

His four volumes and maps were laid before the throne, and he was rewarded with an appointment in Yunnan. Around China he sees on all hands powerful and aggressive neighbours. To the ambitious schemes of these powerful neighbours and the means of checking them he devotes many pages. He dreams even of conquest, and suggests that by encouraging emigration to the southern seas, establishing consuls to look after the emigrants, opening schools to enlighten them in foreign science, and at the same time keeping up the knowledge of their native language, the great islands of that region could be made to fall like ripe fruit into the lap of China. In the territorial acquisitions of other countries Mr. Huang finds three degrees of villainy, which he describes respectively as "stealthily beguiling," "encroaching by degrees," and finally "swallowing up." Notwithstanding the offensive discrimination of these terms, he exhibits a high appreciation of English rule in India. In the latter country, he says, there are no idle officers; each has his sphere, into which no other intrudes. The will of each high functionary is limited by his council. Salaries are sufficiently liberal to prevent extortion. All are animated by a regard for their own good name. The law is faithfully executed and public spirit prompts to efforts for the general good. He is struck by the magnificence of Calcutta and its great public works. On the subject of taxes, he says: "The ground is taxed, houses are taxed, shop-signs are taxed, all manner of beasts are taxed, all handicrafts are taxed, and even fire and water are taxed. There are other taxes more than I can mention; yet you do not hear one murmuring word from the people. Why is this? It is owing to two causes: Firstly, they regard the humane Government of the English as a great improvement on the oppressive cruelty of their native rulers: and secondly, they are aware that the revenue thus collected is expended for the good of the country—in making roads, founding schools, and so on." The author is so impressed by the railway system of India that he is extravagant in his advocacy of something similar in China. He wants a railway from the north-western frontier of China proper into Ili, as the only means of retaining that province and Kashgaria. In reply to objections on the score of the enormous expense of this undertaking, he exclaims with true Chinese vanity: "What other countries can do, China can do, as she is ten times richer, and a hundred times more populous."

#### NOTICE OF SOME DISCOVERIES RECENTLY MADE IN CARBONIFEROUS VERTEBRATE PALÆONTOLOGY

IN the course of my work upon the carboniferous rocks of the neighbourhood of Edinburgh, I have succeeded in obtaining several specimens which throw some additional light upon the little known Selachians of the Palæozoic age. It was considered a great step in advance when Prof. Kner, in Germany, and Sir P. Egerton in England, proved that the spine of the tooth known as *Diplodus*, which occurs frequently in Carboniferous rocks, was the equally well-known *Pleuracanthus*, a genus of not infrequent occurrence in the same beds. A very interesting slab from the ironstone of Burghdee, near Edinburgh, in the Carboniferous Limestone series, advances our knowledge another important stage. Upon it there are several teeth of the species *Diplodus parvulus*, Traq., associated with cranial cartilage, and a spine which is certainly not *Pleuracanthus*, but is totally unlike it, and one which does not appear to have been ever described. Upon showing it to my friend, Dr. Traquair, he said it confirmed an opinion at which he had long since arrived, that the *Diplodus* tooth would be found common to several genera of Selachian fishes. It certainly was a singular fact, and one which must have struck those palæontologists who have most carefully examined the fish-faunas of particular beds and horizons, that the number of the species of spines usually exceed those of teeth. Another important conclusion may be drawn from this discovery, viz. that spines are of very little value in relation to the affinities of sharks. Nothing can be more different than the spine of *Pleuracanthus* and that of *Diplodus parvulus*, Traq.

