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*THE PALÆONTOLOGY OF VERTEBRATES.*

*Outlines of Vertebrate Palæontology.* By A. Smith Woodward. (Cambridge Natural Science Manuals.) Pp. xvi + 470; illustrated. (Cambridge: University Press, 1898.)

IT is now thirty-eight years since the appearance of the first edition of Owen's "Palæontology," which may be regarded as the first systematic treatise on that subject issued in this country. And if the section of that work devoted to the vertebrates be contrasted with the volume now before us, some idea of the enormous strides made in this branch of biological science during the period will be self-apparent. At the time that Owen wrote, our knowledge of fossil fishes remained much in the state it was left by the labours of Georges Cuvier and Hugh Miller; the restoration of the armour-plated fish-like types appearing as more or less grotesque caricatures of what we now know to be their true form; while the classification was as crude as it was unphilosophical.

The group now termed the Stegosauria was at that time placed among the Reptilia, and was represented chiefly by the true Labyrinthodonts and the *Archegosaurus*; the latter of which still figured as the representative of the so-called "archetype." Although among the true reptiles the Ichthyosaurs, Plesiosaurs, and Pterodactyles were already fairly well known, the Anomodonts were in evidence mainly by a few skulls, and their apparent relationship to mammals was undreamt of. North America and Belgium had not yet opened to our view the marvellous array of Dinosaurs; while among birds *Archæopteryx* was still an unknown quantity. To attempt to point out the deficiencies which then prevailed in our knowledge of the Mammalia would far exceed our space, but it may be mentioned that the Creodont Carnivora, and the Amblypod Ungulates, together with several other American groups of the latter order, had not yet been recognised. And whole mammalian faunas, such as those of Quercy, Samos, Maragha, the "Bad Lands" of North America, and Patagonia, were quite unheard of.

The advance during this period of considerably less than half a century, both in the amount of material available for work and in the work actually accomplished, has, indeed, been so vast that the vertebrate palæontology of 1860 is scarcely comparable with that of 1898. The one hardly merited the name of a science at all, while the other is entitled to rank with modern vertebrate zoology, of which, indeed, it is but the complement and keystone. As we have probably already explored most of the bonebeds of the world the science is unlikely to advance during the next forty years by the leaps and bounds which have marked its progress in the past, but even at a much lower rate of speed our successors at the end of that period will probably be surprised at the imperfection of our own knowledge.

With the advantage of all the labours—and failures—of his predecessors in this field at his disposal, it is not to be wondered at that Mr. Woodward has succeeded in

producing a volume that will eclipse or throw into the shade all previous works on the subject. In bringing the classification of fossil fishes up to its present state of comparative perfection the author himself occupies the foremost place among palæontologists; and in regard to this portion of the subject criticism would be almost an impertinence. He has also contributed important original information with regard to the structure and affinities of the extinct crocodiles and certain other groups of reptiles. With regard to the remaining groups of vertebrates, the author's position in the British Museum affords him exceptional opportunities of not only keeping abreast with modern discovery, but also of verifying and criticising the work of his fellow labourers by an examination of many of the actual specimens on which such work is based. And when he has seen reason so to do, he has not hesitated to propose new interpretations.

In his preface Mr. Woodward states that the main object of his work has been to produce a volume suitable to the requirements of "students of vertebrate morphology and zoology who are desirous of examining in detail the palæontological aspect of their subject." And how important it is to bring the workers in the zoology of the present time into closer touch with those who devote themselves to the same study in the past, needs no urging on our part. While, therefore, the work is not to be regarded as one that will satisfy all the needs of the advanced student of vertebrate palæontology, it will be invaluable even to him; and for those for whom it is specially designed it appears, in the main, to be all that can be desired.

