

style in which it is printed and the excellent plates seem to promise that the Transactions will be quite on a level with any journal published in Europe. The illustrations are, indeed, unnecessarily large; but this cannot be pointed to as a fault—at least by those who are not responsible for the cost.

Prof. Spencer's paper is of considerable interest, particularly that section which refers to the nephridia. *Megascolides*, like *Perichæta* (as was first pointed out by Beddard, not by Perrier, as Prof. Spencer asserts), possesses a ramifying network of nephridial tubes which are continuous from segment to segment, and which open on to the exterior by numerous pores; connected with these there are—in the posterior segments of the body—a pair of large nephridial tubes in each segment, which open internally by a funnel. It is from these latter that the single pair of nephridia per segment of *Lumbricus*, &c., are to be derived; the network of minute tubules, which represents the excretory system of the flatworms, has disappeared in such forms as *Lumbricus*.

Prof. Spencer discusses the much-vexed question of the homologies of the sexual ducts, and concludes that they are not derived from nephridia.

Other points of interest cannot be touched upon in this short notice.

Lectures on Geography, delivered before the University of Cambridge, during the Lent Term, 1888. By Lieut.-General Strachey, R.E., C.S.I., President of the Royal Geographical Society. (London: Macmillan and Co., 1888.)

THESE lectures are published opportunely at a time when it is most desirable that the now almost general effort to further geographical education should be properly directed. They form a short course introductory to the work of the Lectureship on Geography now established in Cambridge, and in them General Strachey describes the aspects of the subject which he considers most suitable for the instruction of students at the University. He thus gives a complete summary of the aims and matter of scientific geography—of geography as a natural science related to other natural sciences, much as mathematics is to physical science. He assumes that students, before going to University, have acquired a general knowledge of geography; and, in passing, he points out that the primary object of the school teaching of geography is to impart an accurate knowledge of the main topographical features of the entire earth, all trivial details being omitted, and suitable instruction being given in the physical, economical, and historical characteristics of important places.

As material for the higher or University teaching of geography, the author practically claims the various branches of science which in recent years have been assembled under the term "physiography"; but he is most successful in showing that the science is not a mere patchwork, but a connected whole; and he sees no reason for abandoning the well-known name "geography." Certainly from many points of view the introduction of the new term has retarded the spread of a knowledge of the science.

An excellent epitome of the growth of our knowledge of the astronomical relations of the earth, and a short account of the methods of projection and orography, prepare the way for the history of geographical discovery. This department is reviewed in a manner at once interesting and philosophical, indicating clearly the close connection between the progress of discovery and the political movements of the world. The influence of the form and movements of the earth on terrestrial phenomena, terrestrial magnetism, our knowledge of the interior of the globe, and the relation of geology to geography, are in turn shortly discussed. The sections on land, sea, and air, and on the history of life and of man, indicate the results of

recent investigation, and suggest many points which may well receive much attention from students of geography.

The lectures are written throughout in an agreeable and simple style, and will prove valuable to general readers as an elementary epitome of scientific geography.

F. GRANT OGILVIE.

A Text-book of Elementary Metallurgy for the Use of Students. By Arthur H. Hiorns. (London: Macmillan and Co., 1888.)

WE recently had occasion to notice a useful little work on practical metallurgy by Mr. Hiorns. He has now endeavoured to write a purely elementary treatise on theoretical metallurgy, adapted to the capacity of beginners. The attempt can scarcely be considered successful. In 172 pages printed in large type he deals with the whole of the wide field of metallurgy. This necessitates a very fragmentary treatment. And besides this, errors are so frequent as to render the book quite unsuited for beginners. The following examples may be cited:—The barrel method of amalgamation is stated (p. 90) to be carried on at Freiberg, where it was discontinued twenty-four years ago. One of the seven methods of producing steel is stated (p. 74) to be "by melting raw steel in crucibles." The Coppée coke-oven is described (p. 40) as being of the Appolt type. The coke-oven described (p. 42) as the Simon-Carvès is in reality a Carvès oven. The author appears to be ignorant of the existence of the principality of Catalonia, for the Catalan process is said (p. 54) to be carried on at "Catalan in the Pyrenees."

