some distance on its surface, apparently making the transverse tracks by means of its tarsi." A figure of this insect-track would have been very acceptable in connection with the subject treated of in my above-mentioned paper, *loc. cit.* p. 132, etc.

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BRITISH ASSOCIATION MEETING AT CAMBRIDGE.

ON THE CORRELATION OF THE SLATES AND LIMESTONES OF DEVON AND CORNWALL WITH THE OLD RED SANDSTONES OF SCOTLAND.

BY W. PENGELLY, F.G.S.

The distinguished author of 'Siluria,' as geologists well know, has made a tripartite division of the slates and limestones of Devon and Cornwall, as well as of the Old Red Sandstones of Scotland, South Wales, etc., and given chronological equivalency to the upper, middle, and lower groups of each respectively. Thus he places the Barnstaple and Petherwin beds—the latter being characterized by the presence of *Clymenia* and *Cypridina*—on the horizon of the Upper Old Red, with its *Holoptychius* and *Phyllolepis*; the limestones of Torquay, Newton, and Plymouth, in which are found *Stringocephalus*, *Calceola*, *Bronteus*, *Acervularia*, etc., are made to synchronize with the deposits of Caithness, etc., containing the remains of *Asterolepis*, *Coccosteus*, etc.; whilst the slates of Meadfoot, etc., in South Devon, and Looe, etc., in Cornwall, distinguished by the remarkable Coral *Pleurodictyum problematicum*, are regarded as the equivalents in time of the Lower Old Red rocks of Forfar and the North-east Highlands, which are charged with *Cephalaspis*, *Pteraspis*, and *Onchus*.*

Though this co-ordination may be said to have met a large acceptance, it is not in keeping with the opinions of some who laboured long and sedulously amongst the older rocks of Devon and Cornwall, nor is it unchallenged by some existing writers. The late Sir Henry De la Beche regarded "the bulk of the Devonshire and Cornish rocks as, at least in part, equivalent to the lower beds of the Carboniferous Limestone, to the passage beds between the Old Red Sandstone and Carboniferous Limestone of Ireland, South Wales, etc., and also to some portion of the higher part of the Old Red Sandstones of Herefordshire and adjacent districts."† The Rev. David Williams considered "the Devonian system as occupying an enormous interval between the Old Red Sandstone and Mountain Limestone."‡ Mr. Page says, "We shall use the term 'Devonian' as applying more particularly to the strata as developed in the south of England, and the term 'Old Red Sandstone' as more especially applicable to those of Scotland; believing, as we do, that the Caithness and Forfarshire beds are on a lower horizon than the English Devonians, and that it requires both developments to constitute the 'system' as at present understood by European and American geologists."§ Mr. Bete Jukes says, "It is quite possible that the slates and limestones of Devon,

* 'Siluria,' 3rd edit., p. 433.

† Memoirs Geol. Survey, vol. . p. 103.

‡ Report Royal Geol. Soc. of Cornwall, 1843, p. 123.

§ 'Advanced Text-Book of Geology,' p. 123.

and the red sandstones of South Wales, although each deposited within the same great period, are not strictly contemporaneous, but were formed at different parts of the period. Or it is possible the red sandstone series of South Wales is not a continuous series; that the lower part of it, at all events, is older than any of the Devon series, while the upper part may be newer than much of that series.*

That *some*—that *much*—diversity of opinion should exist, respecting the time relations of the two systems of rocks now under notice, is what might be expected when their lithological and palæontological dissimilarities are remembered; the northern beds are eminently arenaceous, whilst those in the south are almost exclusively argillaceous or calcareous; the former teem with fossil fish, and the latter with the exuviae of molluscs and radiate animals; but, according to our fossil registers, Scotland does not yield the shells, corals, or sponges so abundant in Devonshire; nor are the ichthyolites of the former found in the latter area: they have no organic remains in common.

It will doubtless be remembered, however, that in his 'Palæozoic Fossils of Cornwall, Devon, and West Somerset,' Professor Phillips has figured and described as a scale of *Holoptychius*, a fossil found in the slates of Meadfoot, near Torquay, in South Devon.† It would seem that this identification has not been considered perfectly reliable, since the fossil has not found a place in subsequent works on the Devonshire beds, or in Professor Morris's 'Catalogue of British Fossils.'