One highly important feature in the treatise is the selection of a few of the better-known types of each group to indicate the leading structural peculiarities thereof; and the reader is accordingly spared all mention of the imperfect and unsatisfactory specimens which too frequently render palæontology so unattractive to workers in recent zoology. So far as we are capable of judging, Mr. Woodward appears to have attained remarkable accuracy in regard to the facts connected with the animals he describes. And what makes his descriptions particularly valuable is that the details of structure are arranged in each instance, so far as practicable, in the same order; thus rendering the comparison of one major or minor group with another of the same rank as easy as possible. The admirable illustrations, many of which are original, while others are borrowed from the writings of well-known specialists, serve to explain and accentuate the descriptions; and if the careful reader fails to grasp the leading morphological traits of the groups and genera described, it will certainly not be the fault of the author.

One point that strikes the critic is that the author is somewhat too apt to describe groups or genera with a somewhat over-degree of confidence as to their affinities, and in regard to the remains which have been referred to them.

Take, for example, the genus *Homalodontotherium*, originally described by Sir W. H. Flower, on the evidence of an imperfect skull from the Tertiaries of Patagonia, now in the British Museum. No one reading the description would imagine that there are palæontologists who believe that the reference of this genus to the "Ancylo-

poda" is based on a misconception, and that there are even some who doubt whether the limb-bones assigned to it in this volume are rightly associated. Whenever such doubts exist, either in regard to systematic position or the association of remains, the mention of them is, in our opinion, of prime importance.

Another point to which we take exception is the author's hesitation in adopting the rule of priority in nomenclature, unless strong reasons exist against it in particular cases. The result of this hesitation is that in many cases we have two names given for a genus as if they were of equal value. We find, for instance, *Belodon* or *Phytosaurus*, *Hyopotamus* or *Ancodus*, and *Giraffa* or *Camelopardalis*. In the third case the introduction of the alternative is obviously superfluous, as it is used by no zoologist with any respect for himself; but in the others, the second name is the one that should be employed. Whether he accept priority or no, the author ought to have made up his mind which name he intended to use, and have stuck to that and that alone. The man who hesitates in this respect is lost.

In regard to the classification of the higher vertebrates, the author follows to a great extent the schemes of some of those by whom he has been preceded. But in certain cases innovations are made, some of them doubtfully advantageous. We fail, for instance, to see the advisability of definitely including the problematical Eocene group Tillodontia within the Rodent order, of which it completely destroys the definition. Till their affinities be proved absolutely certain, it seems to us preferable to follow Sir William Flower in regarding such groups as occupying undetermined positions.

In view of recent discoveries with regard to vestiges of a placenta in certain living marsupials, the author's observations in regard to the phylogeny of that group will be read with special interest. Mr. Woodward is of opinion that marsupials have become non-placental by degeneration, and that the loss of nearly all replacement in the dental series is likewise an acquired feature. But he believes that the little *Triconodon* of the Dorsetshire Purbeck had already acquired the modern dental type; and it is consequently to be inferred that marsupials had become differentiated from a primitive placental type by the middle of the Jurassic epoch, and that such marsupials existed in the northern hemisphere. Now in a later passage (p. 431) we read that "the skeleton of these Australian marsupials does not appear to differ in any essential respects from that of the Creodonta and Condylarthra met with in the northern hemisphere at the dawn of the Eocene period. It is quite likely, therefore, that they [the Australian marsupials] are the direct descendants of some unknown families of the latter groups in the southern hemisphere." But he has already admitted the existence of true marsupials in the northern hemisphere during the Jurassic, and it is, therefore, obvious that, allowing time for migration of the evolved marsupials into the northern hemisphere, "some unknown families of Creodonta and Condylarthra" must have existed in the southern hemisphere at least as early as the Lower Jurassic, if not the Triassic! If we read the author's meaning correctly, there is no getting away from this *crux*, and it is certainly a "large order" that the groups in question should be of such vast antiquity. We

are prepared to accept the origin of the Monotremes from the Anomodonts or some allied Batrachians, and have indeed urged it ourselves; but, in the absence of tangible evidence, to be asked to believe that the Creodonts originated in the Trias or Lower Jura from the Theriodonts (which is practically what the above amounts to) at present staggers our powers of credulity.

