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LI.—*The Descendence-Theory considered from some special points of view.* By W. VELTMANN*.

DEVIATIONS from the average constitution of the species may be advantageous to the individuals and, according to Darwin's view, may induce the production of new species by natural selection in five different ways:—

1. From birth a longer duration of life. Here that duration of life is meant which is attained by the animal when it dies a natural death, after existing during its life under normal conditions. The greater this duration of life pertaining to the animal in accordance with its original constitution, the greater also, on the average, will be its actual duration and, consequently, the assistance given by it to the maintenance of the species.

2. Easier nourishment, *i. e.* attainment of the necessary food. In connexion with the inheritance of peculiarities this comes into consideration, inasmuch as deficiency of nourishment is prejudicial to the development and activity of the sexual system, and may also abridge the duration of the time of reproduction, and even life itself.

3. The faculty of more easily escaping pursuers and other dangers. In this, greater protectedness of the eggs and young from destruction is included.

4. Greater facility of effecting copulation (clasping, seizing the female, &c.).

5. Greater fertility.

Among these various momenta, 2, 3, and 4 depend in part upon the stronger and more persistent constitution of the internal organs; but 1 is also dependent upon this. But 2, 3, and 4 are conditional upon the production of special internal and external organs or other properties (colour &c.). The differences in participation in propagation hereby produced, as also those in connexion with 5, may, however, always be very small, as very considerable deviations always occur very rarely and quite isolatedly. The differences in congenital duration of life are, on the contrary, very considerable. These will therefore always have so predominant an influence, that that of the other casual deviations disappears before it. It follows from this that from a species no other species possessing a shorter period of life can be produced. Of all deviations in the external or internal constitution, only those can become constant which tend to a longer period of life.

Differences in fecundity could only have an equal degree of

* Translated from the 'Archiv für Naturgeschichte,' Jahrg. xxxvi. pp. 235-246, by W. S. Dallas, F.L.S.

influence in very fertile animals, therefore in such as lay thousands of eggs.

Whoever endeavours to elevate the Darwinian doctrine from a very general and indefinite hypothesis into a scientific theory must therefore at any rate always take the above point into consideration. He must arrange his "genealogical tree" only in such a manner that all the ramifications which issue out of any given branch possess a longer duration of life than the latter.

Palæontology furnishes us something actual in connexion with the sequence of species. In general it does not agree with an increase in the duration of life. The insects which for the most part, like summer plants in the vegetable kingdom, are extremely short-lived, were preceded by Polyps, Mollusca, and Crustacea; and although we cannot now ascertain how long a Graptolite or Trilobite of the Silurian formation lived, it can hardly be supposed that the insects have originated from animals with a shorter vital period. This could be possible only if Mollusca, Insecta, &c. originated from a common short-lived stem. But where, then, would the side-line have remained which led up from this stem, by the Mollusca &c., to the Insecta? How can it have come about that nothing of it is preserved, whilst of the Mollusca and Crustacea innumerable petrified examples exist? Moreover experience teaches us that even the lowest animals, polyps, rhizopods, &c., possess a longer duration of life than the insects, and also exceed them in fertility.

The case is the same with the Mammalia. With certainty we can scarcely ascribe to these an earlier than Tertiary origin. Fishes and reptiles preceded them; and they can only be regarded as produced from the latter. But reptiles in general live longer than mammals. Among tortoises we have examples of an age of more than 200 years, whilst the most long-lived of terrestrial mammals, the elephant, is rather more than 100 years old.

Darwin, on the foundation of his hypothesis, describes the demonstration of the production of a peculiarity injurious to the animal as destructive of the hypothesis. F. Müller, in his work 'Für Darwin,' calls upon opponents to indicate any one among the great number of natural-history facts which is incompatible with Darwin's opinion. He regards the circumstance that this has not yet been done, even by the observers who are most familiar with the animal world, as a proof of the Darwinian doctrine. But so long as the latter is nothing more than a mere hypothesis, containing only the most general outline of a theory, definite facts can no more be

cited in opposition to it than definite assertions are contained in it. The indefiniteness of the theory causes an equally great indefiniteness in its refutation. The above arguments against the Darwinian opinion, derived from the results of palæontology, make no claim to be unassailable. But so far as it can be regarded as possible to demonstrate the production of an injurious property from the multifarious data standing at the command of Darwinism, even in connexion with this point, it must be the case here. The abridgment of the duration of life is such a property.