This dissimilarity of the organisms of two not very widely separated, and, as has been supposed, contemporary sets of deposits, is, to say the least, very remarkable. The mineral and mechanical characters of the Old Red rocks may sufficiently explain the absence, in them, of mollusks, and other dwellers at the sea-bottom; but there seems no satisfactory mode of accounting for the non-appearance of fishes in the slates and limestones of Devon and Cornwall. Various solutions of the problem have been attempted. We are asked by one to suppose that some geographical difficulty or barrier separated the two areas and prevented the migration and mingling of their inhabitants; whilst another suggests that the Old Red fish were probably at home in fresh water only, and ought not to be looked for in beds so decidedly marine as those of Devon and Cornwall.

The interesting and important discovery, by Sir R. I. Murchison, of the intermixture, in the same Devonian bed in Russia, of the fish of the Upper and Middle Old Red of Scotland with the shells of Devonshire,‡ leaves the difficulty untouched; nor does it appear that the synchronism of the representative beds in Britain necessarily flows from it. It proves, of course, that the fish and shells lived at one and the same time in Russian, not that they did so in British, waters. We may have an example, here, of the distinction between geological *contemporaneity* and *synchrony*, so ably pointed out, on a recent occasion, by Professor Huxley.§ It is possible, for instance, that the fish commenced existence before the shells; that they appeared in Scotland long before their descent upon Russia; that slowly changing conditions compelled them tardily to abandon their earlier home for a more congenial one; and that, on their arrival, they found there the invertebrate tribes which subsequently migrated to where the foundations of the future Devon and Cornwall were being laid.

Be this as it may, some geologists, recognizing the synchronism of the

* 'Manual of Geology,' 2nd edit. (1862), p. 492.

† Pal. Fossils, pl. 57, fig. 256, p. 133.

‡ 'Siluria,' 3rd edit., p. 382.

§ Anniversary Address, Quart. Journ. Geol. Soc., vol. xvii. part 2.

two systems of deposits, and believing that no sufficient reason had been assigned for the absence of the Old Red fish in Devon and Cornwall, have never failed to cherish the belief that, sooner or later, they would be found there; and, indeed, we have heard from time to time that at length the wished-for ichthyolites have been exhumed in the southern area. At the meeting of the British Association held at Cork, in 1843, Mr. Peach brought under the notice of the Geological Section, certain fossils which had then recently been found by Mr. Couch, in the Devonian slates, near Polperro, in Cornwall. The palæontologists to whom they were then submitted considered them to be remains of fishes; and, indeed, the late Mr. Hugh Miller subsequently found a specimen amongst them, of which he said that "if he had found it in the Old Red Sandstone of Cromarty, he would have no hesitation in regarding it as a fragment of some dermal plate of *Asterolepis*." These fossils were found in great numbers in certain localities, and extended along the Cornish coast, at by no means wide intervals, from Fowey Harbour to the Rame Head; they were constantly spoken of as the "Polperro fish," and the slates in which they were found as the "Polperro fish-beds." At length, Professor M'Coy and Mr. Carter of Cambridge subjected them to a rigorous microscopic scrutiny, and pronounced them to be nothing more than sponges belonging to their new genus *Steganodictyum*, of which they formed two species, *S. Cornubicum* and *S. Carteri*. It may be doubted, however, whether certain fossils found with them were not true ichthyolites; indeed, one specimen which, a few years since, I found in the *Steganodictyum* beds at Looe, in Cornwall, has been pronounced, by Sir P. Egerton and others, to be a decided ichthyodorulite.* It has not been identified, however, even generically.

A few weeks since, I had the good fortune to find a fossil in the *Pleurodictyum* slates at Meadfoot, near Torquay; that is, in certainly the lowest group of the rocks of South Devon and Cornwall, and which Sir R. Murchison has placed on the horizon of the *Cephalaspidian* and *Pteraspidian* beds—the lowest of his divisions of the Old Red of Scotland. From the first, I believed it to be a fish-scale or plate; and very recently, Mr. Davies, of the British Museum, has not only confirmed this, but has identified the fossil as a scale—or rather, a portion of one—of *Phyllolepis concentricus*, a fish known only by its fossil scales, and which had hitherto been found only in the Clashbennie beds, belonging to Sir R. I. Murchison's Upper Old Red.