On p. 430 the author revives the old theory as to the complete isolation of Australia "from all other existing continental areas since the remote epoch when Prototheria and Metatheria were the dominant mammals." And in order to support this contention he is compelled to remove the Patagonian Tertiary *Prothylacinus* (p. 388) from the Marsupials, and to place it among the Creodonts. But if an animal with a thylacine-like dentition (perhaps with somewhat fuller replacement) and skull, and an inflected lower jaw is not a Marsupial, it seems to us that we may as well give up our present system of classification altogether. Moreover, the isolation theory involves great difficulties with regard to the origin of the American opossums and selvas and the Australian dasyurids.

There are, however, difficulties into which the author's fondness for the isolation of continental areas leads him in other parts of the world. On p. 419 we are told that "South America must have been quite an isolated region from the close of the Cretaceous to the dawn of the Pliocene." It is true that on p. 429 this isolation is limited, so far as words go, to North America; but the general idea conveyed is the same, and nothing is mentioned with regard to the necessity of connection with other lands to explain the evolution of the fauna. The separation from North America is undoubtedly true, and thus far we are glad to be in agreement with the author. But when he speaks of universal isolation since the Cretaceous, it practically implies that the Ungulates and Rodents of South America have had no connection whatever with those of the rest of the world, since it is more than doubtful if these orders, as such, were evolved in Cretaceous times. And we should like to be informed how the occurrence of Octodonts in both South America and Africa is to be explained; to say nothing of the apparent connection indicated by recent discoveries between the African hyraxes and the Patagonian Toxodonts and Typotheres. Moreover, in this connection the author seems deliberately to have walked into a pitfall of his own digging. The aforesaid Patagonian *Homalodontotherium* is referred (p. 307), in opposition to the views of most writers, to a group of Ungulates known as the *Ancylopoda*, and typified by the European, Asiatic, and North American genus *Chalicotherium*. Now *Chalicotherium* is unknown before the Oligocene, and if South America has been shut off from the rest of the world between the Cretaceous and the Pliocene it would involve the supposition that it originated quite independently of *Homalodontotherium*; or, in other words, two members of one and the same group were developed in isolated areas without the possibility of the existence of a common ancestor.

But this is not all the fault we have to find with Mr. Woodward's treatment of the *Ancylopoda*. He mentions and describes *Homalodontotherium* first, so that the unsophisticated student would take that genus (instead

of *Chalicotherium* or *Macrotherium*) to be the type of the group, whereas it is more than doubtful whether it belongs to it at all. And it must be added that, in our opinion, the whole suborder is an unnecessary one. The teeth of the two genera last mentioned are so like those of the *Brontotheriidae*, that we are persuaded the *Chalicotheriidae* are merely Perissodactyles that have developed an edentate-like type of foot. A somewhat similar type has originated independently among the Artiodactyla in the *Agriochæridæ*, and there is no reason why it should not occur in the Perissodactyles.

Space prevents allusion to several other points inviting criticism; but, in the main, we are satisfied that Mr. Woodward has succeeded in producing a very valuable work, so far as actual facts are concerned. In regard to theories, it is possible that he may see his way to certain modifications in a later edition. An important feature is the bibliography at the end, which is generally remarkable for its accuracy, although the present reviewer must disclaim the authorship of a work with which he is credited under the title of "Deer and their Horns."

R. L.

#### THE SCIENCE OF PREVENTIVE MEDICINE.

*Transactions of the British Institute of Preventive Medicine.* (First Series). Pp. xi + 163. (London: Macmillan and Co., Ltd. New York: The Macmillan Company, 1897.)

IN an editorial note to this volume Dr. Allen Macfadyen writes that "the papers included in this volume have been contributed by members of the staff of the Institute, and were completed early in the present year" (1897), so that more than a year ago the British Institute of Preventive Medicine was able to point to this series of completed but unpublished papers, which, however, only saw the light at the end of 1897, as evidence of the activity of its staff.

