Kansas likewise offers an equally inviting field. If a single location yields up such prodigious possibilities as Mr. White has demonstrated what may we not expect from the rest of the vast field!

C. R. KEYES.

The Devonian "Lamprey," Palaeospondylus Gunni, Traquair. By BASHFORD DEAN (Mem. N. Y. Acad. Sci., Vol. II, Part I), 1899.

This elaborate memoir of thirty quarto pages and a plate drawn and lithographed by the author himself represent a vast amount of labor expended on minute, poorly preserved, and what would seem at first sight insignificant objects, found in the Caithness flags of Scotland. The fossil remains of *Palaeospondylus* are very unsatisfactory for study, and but for the peculiar interest attaching to them as supposed representatives of Palaeozoic Lampreys, they would hardly command attention. But zoölogists have been eagerly awaiting whatever enlightenment palaeontology might offer on the relations and descent of the Cyclostomes, and when Dr. R. H. Traquair announced his discovery of *Palaeospondylus* in 1890, it was hailed with delight as a definite clew to Cyclostome genealogy.

Dr. Dean observes: "Zoölogists were by no means unwilling to accept *Palaeospondylus* as a fossil lamprey; and they even found it a difficult matter to avoid going out in the road to give it a charitable reception. The fossil came, was seen, and was currently accepted. But time has gone by and suspicion come, and the thought is by no means comforting that the wrong prodigal may have been welcomed. Is *Palaeospondylus*, then, a veritable Cyclostome, or is it at least a provisional one?" Dr. Dean's purpose in investigating this question is a critical one, and he states that he has "attempted to analyze the results of preceding writers, to contribute some further data to our knowledge of the structure of this form, and to endeavor finally to determine what conclusions are justified in assigning a place to this fossil. After accomplishing all this in very satisfactory fashion, the author takes up the classification of fishlike vertebrates in general and introduces some novel changes, which will be referred to presently.

Dr. Dean's conclusion as to the Marsipobranch nature of *Palaeospondylus* takes the form of a more emphatic denial than ever (see his previous paper in *Proc. Zoöl. Soc.*, April 1898) that it can be regarded

even provisionally as a fossil lamprey. Dr. Traquair's objection that if *Palaeospondylus* be not a Marsipobranch it is impossible to refer it to any other existing group of vertebrates, Dr. Dean disposes of by boldly placing it in a new class by itself, elevating the order Cycliae, which Gill created for it, to that rank. Such a course may strike one as rather startling, perhaps, but it is certainly effective. An alternative proposition which Dr. Dean suggests may be more acceptable to some ichthyologists "is to place it with *Coccosteus* as doubtfully its larval form." Although there is considerable reason for regarding the variations in this small form as the early stages of some larger chordate, yet there is no direct proof that the adult form was an Arthrodire; hence this association would have to be at best only provisional, and, in the author's opinion, is inexpedient. As to the relations of newly exalted Cycliae to other classes, we are left as much in the dark as ever. Some very excellent figures of the fossil forms are given, together with a diagrammatic restoration.

Very interesting, indeed, are the author's views on the systematic arrangement of the early forms of fishlike vertebrates and fishes proper, with which the paper concludes. Amongst the latter the Chimaeroids are reduced again to the rank of an order instead of a subclass, principally as the result of Dr. Dean's recent embryological investigations, and the Dipnoi are reduced from class rank (Parker) to that of a subclass. *Acanthodes* and *Cladoselache* are grouped together under the primitive Elasmobranch order Pleuropterygii.

Turning now to the most primitive of all chordates, Dr. Dean elevates the Ostracoderms and Arthrodires each to the rank of an independent class, the former with its customary triple subdivision, but the latter separated into two new divisions, Arthrodira proper and Anarthrodira, which rank as subclasses. On the ground of their lacking a mandibular arch and paired limbs, the Ostracoderms were denied by Cope, and following him by Smith Woodward, and others, to be fishes at all, but organisms far removed from the latter, called "Agnatha." The origin and relations of the Ostracoderms are at present among the most important and fascinating questions of palaeichthyology. Dr. Traquair, in an extremely valuable memoir of last December[1] refuses to believe that these forms are Agnatha, declaring Cope's view to rest entirely on negative evidence, and preferring to look upon the lowest

[1] Report on Silurian Fishes (Trans. Roy. Soc., Edinburgh, Vol. XXXIX, Pt. III), 1899.

