

Before concluding these observations, which, however imperfect they may be, have nevertheless, I fear, greatly exceeded the usual space allotted to these Addresses, I am desirous of saying a few words on a subject closely connected with the highest considerations

of our science, and which has been argued with great ability by one of the most philosophical writers of the day. I allude to the Essay of Professor Baden Powell on the Philosophy of Creation. One of the many great and transcendental questions discussed in this Essay is the controversy as to whether we are to give a preference to the old doctrine of the immutability of species, or to the more recently introduced theory of transmutation. The question is undoubtedly one of great difficulty, but it is not the less necessary that we should endeavour to form a definite opinion on the subject, founded on the fullest and most authentic information we can obtain. It may indeed, in some respects, be said to be one of the most important questions in geological investigation. Why do we endeavour to obtain correct information respecting the true order and arrangement of stratification? Why do we endeavour to obtain the most perfect collections of the organic remains of each stratum and formation, and to ascertain the different classes and groups of organized beings which have dwelt and flourished on the surface of the globe at the different periods of its existence? Surely not for the sake of such collections and such knowledge of stratification *per se*. For, although, owing to peculiar circumstances, many geologists may not have the opportunity of carrying their investigations beyond these points, it should never be forgotten that all such information is but a stepping-stone to higher generalizations. It is but the alphabet of one of the languages in which Nature speaks to us, and by means of which we must endeavour to unravel the past history of our globe, and to form some idea, so far as our finite faculties permit us, of the first origin, and inductively of the final objects, of creation. In this point of view, the question as to the immutability or transmutation of species is one which touches the very existence of our science, and I am therefore desirous of briefly pointing out what appears to be a fallacy in some of the statements of Prof. Powell on this subject.

The arguments of the various writers on both sides are fully and fairly given in this work, and the author professes merely to point out the bearings of the question, the difficulties in which it is involved, and to controvert what he considers hasty and untenable assertions on either side. But while doing this, it is impossible to avoid the conviction that he has a decided bias to one side, that he considers the doctrine of transmutation of species more consistent with sound philosophical induction than what he calls the hypothesis of an eternal immutability. I shall not pretend to occupy your time by going through arguments so well known to every palæontologist and geologist. I only wish, as I said before, to point out one or two conclusions which involve what appear to me a fallacy.

After showing how the successive investigations of the great comparative anatomists and zoologists of the last half-century have resulted in the establishment of the doctrine of the unity of composition of animal forms, a result to which the researches of Prof. Owen have mainly contributed, he proceeds to the examination of the question of species. He points out the existence of subspecies and varieties, many of which become permanent, and alludes to the

number of *new* species constantly discovered which have to be inserted between other allied species already known, inferring that the specific differences between each must by such additions tend to diminish continually, and that all species tend to be connected by more and more close affinities. Thus, he argues, all differences gradually disappear, and there results no greater difference between two allied species than between varieties of the same species, and consequently no difficulty in admitting that the difference which does exist is not greater than what might be expected as the result of local circumstances, modifying external forms, and thus practically producing transmutation. Indeed he goes still further, and adopting an infinite duration of time, and an infinite number of species, he argues that there will ultimately be no perceptible difference at all between two allied species. The following is his argument :—

“ But, while the number of species thus tends to become infinitely great, the extreme difference between man (let us suppose) at one end and a zoophyte at the other end of the scale is constant and finite ; hence the average difference between any two species tends to become *infinitely* small ; multiplied by the number of species, it must still be equal to a *finite* quantity ; and the product being *finite* if the first factor be *infinity*, the second must be *zero*.”

This argument appears to involve a fallacy. If this infinite number of allied species is to prove the transmutation of one form into another by showing that the difference between them is infinitely small, it would be necessary to prove either that they had all existed contemporaneously together, or that the allied forms immediately succeeded each other. But when the author calls in the aid of long geological epochs in which some of these closely allied forms existed at long intervening periods, I cannot see how the question of transmutation is thereby strengthened. If A, B, and C are the allied forms, and A and C existed either together or in immediately succeeding periods, and B, which is the connecting link to fill up the gap between them, is only found to exist after many millions of years, or even only after the other two had died out, the theory of transmutation cannot be supported by assuming the gradual change of A into C, through the intervening form of B. If every possible gradation of form existed in the fauna of one period and of one region, or of successive periods and neighbouring regions, then indeed the advocates of the transmutation theory might endeavour to maintain that all these forms were only varieties of one type occasioned by the peculiar conditions of life in which each was placed ; but this conclusion is no longer valid when long periods have intervened between the existence of one form and that of the other. The utmost argument that could be drawn from such premises would be a confirmation of the great doctrine of unity of plan in the creation of all organized life, extending through all ages of the world.