The species of the animal kingdom have been very aptly compared with the paths of the planets (Blasius, 'Fauna Deutschlands,' preface). The orbits of the planets are not invariable, any more than a given species of animals is exactly the same in one year as in another. The variations, however, are, for long periods, confined within definite limits. But, strictly speaking, this cannot be proved for *all time*, as in this case we must also take into consideration the matter existing between the planets &c. Nor can we conclude from the present state of the planetary system as to any given earlier period. It has been attempted to derive the present state of the planetary system from an earlier simpler one—as which a rotating nebular sphere was assumed. This hypothesis was first proposed by Kant, who, however, was by no means the profound mathematician that he is represented by Hæckel (Natürliche Schöpfungsgeschichte). Laplace subsequently presented it in a somewhat more mathematical dress, though not in his strictly scientific 'Mécanique Céleste,' but in a more popular work. Among astronomers, however, it is in tolerable estimation, but only as a simple hypothesis, which is quite incapable of further development into an actual theory (as has been shown by the attempt made by Weiss).

The Darwinian doctrine also will perhaps always number its adherents, as, indeed, its erroneous nature can no more be strictly demonstrated than that of any view as to the flora and fauna of the moon. But every attempt to convert the hypothesis definitely into a theory, even if it should be in tolerable agreement with zoological, botanical, and palæontological facts, would always have something arbitrary about it, as a thousand others might be set in its place.

Considering the near affinity of Laplace's hypothesis of creation and the Darwinian doctrine, it was to be expected that the Darwinists would revert to the former. All such physical views originate from a weakness which attaches even to the greatest naturalists—namely, the tendency to deduce everywhere multiplicity from unity. This has its foundation

in the finiteness of the human reason, which, from its incompetence to grasp the infinite multiplicity of nature, finds itself compelled to refer this back as much as possible to unities. But in this case it cannot arrive at absolute unity, as multiplicity is not included in unity. Such endeavours stand in contradiction to the causal principle, upon which, however, the Darwinists (as, *e. g.*, Hæckel, in his 'Generelle Morphologie') lay so much stress. A homogeneous mass of vapour which at a definite moment is so arranged about its axis of rotation as to represent a body of rotation the diametral sections of which agree perfectly with each other with regard to the diffusion of matter in them, will always retain this property; the unity remains unity. But if we ascribe to the various diametral sections from the commencement any definite difference, there is no reason whatever why we should not regard any other difference that we please, and therefore the condition of the planetary system such or such a number of years ago, as aboriginal.

This applies just in the same way to that particle of primordial slime which, according to Hæckel, formed the commencement of organic nature. Hæckel ascribes to his "*Monera*" a perfect homogeneity without any internal differentiation. All movements that occur in such a body from a given period are then necessarily functions of its form and of the arrangement of all other matter at that moment. The perfectly irregular manner in which the *Monere* extends its pseudopodia would agree with this, as the arrangement of external matter is likewise perfectly irregular. But now let us imagine that such a particle of plasma acquires a calcareous or siliceous shell. The form of this can only be quite irregular; for, like the growing forth of the pseudopodia, it is a consequence of causes acting quite irregularly. Observation teaches us, however, that the solid shells of the *Polythalamia* have in part a perfectly definite form. This can be no function of the external world, as the totality of matter certainly stands in no definite relation to the form and arrangement of the spiral shells of these little animals, which, like those of many *Cephalopoda*, are divided into chambers. We must therefore necessarily assume that the apparently homogeneous and formless mass of plasma which produces the shell stands in a definite relation to the latter, or that a foreign force, not attached to the atoms of the plasma, produces the shell. Hæckel touches upon this point in his 'Generelle Morphologie' (Bd. i. p. 190), and is of opinion that the cause of this phenomenon must be sought in the special combination of the atoms into molecules. In those *Protozoa* whose shell has a geometrically regular form this

supposition might not be absolutely absurd, as we must assume something of the same kind in the case of crystals. But at the assumption that the molecules of any chemical compound stand in a definite relation to the spiral form of the shell of *Cornuspira planorbis* or of the fossil *Nummulina radiata*, every "thinking" naturalist would certainly shake his head.