Altogether, the book compares very unfavourably with the author's work on assaying, and appears to have been hastily written. An illustration of the want of care displayed is afforded by the table of the specific gravities of eighteen metals (p. 11), in which in nine cases the figures differ from those given in the author's companion volume. With a little care, the author could have avoided such statements as—"An analogous compound, 'Boghead' of Scotland, which is a bituminous schist, is richer in bitumen than ordinary coal." Again, manganese, the author states (p. 74), "prevents the separation of carbon in the form of graphite, which is the opposite of silicon." The appendix of examination questions, covering 65 pages, appears to indicate that Mr. Hiorns's intention has been to write a cram-book for the elementary stage of the Science and Art Department's examination in metallurgy. It is, however, doubtful whether a student who made such blunders as occur in this book, would satisfy his examiners.

B. H. B.

LETTERS TO THE EDITOR.

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Weismann's Theory of Variation.

ACCORDING to Weismann ("Die Bedeutung der sexuellen Fortpflanzung für die Selektions-Theorie," Jena, 1886), heredity does not consist in the parent having the power to reproduce offspring in its own likeness, but in the property of the germ (ovum or spermatozoon) in each generation to develop into an individual of a certain invariable type. He starts from the fact that in development the germinal cells are separate from the beginning, are portions separated off from the original fertilized ovum. He distinguishes between actual and virtual differences. Different individuals developed from successive remnants of a given *Keimplasma* may show actual differences; but these are due to the action of conditions affecting the particular individual during its development and life: these differences are not inherited, cannot possibly be transmitted to the offspring, because

the germ-cells in this altered individual, which were originally continuous with the germ-cell from which the individual itself developed, remain entirely unaffected by the action of the conditions on the body, and when they begin to develop have exactly the same properties as the germ-cell in the generation preceding.

Heredity, then, according to Weismann, is simply the property possessed by a germ to develop into exactly the same type in each successive generation. He says: "Ich stelle mir vor, dass die Vererbung darauf beruht, dass von der wirksamen Substanz des Keimes, dem Keimplasma, stets ein Minimum unverändert bleibt," &c.

As the action of conditions can give rise to no hereditary individual differences, these must be due to some other cause. This cause, Weismann says, is to be found in sexual, or, as Haeckel calls it, amphigynous, reproduction. Sexual reproduction consists in the fusion of two complementary germ-cells or of their nuclei: each of these germ-cells has a specific molecular structure, on which depend the hereditary tendencies of the organism whence the germ-cell is derived. Thus, in fertilization, two hereditary tendencies are mingled, and thus the offspring does not resemble exactly either of its parents, but combines the characters of each together.

In order that there shall be no ambiguity about his argument, Weismann precisely states what, according to his view, and, as he believes, in actual fact, occurs in monogonous reproduction, *i.e.* in parthenogenesis, where there is only one parent instead of two. If, in a species reproducing parthenogenetically, all the individuals were perfectly similar, all the descendants throughout any number of generations would continue similar, leaving aside evanescent differences due to conditions, and which are not hereditary. In such a case no selection, Weismann says, would be possible, and therefore no evolution in any direction.

"Processes of selection in the proper sense of the word, those which produce new characters by the gradual increase of characters already present, are not possible in species which reproduce asexually."

"If it were once proved that a species reproducing itself solely by parthenogenesis had been transformed into a new species, thereby it would be proved at the same time that other causes of modification exist than processes of selection, for by selection the new species could not have been formed."

But with sexual reproduction it is quite otherwise. Weismann points out that no two individuals of different generations could ever be similar where reproduction is sexual, and even the individuals of one family, born of the same two parents, would not be similar, because the various tendencies in the parents are present in different intensities at different times, though he gives no reason for this assumption.

According to Weismann, the individual hereditary differences so produced are the basis on which selection acts; and these differences thus explained, summed up or combined in different ways by selection, give a complete and satisfactory explanation of all organic evolution.