As considerable interest is naturally being evinced in the Institute, which has just taken up its abode in a new home at Chelsea, it is perhaps desirable to give more than a mere review of the work that has so quietly and steadily, but unostentatiously, been going on in the old habitation.

As Lord Lister points out in a short introductory notice, "The British Institute of Preventive Medicine was incorporated on July 25, 1891, with the view of founding in the United Kingdom an institute similar in character and purpose to the 'Institut Pasteur' in Paris, the 'Hygienisches Institut' in Berlin, and other establishments of a like nature existing abroad." The main objects of the Institute, as set forth in the memorandum of Association, are as follows:—

"(1) To investigate the means of preventing and curing the various infective diseases of men and animals, and to provide a place where researches may be carried on for this purpose.

"(2) To provide instruction in preventive medicine to medical officers of health, medical practitioners, veterinary surgeons, and advanced students.

"(3) To prepare, and to supply to those requiring them, such special protective and curative materials as

have already been found, or shall in future be found of value.

"Further, to provide the means for carrying out investigations in all branches of bacteriology, including those of practical importance to chemists, agriculturists, and manufacturers."

It had evidently also been anticipated that it would be necessary to carry out the examination of water and sewage as regards their bacteriological and chemical contents, and with this in view a chemist has been appointed on the staff to take charge of such work. How far the objects of the Institute have been gained is evident from even a superficial glance at the papers contained in this first series of *Transactions*; while on a more careful study of the contents of this volume it is evident that much work of permanent value has been done under the direction of Dr. Macfadyen, Dr. Hewlett, and Mr. Lunt.

The first paper, which is evidently based on work carried out in connection with the production of anti-streptococcic serum, deals especially with the exaltation of the virulence of the streptococcus pyogenes and the streptococcus erysipelas by passing them through the rabbit. In the course of twenty-six such passages, Dr. Bulloch found that he was able to increase the virulence from a strength such that one-quarter of a c.c. was necessary to kill one kilogramme of rabbit to a strength such that one-millionth c.c. was sufficient to bring about the same result; but Dr. Bulloch comes to the conclusion that (1) the degree to which the streptococcus can be exalted by passage through a susceptible animal varies; (2) that an animal immunised against a streptococcus from a case of erysipelas is also immune against a streptococcus from a case of abscess, which indicates that so far, at any rate, as a horse is concerned, these organisms have a very similar action, and that, therefore, they are closely allied from a biological point of view.

The second paper, "On the so-called 'pseudo' Diphtheria Bacillus, and its Relation to the Klebs-Löffler Bacillus," by Dr. Richard T. Hewlett and Miss Edith Knight, has a practical bearing on the diagnosis of diphtheria by microscopic and cultural examination. Drs. Hewlett and Knight arrive at the conclusion that at least two forms have been described as "pseudo" diphtheria bacilli: "(a) one in morphology, a Klebs-Löffler bacillus, but non-virulent (Roux and Yersin, &c.), and (b) another shorter, plumper, and more regular in form, and staining more uniformly than the Klebs-Löffler bacillus ('Löffler, Von Hoffmann, Park, Beebe, Peters, &c.),' but that "the term should be reserved for the latter form." They also maintain that by gradual heating it is apparently possible to convert a typical Klebs-Löffler virulent bacillus into a typical non-virulent "pseudo" bacillus, and by cultivation and incubation and passage through an animal to convert a "pseudo" into a Klebs-Löffler bacillus. From what we know of the history of epidemics of diphtheria, and of the cultural characteristics of organisms that are carried through a long series of generations, there is no doubt that the virulence of the diphtheria bacillus varies enormously; but whether we have simply a non-virulent form and a virulent form of the same organism, or whether two organisms—of the same group, no doubt, but having permanently different