bodies. The former he calls Anagenesis and the latter Catagenesis. His anagenetic class "tends to upward progress in the organic sense; that is, towards the increasing control of its environment by the organism, and towards the progressive development of consciousness and mind." He well criticises Herbert Spencer's definition of evolution as a process of "integration of matter and dissipation of motions," claiming, correctly, we think, and with much originality, that such a definition only applies to inorganic bodies, that in organic progressive anagenesis there is absorption of energy. "In the anagenetic energies, on the other hand, we have a process of building machines, which not only resist the action of catagenesis, but which press the catagenetic energies into their service. In the assimilation of inorganic substances they elevate them into higher, that is, more complex compounds, and raise the types of energy to their own level. In the development of molar movements they enable their organisms to escape many of the destructive effects of catagenetic energy by enabling them to change their environment, and this is especially true in so far as sensation or consciousness is present to them."

All this prepares the way for the reception of the view expressed in the final chapter, entitled "The Functions of Consciousness." Here the author steps on less certain, because metaphysical, ground, whither many will not care to follow him, and although Lamarck has attributed the movements of animals to their needs, which we interpret to mean bodily necessities as much as mental volitions, Professor Cope goes farther than the French philosopher, and attributes consciousness to all animals. "Whatever be its nature," he says, "the preliminary to any animal movement which is not automatic is an effort;" hence he regards effort as the immediate source of all movement; that the control of muscular movements by consciousness is distinctly observable; that reflex acts are the product of conscious acts. He concludes, then, that "consciousness has been essential to a rising scale of organic evolution. In the long run the most intelligent have survived; hence he postulates a primitive consciousness which he has called Archæsthetism, which "maintains that consciousness as well as life preceded organism, and has been the *primum mobile* in the creation of organic structure."

Finally, in approaching an explanation of the phenomenon of anagenesis, our author asks: "Why should evolution be progressive in the face of universal catagenesis? No other ground seems discoverable but the presence of sensation or consciousness, which is, metaphysically speaking, the protoplasm of mind. The two sensations of hunger and sex have furnished the stimuli to internal and external activity, and memory, or experience with natural selection, have been the guides. Mind and body have thus developed contemporaneously and have reacted mutually. Without the co-operation of all these factors, anagenesis seems impossible."

This is certainly very suggestive, and will commend itself to those who, taking for granted the Darwinian view that all variation is fortuitous and indefinite, and all evolution purely material and mechanical, reject it because they suppose that evolution is purely materialistic and excludes mind from creation; whereas it is not at all improbable nor unthinkable, even, from a scientific standpoint such as that taken by our author, that mind and consciousness are immanent in each operation of the laws underlying the evolution, not only of life on our globe, but also of the earth itself and of the universe of which it forms a part.