Now, let us examine this theory a little. For the sake of simplicity we will in most cases consider the effect of the supposed processes on one organ. In the first place, what ground is there for assuming that *Vermischung* would ever cause an increased development in the offspring of an organ possessed by the parents? Heredity, as understood by Weismann, is nothing more than the property in the germ-cell of developing into an individual like that from which it was derived. If each parent possessed a given organ in the same degree of development, a degree unaffected by external conditions, then both the ovum and the spermatozoon will, on this view of heredity, have the property of developing into an individual with the same organ developed to the same degree. When the two properties are combined by fertilization, the fertilized ovum ought to have the property of developing this character with still greater certainty, but why should it have the property of developing the character to a higher degree than that reached in either parent? By *Vermischung*, in its literal sense, the union of the two hereditary powers cannot have this effect. If by *Vermischung* it is meant that the offspring is intermediate between the two parents, then the mean of two equal characters is the same character again. And if this is what Weismann means by *Vermischung*, then a character developed to a certain degree in one parent, and not at all in the other, would in the offspring be developed to exactly half the degree in which it existed in

the one. And so on. But it is obvious that in this way no increase of any character could ever occur.

But of course *Vermischung* may mean something else. It may mean that the hereditary powers of ovum and spermatozoon are added together, that the result of copulation between the germ-cells is not the mean, but the sum, of the properties of both. In this case, evolution would be extremely rapid, for each child would be equal to both its parents rolled into one. If each parent, say, among cattle, had horns equally well developed, the offspring would have horns twice as big. And it is obvious that in this way no decrease could ever occur, for if one parent had an organ developed and the other had no trace of it, the offspring would have it in the same degree as the one.

Now, it seems to me that, if *Vermischung* does not mean either of these things, there is only one other meaning it can have, and that is, that the hereditary powers of the copulating germ-cells reinforce one another to some extent, but not to such an extent that the result is equal to their sum. If this be the meaning, then there can never be any decrease in a character once formed. For, if every individual of a species possesses a certain organ, let us take the hind-legs in a mammal, then if two individuals which have these organs less developed than any other individuals in the species, copulate, the offspring resulting must have hind-legs better developed than either of them. Thus the whale could never have been evolved.

It follows, therefore, that, on Weismann's theory of variation, evolution is impossible. And as acquired characters are not inherited, no other theory of variation can be discovered. Therefore evolution is impossible altogether: the extremes meet, and the Darwinian principle overstrained goes rather to prove the fixity of species than their plasticity.

J. T. CUNNINGHAM.

Mr. Howorth on the Variation of Colour in Birds.

ALLOW me to assure Mr. Howorth that I have no theory to maintain. I simply called attention (*supra*, p. 318) to an overlooked hypothesis, propounded long ago, and, so far as I know, still unrefuted. Neither have I any wish to argue the question. Indeed, controversy about it is happily almost impossible, since he admits the chief fact of which I reminded him to be what he now terms (*supra*, p. 365) "an elementary postulate"—an expression far stronger than I should venture to use; but had he before shown any disposition to recognize it, my remarks had not been written. On the contrary, he implied (*supra*, p. 294) that it was a recent discovery, as it certainly appears to have been to him. I trust he will excuse me for having pointed out its want of novelty, just as he seems to excuse Prof. Geikie for pointing out the antiquity of his views as to the former climate of Siberia; and at the same time I have to ask Mr. Howorth's pardon for demurring to some of the assertions in his last communication, especially that as to the avifauna of Siberia having been "worked out from end to end." I dare not hope to see the day when this shall be done; but then I am not of a sanguine temperament.

I take this occasion to mention that in line 3 of the second paragraph of my former letter (p. 318) the word "Russian" was omitted before "explorers and naturalists." Of course it will be understood to cover Poles, as well as all those foreigners who were employed by the Russian Government.

ALFRED NEWTON.

Magdalene College, Cambridge, February 16.

Currents and Coral Reefs.

MAY I be allowed space to call attention to a remarkable fact relating to the growth of coral reefs, which has apparently (as far as I can ascertain) had no explanation, and which might assist materially in the elucidation of some problems relating to ocean currents about which—although the broad facts are known—a great deal of doubt exists? It might also give us some idea of the flow of submarine currents, the direction of which it is very difficult to determine.

It will be observed that in all coral formations there are in some places remarkable extensions of them from the land, which is not accountable for by supposing the depths only to be shallower in those directions, and the only alternative we have then is that the food supply must come chiefly from that direction, and this supply could only be kept up by currents striking the reef at these points. To give an instance of this, I might