Another fallacy may, I think, be detected in the manner in which Prof. Powell, after stating the arguments on both sides, points out the real alternative. He says, “ the only question is as to the sense in which such *change* of species is to be understood ; whether indi-

viduals naturally produced from parents were modified by successive variations of parts in any stage of early growth or rudimental development, until in one or more generations the whole species became in fact a different one ; or whether we are to believe that the *whole race* perished without reproducing itself, while, independent of it, *another new race*, or other new individuals (by whatever means) came into existence, of a nature closely allied to the last, and differing often by the slightest shades, yet unconnected with them by descent ; whether there was a propagation of the same *principle of vitality* (in whatever germ it may be imagined to have been conveyed), or whether a new principle or germ originated independently of any preceding, *out of its existing inorganic elements.*”

In the sentence which I have just quoted, there are two sets of alternatives, and I think that in each set the author has inserted a fallacy in stating the second alternative respecting the theory of immutability. In the first set he has assumed, without any warrant, that a whole former race has perished and is succeeded by another of a closely allied nature and often differing only by the slightest shades. In such a case, viz. where the difference is very slight, it may be possible that the second race is really the descendant of that previously existing, slightly modified by the external conditions of life in which it was placed. But the author has omitted all reference to those species which occur in the new or upper formations, whose resemblances or analogies to those of the preceding period are very distant or imperfect, and which cannot therefore be looked upon as the descendants or modifications of the pre-existing forms. There are undoubtedly species which have been continued through many geological periods, have survived many local disturbances, and which, while others may have perished, have been kept alive by greater vital energies or other influences, and have become the associates of new forms introduced for the first time and having no resemblance to or analogy with the forms which had preceded them. We know that some species pass into many varieties, sometimes even contemporaneously with the existence of the typical form ; there is, therefore, surely nothing inconsistent with the theory of immutability in supposing, under peculiar circumstances, that varieties of some species may also take the place in a subsequent period of the original typical form. This, however, is the exception, and not the rule.

With regard to the second set of alternatives in the passage I have quoted, I think Prof. Powell is too much begging the question when he concludes the sentence with these words : “out of its existing inorganic elements.” Surely this is taking too physical or material a view of the matter, and one not required by those principles of inductive philosophy which he so strongly supports. The advocates of immutability of species do not generally talk of a principle of vitality originating out of inorganic elements. When old forms die out, and are succeeded by new, the *matter* of which the new consist is derived from the existing inorganic elements ; but the life or principle of vitality by which it is animated must proceed from a different source, from that same source, mysterious it may be, which first

breathed life into those creatures which dwelt in the oldest palæozoic ages. Organic life on this earth must have had a beginning, and that beginning must have proceeded from a source very different from that dead matter which formed the visible body; and from that same source proceeded the principle of vitality which animated the new forms when successively created on the earth. And with reference to this question, I must emphatically deny the right assumed by Prof. Powell, when he puts what he calls an imaginary case of a truly new species making its appearance, to question those who deny the theory of transmutation, how this new species made its appearance; whether it appeared as an ovum or seed, or at what period of growth, &c. When Prof. Powell can state in what form the first living organisms appeared on the earth's surface, he may demand an answer to this question. It is the more remarkable that Prof. Powell should make this demand, as he has stated, in a former part of the Essay, that in a geological point of view the term "Creation" signifies the fact of origination of a particular form of animal or vegetable life, without implying anything as to the precise mode of such origination: not that I think this definition altogether satisfactory, but yet it might have precluded him from making such a demand.

But I have been led into a longer statement than I had intended. I will merely add that, notwithstanding these criticisms that I have ventured on, the essays of Prof. Powell deserve a careful and attentive reading. They are eminently suggestive and replete with deep thoughts and scientific views, and form an interesting element of the geological, or rather geognostic, literature of the day.

As in some measure connected with the same subject, I must direct your attention to a paper published by Mr. Alfred Wallace* on the law which has regulated the introduction of new species. Mr. Wallace is a naturalist of no ordinary calibre. His travels in South America and elsewhere are a sufficient guarantee of his high merits; he now writes from Sarawak, Borneo. From a careful examination of the actual distribution of existing forms of animal life, and the gradual but complete renewal of the forms of life in successive geological epochs, he has deduced the following law:—*Every species has come into existence coincident both in space and time with a pre-existing closely allied species.* The question is one of great importance, and deserving the careful investigation of every geologist; but I think it may be doubted whether this assumed law can be maintained as a universal generalization.

* Ann. of Nat. Hist. vol. xvi. p. 104.