

tain $V = .0484$, a difference of 5 per cent. As a check upon the accuracy of the readings, it will be seen that the differences between the velocities in Cases I. and II. and between those in III. and IV., representing double the velocity due to the difference in density of the water in different parts of the tube, are about equal; also the differences between Cases I. and III., and II. and IV., representing the variation due to imperfect adjustment of the axis, are approximately the same. In order to show that there was no appreciable effect from convection currents while the ring was in a horizontal position, several readings were taken after the tube had remained at rest for some time, none of which showed a motion larger than .015 mm. per second.

In order to obtain the best possible results, the ring should be mounted as rigidly as possible in a room of equal temperature throughout, and the axis should be capable of accurate adjustment parallel to the ring. If the radius of the ring were made smaller, although the effect of the earth's rotation would be less, it would be easier to keep all parts of the tube at an equal temperature, and the ring could be turned more quickly. Moreover, since the motion would not be so great, the velocity of the water would diminish less rapidly, so that more accurate readings could be obtained. With a more mobile liquid the motion would of course continue longer. Even with the comparatively crude apparatus described above, however, it is not difficult to show that the earth revolves.

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January 13, 1913

CROSSOPTERYGIAN ANCESTRY OF THE AMPHIBIA

For many years evidence has been accumulating for the view that the Amphibia have been derived not from Dipnoi but from Crossopterygians of some sort. Pollard¹ held that the Amphibia were remotely related to the

¹"On the Anatomy and Phylogenetic Position of *Polypterus*," *Zoöl. Jahrb. Abt. f. Anat. u. Ont.* (Spengel), V. Bd., Jena, 1892, pp. 387-428, Taf. 27-30.

living *Polypterus* and Baur² was able to strengthen the evidence, to some extent, from the Stegocephalian side. More recently Thévenin³ has expressed similar views, while Moodie,⁴ correcting Baur's observations on the lateral line grooves in the skull has seemingly demonstrated the general homology of the skull top of *Polypterus* with that of Stegocephalia. Gegenbaur⁵ supported the homology of the Stegocephalian cleithrum with the "clavicle" of *Polypterus* and other fishes, while Klaatsch⁶ showed that the pectoral limbs of *Polypterus* both in musculature and osteology in many respects remotely suggest Amphibian conditions. On the other hand, Goodrich's⁷ studies on the scales of fishes, together with the evidence offered especially by the brain of *Polypterus*, tend to remove that genus widely from genetic relationship with the Amphibia.

The Paleozoic Crossopterygii have hitherto yielded a few, though significant, hints of Amphibian relationship. The Texas Permian Crossopterygian fish named by Cope *Ectosteorhachis nitidus* and recently figured by Hussakof⁸ as *Megalichthys nitidus*, suggests remote Stegocephalian affinities in the skull and the same is true of *Rhizodopsis*, as figured by Traquair⁹ and of *Osteolepis*, as figured by

²"Les Plus Anciens Quadrupèdes de France," *Annales de Pal.* (Boule), tome V., 1910, pp. 1-64, pl. I.-IX.

³"The Lateral Line System of Extinct Amphibia," *Journ. of Morphol.*, Vol. XIX., No. 2, 1908, pp. 511-540; 1 pl.

⁴"Clavicula und Cleithrum," *Morphol. Jahrb.*, XXIII. Bd., Leipzig, 1895, pp. 1-21.

⁵"Die Brustflosse der Crossopterygier," *Festschr. für Gegenbaur*, I. Bd., 1896, pp. 259-391, Taf. I.-IV.

⁶"The Stegocephali. A Phylogenetic Study," *Anat. Anz.*, XI. Bd., 1896, No. 22, pp. 657-673.

⁷Cf. Lankester's "Treatise on Zoology," Part IX., first fascicle. "Cyclostomes and Fishes," by E. S. Goodrich, 1909, especially pp. 217-219, 290-300.

⁸"The Permian Fishes of North America," Publ. No. 146 Carnegie Institution of Washington, pp. 168 and pls. 30, 31.

