land offers the advantage of a relatively high southern latitude, but it seems improbable that the astronomical observing conditions can surpass those of the Orange Free State and Transvaal, which have received extremely favorable reports from experienced observers who have worked there. Nevertheless, the claims of New Zealand should not be allowed to pass by without some examination. Mr. Crust points out that in Central Otago there is a treeless area at an elevation reaching 3,000 feet where the rainfall is less than 15 inches a year, while the number of clear nights may be so high as 276 a year.

DISCUSSION

PALEOSPONDYLUS[1]

THE fossil remains found in the old Silurian beds of Scotland are generally considered to be related to the myxinoids and have been named Paleospondylus. Of the several views which have been held by comparative anatomists as to the relation of Paleospondylus to other vertebrates, the majority of investigators believe that the fish-like animal which left its remains in the old red sandstone was a myxinoid. W. J. Sollas and I. B. J. Sollas published an account of the structure of the skeleton from serial sections of the fossils. These reconstructions from these sections give us the best view of the relation of the different parts of the head skeleton of this fossil yet published. The skeletal pieces lying ventrad of the ear capsule have been considered to belong to the skeleton of the gills. As a myxinoid the gills were probably located well behind the head as in the living myxinoids and the skeletal piece named the *post-branchial plate* occupies a position and has the relation to the other skeletal pieces of the *external lateral velar bars* of the living myxinoids. They lie ventral to and project back beyond the skull just as these velar bars do in the living myxinoids. The development of the notochordal skeleton of rings was continuous from the head to the tip of the tail in Paleospondylus, whereas in the living myxinoids there is a long interval between the head and the tail in which no skeletal pieces are developed. To this extent at least Paleospondylus was more advanced than the living myxinoids in the development of the skeleton for the attachment of the muscles of the body.

The admirable work of Patten and Stensiö and other students of early vertebrate animals, especially their researches among the ancient ostracoderms, brings out the need of fuller knowledge of the velum as a potent organ in the head of early vertebrates. Guided by the anatomy of living petromyzonts Stensiö located the velum in ostracoderms between what he has named the spiracular and prespiracular gills, and says that the prespiracular gill was part of the velar tissue. These deductions are based on certain bony ridges on the inner face of the bony head shield of these animals and the folds of soft tissue in the head of Ammocoetes. This reconstruction of the ostracoderm head is far from satisfactory viewed from the standpoint of the anatomy of Ammocoetes and of the ostracoderms.

Stensiö agrees that the living myxinoids and petromyzonts are primitive in their structure and for the most part not degenerate. He thinks, however, their skeleton is regressive from the ostracoderm condition of a continuous head-trunk shield of bone. He also decides the absence of pectoral fins in marsipobranchs is secondary. He assumes their ancestors had them, but that they have disappeared from the living forms of myxinoids and petromyzonts.

(1) We do not know the stages of descent of the present-day myxinoids and petromyzonts, but that they had paired appendages at any time in their history is not supported by any facts. Their whole development and life history shows that paired appendages had not been developed. There is no slightest trace in their anatomy.

(2) Among living vertebrates bone is the final stage of skeleton, not the first or most primitive stage and there is no support for the idea that the ostracoderm bony skeleton is the primitive condition from which all other forms of skeletal tissue and support organs have been derived. This is true from the standpoint of comparative morphology as well as ontogeny.

(3) The conclusion that the bony head skeleton of the ostracoderms was preceded by a cartilaginous structure similar to that of living petromyzonts is valid and well grounded in the morphology of the living marsipobranchs.

(4) The branchial basket of the marsipobranchs, as I have shown, is a development of the external velar skeleton and is not derived by the degeneration of the bony head shield of ostracoderms, from bone to cartilage and fibrous tissue with subsequent removal of this skeletal tissue by perforation, leaving only narrow strips and bars of cartilage with fibrous tissue left in the interspaces.

The marsipobranchs are primitive vertebrates when compared with other fish forms more advanced in differentiation and specialization of tissues and organs, but they are far along the road of vertebrate evolution. If one may guess the duration of geologi-

[1] Dr. Howard Ayers, author of this communication, died on October 17.

cal time they are half way from their ancestors to mammals.