Ostracoderms "as having definitely split off from the Elasmobranchs, from which they doubtless originally came." Dean believes in a wider separation, however, from the groups represented by recent forms; but regarding the differences between Ostracoderms and Arthrodires, he makes the following significant remark: "A renewed examination of the subject has caused me to incline strongly to the belief that Pterichthys and Coccosteans are not as widely separated in phylogeny as Smith Woodward, for example, has maintained. But as far as present evidence goes, they appear to me certainly as distinct as fishes are from amphibia, or as reptiles are from birds or from mammals" (p. 24). The reference to Smith Woodward bears, of course, on the recognition of Arthrodires by that author as an order of Dipnoi.

Whatever may be thought of the class Cycliae, there is no question but that Dr. Dean has scored an advance by elevating the Ostracoderms and Arthrodires to a higher rank and placing them in close proximity to one another. A separation of the two classes is rendered necessary of course, thus prohibiting the revival of McCoy's "Placodermata," by the absence of "jaws," endoskeletal structures, and paired limbs in the first-named group. Nevertheless the two classes have a number of points in common, and should we be led to infer with Traquair an Elasmobranch derivation of the Ostracoderms, it would be natural to trace Arthrodires to the same source. Whether there were really "Agnatha," and how far the archaic fishlike vertebrates were removed from the groups represented by living forms, must be left for future study to decide. Or possibly we may never have the solution of these perplexing problems.

In one minor point only the reviewer finds himself in disagreement with Dr. Dean, and this relates to the subdivision of Arthrodires (or "Arthrognaths," to use his new term) into Arthrodira proper and Anarthrodira. The latter includes *Macropetalichthys*, *Trachosteus*, *Mylostoma*, and certain transitional forms which the author promises shortly to describe. When the cranial and body armoring of *Trachosteus* and *Mylostoma* are made known, their position may become evident. At present we are acquainted only with the cranial osteology of *Macropetalichthys*, and this is so far different from that of typical Arthrodires that in the reviewer's opinion it cannot be retained in the same class. As typical of an independent family, it had best be removed with the Asterosteidae to a position amongst the Ostracoderms, as we certainly do not wish to make of it an independent class. The comparisons between

this form and the cranial and dorsal shields of Arthrodires indicated by Cope and the reviewer a few years ago were based upon a misconception of the septum dividing off the so-called "nuchal plate;" but in reality no homology exists between arrangement of cranial plates or the sensory canal system of this form and those of Arthrodires. No plates corresponding to the dorsal or ventral armoring of *Coccosteus*, etc., are known, nor is there any evidence of a lower jaw, of paired fins, neural or haemal arches, nor any form of dental plates attached to the roof of the mouth. Finally, the bone-structure is perceptibly different from that of typical Arthrodires, and the under side of the head is unparalleled in the latter group. This form is certainly worthy of careful reinvestigation.

The whole matter of Dr. Dean's Anarthrodira, is, however, of subordinate importance as compared with his main theme, which is admirably treated; and palaeontologists will be sure to appreciate his clear exposition of the same, supplemented as it is by a complete bibliography and expertly drawn figures.

C. R. EASTMAN.

Some High Levels in the Postglacial Development of the Finger Lakes of New York. By THOMAS L. WATSON. With 30 figures and 3 maps. The figures being mostly full page half-tones, maps, and diagrams. Appendix B. Report of the Director of the New York State Museum, 1899.

Dr. Watson presents in a very clear and interesting manner the results of the earlier works of other investigators and of his own extended observations on the high level terraces and water marks in the Finger Lakes region. He finds that at the time of maximum advance of the "ice of the second glacial period" (by which he probably means the early or late Wisconsin of some writers) the ice front extended to and beyond the present divide which separates the waters draining northward into the St. Lawrence and those of the Chemung-Susquehanna draining to the southward. The preglacial valleys now occupied by the Finger Lakes were entirely overridden by the ice but were not completely filled with the glacial débris, so that as the ice front began to retreat and had drawn back to a position north of the divide there was formed, in the valleys, numerous local glacial lakes which drained southward through several channel ways. These channel