⁹"On the Cranial Osteology of *Rhizodopsis*," *Trans. Roy. Soc. Edinburgh*, Vol. XXX., 1881.

Pander.¹⁰ *Sauripterus* Hall, a supposed Rhizodont from the Upper Devonian of Pennsylvania has a pectoral girdle and forepaddle which distantly approach Stegocephalian conditions¹¹ and so also, but in less degree, has *Eusthenopteron*.¹²

Far more definite evidence of the supposed relationship of the Stegocephali with the Paleozoic Crossopterygii has recently been adduced by D. M. S. Watson,¹³ of Manchester, in describing some of the large Stegocephalia of the Coal Measures preserved in the Newcastle Museum. He finds that the skulls of the Carboniferous Labyrinthodonts, "*Loxomma*" and *Pteroplax* reveal striking resemblances to the Carboniferous Crossopterygian *Megalichthys*:

The Basisphenoid of *Megalichthys* has sometimes carotid foramina just as in *Loxomma*. It has small but distinct basi-ptyergoid processes which are, however, not provided with articulating surfaces but with sutural ones. The long parasphenoid extends forward to the premaxillæ as it may do in *Pteroplax*. Its lateral borders are in contact with the Pterygoids, to which they afford support, and the bone is connected with the roof of the skull by a fused ethmoid.

The pre-vomer is identical with that of "*Loxomma*" in the majority of its attachments, carries one large tusk and a pit for the replacing tooth. It meets its fellow of the opposite side and forms the front of the posterior naris; it is doubtful, however, if it meets the palatopterygoid.

The Palatopterygoid of *Megalichthys* is exceedingly like the palatine and pterygoid of *Pteroplax*. They have similar relations to the basisphenoid, parasphenoid and maxilla. There is the same row of small teeth parallel to those of the maxilla with

larger teeth inside them, and the pterygoid is covered with the same shagreen of fine teeth.

Examination of these primitive and extremely well-preserved skulls seems to show that the ordinary idea of autostylism of the Tetrapoda is incorrect in postulating a connection between the pterygo-quadrates cartilage and the otic region. It is, I think, quite certain that there never was such a connection in primitive forms, except through the dermal bones of the temporal region. The lower attachment with the basisphenoid I have just shown to exist in Crossopterygians, which are hence "amphistylic," in a different way to Notidanus.

The large teeth on the palatine, with infolded bases, exhibit a curious type of tooth replacement which is

very characteristic of the Stegocephalia, and is unknown elsewhere except in the Crossopterygian fish, where it occurs in a very typical form in the vomerine tusks of *Megalichthys*, and no doubt in many other genera, and in *Lepidosteus*. This occurrence seems to me a strong additional reason for regarding the Tetrapoda as derived from this group of fish.¹⁴

The lower jaw of "*Loxomma*" likewise approaches the Crossopterygian type in the fact that the splenial is "entirely a bone of the outer side of the jaw as is the first infradentary of the Crossopterygian mandible."

Watson's observations also have important bearing on the relations of the Permian reptilia. These have been distinguished from contemporary Stegocephalians chiefly by the single basi-occipital condyle and by the large pterygoids, which leave only a small interpterygoid vacuity, divided by a narrow parasphenoid. Watson has shown that these and other "reptilian" characters are fully exhibited in "*Loxomma*," *Pteroplax*, *Anthracosaurus* and other Carboniferous Stegocephalians, that these characters they share also with *Megalichthys* and that no palate with large vacuities like that of *Eryops* or *Capitosaurus* has ever been found in Carboniferous rocks. He therefore concludes that "the reptilia were separated off very early in the history of the Stegocephalia, preserving features which were

¹⁰ "Ueber die Sauridipterinen, Dendrodonten, Glyptolepiden und Cheirolepiden des Devonischen Systems," 1860, pls. 1-3.

¹¹ Cf. Gregory, SCIENCE, N. S., Vol. XXXIII., 1911, p. 509. A figure of this forelimb by Hussakof has recently been published by Dr. Bertram Smith in the *Journal of Morphology*, Vol. 23, No. 3, 1912, p. 544.