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A NEMATODE PARASITE IN MYXINOIDS

IN studying Bdellostoma, the nematode parasite was found in the large subdermal blood sinus. It was usually located in the dorsal part of the sinus in the head region, and in the preserved specimens the worms were found closely coiled together and interlaced with the strong tendons connecting the skin to the trunk in the median dorsal line, also sometimes intertwined among the connective tissue strands which fasten the skin of the ventral and ventro-lateral part of the head to the muscles. The myxinoids appear not to harbor many parasites, which fact may be related to their long-continued existence. Specimens of this nematode were sent to G. Steiner, senior nematologist, of the U. S. Department of Agriculture in 1928. Steiner named it *Tetanonema strongylurus,* new genus, new species. At that time nothing was known of the method of propagation. I have recently found, however, that the microscopic embryos of the parasite leave the body of the parent Bdellostoma in the eggs and are to be found in the growing embryo before hatching as well as after hatching, coiled in the tissues of the gills. Whether they infest other parts of the embryo Bdellostoma is yet unknown. So far as I know this is the sole animal parasite occurring in the myxinoids, and no plant parasite is known to attach itself to or live within the body of these animals. How the filaria of this nematode enter the Bdellostoma egg and at what stage of the growth of the egg is not known. They enter before the micropyle is fully formed. None of the adult nematodes have been found in the gills of the adult Bdellostoma, but colonies of the worms numbering up to one hundred or more occur in the subdermal blood sinus.

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THE THICKNESS OF THE GLACIAL DEPOSITS IN OHIO

AN examination of nearly 2,800 well records, obtained from the files of four oil companies which operate in Ohio, has revealed some interesting facts concerning the topography of Ohio in preglacial and interglacial time. It was possible to obtain figures for the thickness of the glacial drift over an area of approximately 4,637 square miles in north central Ohio, in Cuyahoga, Summit, Lorain, Medina, Ashland, Wayne, Richland, Holmes, Tuscarawas, Portage and Coshocton counties. As expected, it was found that the thickness of the glacial drift is much greater in the preglacial and interglacial valleys, the majority of which coincide, in trend, with the present valleys. On the buried uplands between the valleys, the thickness of the drift varies, and appears to be thinnest along Lake Erie, where in places it is not much above 20 feet in thickness. Fourteen quadrangles show average thicknesses over the buried uplands varying from 37 to 67 feet. For the entire area, the thickness over the buried uplands averages 51 feet.

The depth of the glacial drift in the buried valleys averages from 155 feet in the Wellington quadrangle to 380 feet in the Cleveland quadrangle. The average thickness of the drift for all the buried valleys in the entire area is 205 feet. The maximum thicknesses in feet for the fourteen quadrangles range from 192 feet for the least, to 763 feet for the greatest. Thicknesses of 300 feet and over are common throughout the area. The thickness of the drift, over all, taking the average for buried valleys and uplands in the entire area, is 95.7 feet. This figure was derived by taking the average of all the well records, a total of 2,782. The Oberlin and Berea quadrangles, located farthest north, along Lake Erie, have the least thickness, 54 and 43 feet, respectively, whereas the area farther south represented by the Medina, Akron, Ashland, West Salem, Wooster, Massillon, Canton, Perrysville, Loudonville and Millersburg quadrangles have thicknesses of 85, 111, 90, 81, 80, 154, 97, 88, 90 and 94 feet, respectively. The greater thicknesses are explained by the facts that, where they occur, there are either deep buried valleys or morainic belts.

The greatest thickness in the entire region and possibly in the State of Ohio, 763 feet, is located south of Cleveland, in Newburg township, about two miles directly east of the village of Independence. Here a north-south buried valley marks the course of the preglacial or interglacial Cuyahoga River. Other thicknesses in this valley are 605, 560, 519 and 500 feet and many more greater than 400 feet. The elevation of the bed-rock which marks the buried surface, at the point where the thickness of the drift is 763 feet, is 13 feet below sea-level and 586 feet below the present level of Lake Erie. The bottom of this valley stands 800 to 900 feet below the buried upland, as indicated by well records in Newburg and Independence townships. It appears to have been a narrow gorge in the youthful or early mature stage in the cycle of erosion and may have stood much higher than at present. The buried valleys throughout the area are, with few exceptions, narrow at the bottom, but their upper portions are broad, with rather gently sloping uplands. It is probable that the valley of the old Cuyahoga, and other buried valleys in the region, are not the result of stream erosion alone, but have been deepened and otherwise changed by glacial erosion.

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