

The Ordovician chert of Chypon's Farm, in Mullion parish, continuous with the Radiolarian chert of Mullion Island, was examined in 1899, and yielded: Sphæroidea, 3 genera (with 3 species); Prunoidea, 3 genera (6 species); and Discoidea, 1 genus (1 species).

Dr. Hinde's latest memoir on Radiolaria has been prepared as an Appendix for the "Geology of Central Borneo," to be published by Professor Dr. G. A. F. Molengraaf, of the Dutch Exploring Expedition, in 1893-4. In his Introduction Dr. Hinde describes the outcrops and general character of the Radiolarian rocks under notice, namely, jaspers, cherts, hornstone, and diabase tuff. Their local occurrence in the siliceous rocks and in the tuffs, and the distribution of these fossil Radiolaria in other countries, are indicated in the table at pp. 44-46, and treated in detail in the text:—

	Genera.						Species.
<i>Beloidea</i>	1	...	...	1
<i>Sphæroidea</i>	5	...	...	17
<i>Prunoidea</i>	5	...	...	12
<i>Discoidea</i>	6	...	...	16
<i>Cyrtosidea</i>	13	...	...	54
				30			100

These rocks are stated to underlie strata of Cenomanian age, and they seem to belong either to the latest Jurassic or the earliest Cretaceous age, as is the case also with the Radiolarian cherts and jaspers of the Coast Range in California.

Great services have been rendered to geology by Dr. Hinde's elucidation of the relics of some very obscure Invertebrata, in his successful studies of the Silurian Conodonts, of Sponges of every group and age, and now of Palæozoic and other Radiolaria. He has thus indicated how the relative age of many rocks may be determined by the evidence of several kinds of microscopic fossils.

II.—*HELICOPRION*—SPINE OR TOOTH?

"Ueber die Reste von Edestiden und die neue Gattung *Helicoprion*."

By A. Karpinsky. Verhandl. k. russ. min. Ges. St. Petersburg, ser. II, vol. xxxvi, No. 2, with 4 pls. and 72 text-figs. (1899).

PALÆONTOLOGISTS are indebted to the eminent Director of the Imperial Russian Geological Survey for one of the most exhaustive memoirs on a fossil ever published. Dr. Karpinsky's description of the strange 'ichthyodorulite,' *Helicoprion*, is a model of what such a work should be—thorough from every point of view, geological, chemical, and biological. It is, moreover, illustrated by exquisite plates, besides numerous text-figures, representing not only the outward form of the problematical fossils dealt with, but also every feature of their microscopical structure.

Helicoprion, to a superficial observer, looks much like an ammonite; but on closer inspection it is easily recognizable as a spiral consisting of teeth firmly fixed together by their bases. Fragments of a more or less similar spiral have already been

described under the name of *Edestus* from Carboniferous strata in North America, Russia, and Western Australia; but no specimens at all approaching the two best of the fossils now made known by Dr. Karpinsky have hitherto been discovered. The rival theories by which *Edestus* has been sometimes ascribed to the jaws, sometimes to the external dermal armour of a shark or skate, can thus be discussed again in the light of important new facts. If the *Edestidæ* must still remain as Elasmobranchs of uncertain zoological position, the memoir before us at least makes great accessions to our knowledge of the essential points in the structure of their so-called segmented spine.

The new fossils forming the subject of the memoir were discovered by Mr. A. Bessonow in the Permo-Carboniferous (Artinsk Series), near Krasnoufmsk, in the Government of Perm. They comprise two nearly complete spirals from 0.238 m. to 0.260 m. in diameter, besides three fragments, and were sent by their discoverer to the Museum of the Imperial Geological Survey, St. Petersburg. The ends of both spirals are incomplete, but both exhibit approximately $3\frac{1}{2}$ whorls, all in one plane and apparently bilaterally symmetrical. The segments or teeth of the central whorls are relatively very small, but they rapidly increase in size towards the periphery, and are largest at the free outer end. In one specimen 136, in the other specimen 146 segments are preserved or indicated. The segments resemble those of the typical species of *Edestus* in all respects, except that the enamel extends far down the middle of the side of the base, and there is a notch at the inner extremity of the base. These two features, together with the remarkable extent of the spiral, are rightly judged by Dr. Karpinsky to be the marks of a distinct genus, which he names *Helicoprion*. All the new specimens are placed in a single species, named *H. Bessonowi* after their discoverer. *Edestus Davisi*, H. Woodw., from the Carboniferous of Western Australia, is provisionally referred to the same new genus.

After a detailed description of the general characters of these remarkable fossils, Dr. Karpinsky illustrates their microscopical structure by a series of beautifully prepared sections. They are shown to consist of vaso-dentine, without any trace of bone-cells; and the superficial enamel seems to be the ordinary gano-dentine or vitro-dentine.

Chemical analyses by Mr. B. Karpow are also discussed, and the conclusion is arrived at that the fossil itself consists chiefly of a substance closely resembling apatite.

Two or three of the specimens exhibit numerous small granules over and around the bases of the segments. These are next treated in great detail, and the description is again illustrated by beautiful microscopical preparations, of which figures are given. Dr. Karpinsky regards these granules as shagreen or placoid scales, though he finally admits that he does not know shagreen granules of precisely the same structure in any other Elasmobranchs. In our opinion they are not dermal structures, but the well-known

granular calcifications of Elasmobranch cartilage,¹ which are often mistaken for shagreen by palæontologists.