¹² Cf. Patten, "The Evolution of the Vertebrates," 1912, p. 391.

¹³ "The Larger Coal Measure Amphibia," *Mem. and Proc. Manchester Literary and Philos. Soc.*, Vol. LVII., Part I., No. 1, 1912, pp. 1-14, 1 pl.

¹⁴ *Ibid.*, p. 5.

rapidly lost by the latter group, which had a much accelerated evolution." With this conclusion the trend of recent work on the Permian Tetrapoda by Case, Williston, Moodie and Broom, seems to be in accord.

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SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 508th regular meeting was held in the assembly hall of the Cosmos Club, February 22, 1913, with President Nelson in the chair and 76 persons present.

The program consisted of a lecture by Edmund Heller on "Hunting with Rainey in Africa." The communication was chiefly descriptive of the maps and numerous lantern slides exhibited and also of the physical features and vegetation of the country as well as the animals secured during the expedition.

THE 509th meeting was held March 8, 1913, with Vice-president Paul Bartsch in the chair and 37 persons present.

Under the heading "Brief Notes, etc.," Wm. Palmer exhibited the head of the small devil ray (*Mobula olfersi*) and a plaster cast made from the same, and explained the feeding habits of this fish. A. C. Weed gave some further account of its habits, and Theodore Gill added some historical notes about devil fishes.

Barton W. Evermann reported results of the sale of blue fox skins from the Pribilof Islands at Lampson's (London) auction of March 7. The 384 skins offered sold at an average price of \$56, the highest price being \$85.

The regular program consisted of two communications. J. W. Gidley gave an account of a fossil camel recently found in America north of the Arctic circle. The only bone found was a phalanx. The species was an extinct one and its occurrence so far north was regarded as further proof that there once existed land connection between the continents by way of Alaska. The paper was discussed by Messrs. Wilcox, O. P. Hay, Weed, Gill, Evermann, Lyon and others.

The second communication was by Paul Bartsch on "Some Remarkable Philippine Mollusks obtained by the U. S. Bureau of Fisheries Expedition." Specimens of the mollusks described were exhibited by the speaker.

THE 510th meeting was held March 22, 1913, with Vice-president Bartsch in the chair and 50 persons present.

Barton W. Evermann reported the executive order of President Taft made March 3, 1913, setting aside the entire chain of the Aleutian Islands as a wild mammal and bird reservation. The reservation is to be under joint charge of the Departments of Agriculture and of Commerce.

A. D. Hopkins announced the recent organization of a new scientific society, The Society for the Advancement of Forest Entomology in America.

The regular program consisted of two communications:

Recent Progress in the Study and Culture of the Common Eel: HUGH M. SMITH.

This was a comprehensive outline of the recent discoveries concerning and the completed life history of the common eel. Statistics of the commercial uses of the eel and the methods employed abroad for its propagation and distribution were given. Numerous lantern slides were shown.

Tree-Shrews: MARCUS LYON, JR.

This paper was based upon a study of many specimens of these squirrel-like insect-eating animals. Of less than 800 known specimens in museums, the British Museum possesses 355, the U. S. National Museum 24, and about 100 are in other collections. The paper was illustrated by lantern slides. Messrs. Bartsch and Wm. Palmer took part in the discussion.

THE 511th meeting was held April 5, 1913, with President Nelson in the chair and 43 persons present.

Under the head of Brief Notes, Paul Bartsch reported observations on the habits of the two common toads of the District of Columbia, *Bufo americanus* and *Bufo fowleri*.

Henry Talbott made some remarks on the probable agency of man in the dispersion of animals during the later geological ages. The regular program consisted of two communications:

A Commercial Aspect of Paleontology: by a Layman: HENRY TALBOTT.

The Zoological Results of the Denmark Expedition to Northeast Greenland: FRITS JOHANSEN.

The speaker, who accompanied the expedition, gave an account of climatic conditions and the fauna and flora encountered. Mammals and birds received the principal attention. Maps and numerous lantern slides were used.

D. E. LANTZ,
Recording Secretary