In connexion with the first appearance of life, Häckel lays great stress on the artificial preparation of organic compounds. Hitherto, however, no one has prepared hydrates of carbon and albuminates from their elements; and, with respect to the artificial preparation of urea, formic acid, and other *retrogressive products* of the animal organism, there was never really any cause for making so much fuss about it. The expired carbonic acid is also a retrogressive product; and this had long been prepared artificially. The chemical processes which take place in organic bodies seem much rather to speak in favour of the assumption of special forces.

Let any vegetable be planted in pure siliceous sand containing as nourishment for it only carbonic acid, ammonia, and the necessary inorganic salts. Let the whole be kept at a temperature of about 68° F., and covered with a glass vessel which is always kept at a scarcely higher temperature. The plant and the soil in which it grows therefore receive light and heat from without. Let us now see what becomes of these two agents.

If we burn hydrates of carbon in oxygen, two things take place:—

1. Separation of the carbon from the water of the hydrate of carbon; 2, combination of the carbon with the oxygen. At the same time heat is always evolved.

In the above plant the direct opposite of this takes place. Under the influence of light the oxygen of carbonic acid separates from the carbon, and the latter combines with water to form hydrate of carbon. During this, heat, or, at any rate, mechanical motion (in the form of light and heat) must necessarily disappear.

If, then, the plant be allowed to grow, say, through a whole summer, and the hydrates of carbon produced be then burnt, carbonic acid and water are again formed. A portion of the heat manifested during this process can then be converted into mechanical work, whilst another part passes over to bodies which are at least at a temperature of 68° F., and by this means the products of combustion again acquire this original temperature.

Now this whole process seems to stand in contradiction to the second principle of the mechanical theory of heat, or to

Carnot's principle, which lies at the foundation of this theory. According to this, heat cannot be converted into mechanical work without at the same time heat passing somewhere from a warmer to a colder body. But such a transfer has in this case nowhere taken place. We might, indeed, say that the heat of the sun has passed in the form of light from the hotter sun into the colder plant. But the quantity in question can be only a very small fraction of the heat which has become latent in the hydrates of carbon; at any rate, it is much less than that converted into work during combustion. The amount of heat represented by the absorbed light is therefore included in that converted into work, and therefore has not, as Carnot's principle requires, been *permanently* transferred to a colder body.

No one has yet succeeded in devising any process in inorganic nature in which Carnot's principle does not apply, although many physicists and technicians (*e.g.* Hirn) have tested their acumen upon this point. If, now, we detect such processes in organic nature, this indicates that special forces are active in the latter. In fact, the above departure from Carnot's principle may be simply explained by the assumption that in the plant a force is at work capable of ruling in a definite manner the irregularly interwhirling heat-movements. In order that we may not thus come into contradiction with the principles of the vital forces, we must assume that this force always forms a right angle with the path of an atom upon which it acts, and therefore, in the mechanical sense, performs no work.

The Darwinists often claim for themselves the privilege of being the only "thinking" naturalists. In order to attribute this superiority to themselves with greater justice, one might advise them to make themselves a little better acquainted with the doctrines of mathematics. From the upholders of the exclusively mechanical conception of nature we must necessarily require that they should be thoroughly versed in mathematics and mechanics. Natural history and mathematics are, indeed, two departments which lie rather far apart; but just as the union of the dissimilar has led to many new results in cattle-breeding and horticulture, it may also be possible that a hybridization of the sciences might lead to new and peculiar results. It is true that the union must be such that bastard productions in the bad sense may not proceed from it. Of many of the views put forward in Hæckel's 'Morphologie' and other Darwinistic writings it may be affirmed that they would have received an essentially different form by "adaptation" to the laws of mathematical thought.