This fossil then appears to necessitate the belief, either that the organism which it represents had a greater vertical range than has been supposed,—that is, that it belonged to the Lower and Middle, as well as Upper Old Red fauna,—or that the *Pleurodictyum* beds of Devon and Cornwall, instead of being on the horizon of the Lower, are on that of the Upper Old Red series of Scotland.

To accept the first of these, apparently the only two alternatives, would be to accept the difficulty of supposing that *Phyllolepis* dates from Cephalaspidian times; that it witnessed the extinction of this family as well as the subsequent introduction and withdrawal of *Cocosteus*, *Asterolepis*, and others; and yet that, unlike its early contemporaries, it failed to leave behind any trace of its existence in the Old Red rocks, save only in the upper of their three groups.

Rejecting this hypothesis, however, we seem compelled to adopt its rival, which amounts to this:—there are in Devon and Cornwall no representatives of the Lower and Middle Old Red rocks of Scotland, but the lowest—the *Pleurodictyum* beds—of the former are on the horizon of the

* See 'Geologist,' vol. iv. pl. vi. p. 346.

upper division of the latter; an opinion probably in harmony with that of Sir H. De la Beche already quoted.

In an earlier paper on this subject—based exclusively on the statistics of the invertebrate fossils of Devon and Cornwall, considered both specifically and generically—I expressed the opinion, that the lowest beds of Devonshire do not constitute the basement of the Devonian system, and that the Barnstaple beds were rather Carboniferous than Devonian, or were, perhaps, “passage-beds” between them.* It is not without interest to find this opinion supported by the more reliable, because vertebrate, evidence now produced. It will be remembered, too, that the indications of the Holoptychian scale, already mentioned as having been described by Professor Phillips, and which was also found in the Meadfoot slates, are to the same effect.

Like the Old Red Sandstone fish found in Russia by Sir R. Murchison, the *Phyllolepis* scale was surrounded with marine shells,† and also by corals of the family *Cyathophyllidæ*; the ancient fish to which it belonged was therefore not incapable of living in the sea.‡

NOTICE OF FOSSILIZED MAMMALIAN REMAINS FROM THE BED OF THE GERMAN OCEAN.

By C. B. ROSE, F.G.S., ETC.

It has for a very long period been known that, during the degradation of the cliffs of the counties of Norfolk, Suffolk, and Essex, teeth and bones of various mammals have been exhumed, and more largely those of pachyderms.

In Queen Elizabeth's time, huge bones were found at Walton, near Harwich. They were then considered to be those of giants. In the ‘Philosophical Transactions’ for 1745, a Mr. Baker records the finding of a fossil elephant at Mundesley Cliff; and, in 1746, Mr. Wm. Arderon, of Norwich, makes mention of similar remains discovered at Hasborough and Walket, on the Norfolk coast. My present object is, to lay before you a few of the specimens which have been brought up from the bed of the German Ocean, entangled in the trawling nets of the Yarmouth fishermen. Had they been more portable, I would have exhibited tusks and other large remains of these huge beasts, of which there are some fine specimens in the collection of Messrs. Owles, Steward, Nash, and my own. The late Miss Gurney, of Northreps, was the possessor of a large collection of fossil mammals from the cliffs of Cromer and its vicinity, and which may now be seen in the Museum at Norwich. The Rev. John Gunn, of Irstead, has made an extensive and rich collection of similar remains, from Mundesley and Hasborough.

In the course of years vast numbers of teeth and bones have been collected. The late Mr. Woodward, of Norwich, says, in his ‘Geology of Norfolk,’ “Mammalian remains have been dredged up on the Knole Sand, off Hasborough. This spot presented us, in 1826, with the finest tusk of the mammoth; it measured 9½ feet along its curvature, and weighed 97 lbs.” But off Dungeness a tusk was dredged up which measured 11 feet in length, and yielded some pieces of ivory fit for manufacture. The oyster-bed off Hasborough was discovered in 1820, and, from the number of grinders of the elephant found there, Mr. Woodward felt himself war-

* ‘Geologist,’ vol. v. pp. 28 and 31.

† ‘Siluria,’ 3rd edit., pp. 383 and 433.

‡ This scale has been transmitted to me and will shortly be figured.—ED. GEOL.