These conclusions are supported by another specimen in a nodule obtained from a much lower horizon, viz. on that of the Wardic Shales at Hailes Quarry, near Edinburgh. Here we have a *Hybodont* tooth associated with the spine known as *Tristychius*. The tooth, indeed, cannot be distinguished from *Hybodus*; it is deeply furrowed as in many of the Mesozoic species, and has the two depressed lateral cusps. This form of tooth is

very persistent, extending from the Lower Carboniferous to the Chalk. Gernar was the first, I think, to point out the existence of a *Hybodont* tooth in rocks of Carboniferous age, but (though I have not yet carefully examined his figures and description) the spines appear to be different from those I find associated with the Hailes specimen, though they appear to me to be of the same general type. That a *Tristychine* spine, with its smooth surface and strongly arcuate shape, should be associated with a *Hybodus* tooth is certainly unexpected, and shows again the necessity of caution in dealing with spines, for the Mesozoic spines associated with *Hybodus* are very different from *Tristychius*. *Hybodus* and *Diplodus* are therefore generalised forms of teeth associated with spines known as *Tristychius*, *Pleuracanthus*, with one undescribed genus, probably with many others. Messrs. Hancock and Atthey, to whom British science is indebted for some of the most important ichthyological observations made since Agassiz' time suggested the possibility of *Cladodus* being the tooth of *Gyracanthus*. I have seen nothing to confirm or refute this suggestion. They also referred certain small tooth-like bodies with success to the dermal skeleton of that genus. I have obtained a nodule from the Wardic shales, which has these in a remarkably good state of preservation in connection with a large fragment of the fin of that powerful shark. These dermal denticles are so closely approximated to each other that they form a dense covering, through which however appear distinctly traces of the skeleton of the fin. The occurrence of the genus at so low a horizon is of itself deserving of record, and in addition to this fragment, I have found imperfectly preserved specimens of spines of the same genus at the same place.

The remains of Labyrinthodonts are exceedingly scarce below the Burdichoun horizon. I am not aware of more than one having been discovered, and that proves to be *Ophiderpeton*, or a closely allied genus. This specimen was discovered in the Wardic shales, low down in the Calciferous sandstone series. The position of the Wardic shales in the Carboniferous series has not yet been exactly defined. Owing to the confused nature of the rocks, and the fact that they are so deeply covered with drift in a good deal of the Edinburgh area, it has not been found possible to settle quite clearly the relative position of the different members of the Carboniferous series. Nevertheless the opinion appears to be universal that the shales along the shore between Seafield and Granton are very low in the Carboniferous system. All that I have seen confirms this conclusion. I was amused, indeed, to see them in an otherwise well got up map, lately published, coloured as the Millstone grit! Antiquated, surely! The fossils are generally identifiable with those which are everywhere found to underlie the marine limestones (in the Scotch beds, at any rate), and from all that the drift will let one see, there must be several thousands of feet of such rocks with the Wardic and Granton beds near the base. This being so, the occurrence of this vertebrate so low down is of interest and importance, and helps to confirm Prof. Fritsch's view, arrived at in his case from anatomical considerations, that *Ophiderpeton* and its allies are the roots of the Amphibian genetic tree.

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#### A NUMERICAL ESTIMATE OF THE RIGIDITY OF THE EARTH<sup>1</sup>

ABOUT fifteen years ago Sir William Thomson pointed out that, however it be constituted, the body of the earth must of necessity yield to the tidal forces due to the attraction of the sun and moon, and he discussed the rigidity of the earth on the hypothesis that it is an elastic body.

If the solid earth were to yield as much as a perfect fluid to these forces, the tides in an ocean on its surface would necessarily be evanescent, and if the yielding be of smaller amount, but still sensible, there must be a sensible reduction in the height of the oceanic tides.

Sir William Thomson appealed to the universal existence of oceanic tides of considerable height as a proof that the earth, as a whole, possesses a high degree of rigidity, and maintained that the previously received geological hypothesis of a fluid interior was untenable. At the same time he suggested that careful observation would afford a means of arriving at a numerical estimate of the average modulus of the rigidity of the earth's mass as a whole. The semi-diurnal and diurnal tides present phenomena of such complexity, that it is quite beyond the power

<sup>1</sup> Paper read by G. H. Darwin, F.R.S., at the British Association Southampton meeting.