Having described the new fossils and determined their generic and specific characters, Dr. Karpinsky concludes with a most exhaustive discussion of their true nature, which is facilitated by the concise sketch of our previous knowledge of *Edestus*, given as an introduction to the memoir. He regards four results as established: (i) that *Helicoprion* belongs to an Elasmobranch; (ii) that the bases of all the segments of the spiral were embedded in the soft parts of the fish; (iii) that the spiral must have been situated in the vertical median plane of the fish; and (iv) that the whole of the spiral, except the large end, must have been exposed. In a diagrammatic sketch he represents the problematical fossil as originating in the upper jaw, and curling forwards and upwards so that the spiral forms a terrible weapon above the snout. On this supposition, each individual would possess only a single weapon of the kind.

In connection with the last-mentioned circumstance, it would be interesting to know whether the five examples of *Helicoprion* discovered in the quarry near Krasnoufimsk were found close together at one time, or whether there is any other evidence of their natural association. For a recent discovery by Dr. Traquair in the Lower Old Red Sandstone of Turin Hill, Forfarshire,² proves undoubtedly that there were Palæozoic sharks with sharp, piercing teeth, which were never shed, but became fused into whorls as the animal grew. If he be correct, the teeth in these Lower Devonian sharks even formed spirals; for he considers that the so-called *Onychodus anglicus* from Ledbury, figured in the Brit. Mus. Catal. Foss. Fishes (pt. ii, pl. xv, fig. 1), truly belongs to the same Elasmobranch genus as the head from Forfarshire. It is well-known that the crushing dental plates in the Elasmobranch *Cochliodontidae* sometimes became considerably in-rolled at the outer margin where they could not break away.³ The discovery of Elasmobranchs with cutting or piercing teeth similarly disposed is therefore not surprising. The fact that the known specimens of *Edestus* and *Helicoprion* are bilaterally symmetrical does not necessarily relegate them to the median line, if they happen to be whorls of teeth; for several of the anterior rows of teeth in the living *Chlamydoselache* exhibit essential bilateral symmetry.⁴ Moreover, it may be remarked that the possibility of *Edestus* and *Helicoprion* being whorls of teeth from the mouth is not negatived by the absence of lateral facettes or marks of contact with adjoining whorls: they may have been well separated, as in the existing shark just mentioned. The conception

¹ Compare figures by Williamson, Phil. Trans., 1851, pl. xxx, fig. 29; and A. Fritsch, "Fauna der Gaskohle," vol. ii (1889), p. 101, figs. 178, 180.

² R. H. Traquair, "Notes on Palæozoic Fishes": Ann. Mag. Nat. Hist. [7], vol. ii (1898), p. 69 (*Protodus scoticus*, E. T. Newton, sp.).

³ E.g. *Cochliodus contortus*, Ag.: J. W. Davis, Trans. Roy. Dublin Soc. [2], vol. i (1883), pl. lii, figs. 4a, 5.

⁴ S. Garman: Bull. Mus. Comp. Zool. Harvard Univ., vol. xii, No. 1, p. 6, pl. ii.

of a gigantic shark armed in both jaws with several series of teeth like those now described under the name of *Helicoprion* is, indeed, sufficiently startling; but it seems to us more likely to be realized than the hypothesis which Dr. Karpinsky's most interesting researches have led him to propose. A. S. W.

III.—FAUNA DER GASKOHLLE UND DER KALKSTEINE DER PERM-FORMATION BÖHEMS, von Dr. ANT. FRITSCH, F.R.G.S. Bd. iv, Heft 1, Myriopoda, Pars 1; and Bd. iv, Heft 2, Myriopoda, Pars 2, Arachnoidea. 4to; pp. 1–32 and 33–64, pls. cxxxiii–cxliv and cxlv–cli. (Prague, 1899.)

THE progress of this important work, dealing with the fauna of the Gas-coal of Bohemia, has been noticed from time to time in the GEOLOGICAL MAGAZINE. In the fourth volume the author commences the description of the Articulata of the Permian formation. There is little to say concerning the Hexapoda, or Insects proper; three species of *Phryganea* are recorded as evidenced by the cases of the larvæ of the Caddis-fly, and some fragments of the wings of the adult insect. Of Orthoptera (Cockroaches) he describes *Etoblattina Bohemica*, *Arthroblattina Lubnensis*, and two others, chiefly from wings, and three insects of uncertain determination.

Pages 13 to 55 of the two parts are occupied with descriptions and figures of the wonderful series of Myriopoda, of which no fewer than thirty-four species are enumerated, some being smooth unspined forms like the modern *Julus*, others armed with rows of powerful curved and branched spines (each compound or double division of the body bearing two pairs of legs), well-developed tracheæ, a head furnished with compound and simple eyes (ocelli), and one pair of antennæ.

Such forms of centipedes have long been known from the Carboniferous Series, both in England and America. The earliest record of the discovery of terrestrial Arthropods from the Coal-measures of England was made by the late Rev. P. B. Brodie in 1845, in his "History of Fossil Insects." In this work Professor Westwood states that he regarded the organism (which we now know to be part of a gigantic spined Myriopod) as the remains "of some large Caterpillar furnished with rows of tubercles." The late J. W. Salter in 1863 described a similar fossil from the Clay-ironstone of the Staffordshire Coalfield under the name of *Eurypterus* (*Arthropleura*) *ferox*, and referred to it, as a most curious crustacean fragment, part of the spined abdomen of a *Eurypterus*. Messrs. Meek & Worthen, in their Geological Survey of Illinois (1868), were the first who correctly recognized these fossils from America as the remains of gigantic spined Myriopods. Similar forms have since been described by Scudder in America and Dr. Woodward in England (see GEOLOGICAL MAGAZINE, 1887).

Numerous illustrations are given in the text to show the character and arrangement of the rows of branched spines upon the sides of the dorsal surface of the segments, the tracheal openings, the jointed