

westward of the Needles, will not doubt but that the two promontories were once united, forming a rocky neck of land from Dorset to the Needles. This chain of chalk might, or might not, be so cleft in twain as to allow the rivers of Dorset and Wilts. to find a passage through them to the main ocean. My opinion, however, is that they had no such outlet, but that, at that far distant period, the entire drainage of more than two counties, embracing the rivers that join the sea at Poole and Christchurch, flowed through what is now called Christchurch Bay, down the Solent, and joined the sea at Spithead.

According to this theory, the Solent was at that time an estuary somewhat like the Southampton Water, having but one opening to the British Channel; but of so much more importance than the latter as it was fed by a vastly greater flow of fresh water; and it further supposes that the bed of the Solent was scooped out originally by a river, which from the extent of its drainage one may guess to have been little inferior to the Thames or the Humber. And this opinion acquires countenance from the circumstance that it accounts, in a most satisfactory way, for the equality of depth and breadth in the Solent Sea. Of course, according to this view, this sea would lose its original condition as an estuary at the time when the British Channel had so far made a breach through the chain of rocks connecting the Isle of Wight with Dorsetshire as to give an opening into itself for the Dorsetshire rivers, somewhere opposite to the town of Christchurch. From that time forth the Solent would become what it is at present, losing its character as an estuary, and assuming that of a long narrow sea. And at the same period, of course, the Isle of Wight would part with its peninsular character, and be severed from the mainland, but at a point far apart from that at which the severance is usually supposed to have taken place. The distant period at which such changes took place it would be hopeless to guess at, amid the dimness of the data on which calculations could be founded. It could not be less, however, than many thousands of years, seeing that since that time, the British Channel has not only made a broad breach of twenty miles through a chain of slowly yielding rocks, but has also pushed its way gradually across the broad extent of the Poole and Christchurch Bays.

In conclusion, I would observe, that if your correspondent at Lymington simply put his question about the separation of the Isle of Wight as an archaeological inquiry, I fear he will consider my answer to it as somewhat dreamy. But I am confident, if he and others who may honour me with a careful perusal of my observations, are tolerably acquainted with the geology of the neighbourhood, and have had their minds disciplined for realizing the operations of nature on a large scale and through lengthened periods of time, they will perceive in this paper opinions indicative of more than novelty, having, as I believe, very important geological facts to uphold them.

Yours, etc.,

W. Fox.

Brixton, Isle of Wight, Nov. 8.

Tracks, Trails, and Imprints.

DEAR SIR,—At nearly the same time, probably, when I was pointing out the desirability of careful drawings and casts being made of the tracks and trails of living annelids, mollusks, insects, etc. ('Geologist,' No. 52, p. 138, April, 1862), for the guidance of the palæontologist in decipher-

ing fossil surface-markings, my friend Dr. J. W. Dawson, of Montreal, must have been engaged in the useful labour of preserving faithful records of the track-marks of *Limulus polyphemus* on the sands of Orchard Beach (Gulf of St. Lawrence), for the purpose of comparing them with the fossil tracks, termed *Protichnites* and *Climactichnites*, found in the Potsdam sandstone of Canada.

The results of these well-directed researches have been described and illustrated by Dr. Dawson in the Canadian 'Naturalist and Geologist' for August, 1862 (vol. vii. No. 4), p. 271, etc.; and it appears certain that the trail of *Limulus* on wet sand is very similar to *Protichnites*, excepting that the latter has not the lateral furrows that are produced in the former by the edges of the carapace. Swimming in very shallow water, *Limulus* produces on the sand a trail very similar to *Climactichnites*; the latter, however, showing lateral and median ridges, whilst the former has furrows instead.

Dr. Dawson agrees, therefore, with Professor Owen in referring the *Protichnites* to a Limuloid animal; and is strongly inclined to refer *Climactichnites* to the same agent. Still he thinks it not impossible that the large Lower Silurian Trilobite, *Paradoxides*, may have been the animal that produced all the marks in question.

With the fact before him, that *Climactichnital* markings are left on a subaquatic surface by *Limulus*. Dr. Dawson, of course, rejects the hypothesis of *Climactichnites* being gallery-tracks, as advanced in my paper above referred to (*loc. cit.* p. 139). Still these recent tracks differ from what Dr. Dawson regards as their primæval analogues, in that their "lateral and medial lines are furrows instead of ridges;" and therefore the identification is not complete. I would ask that the question still remain open until Dr. Dawson and other good naturalists have more material at hand and a wider basis for conclusions.

"I may add that the burrowing of *Limulus polyphemus*," Dr. Dawson remarks, "is easily effected in soft sand, but is confined to a mere burying of itself beneath a very slight smooth elevation." The great well-known North American Trilobites (*Paradoxides*), however, whose bodies exactly fit in width to the *Climactichnital* and *Protichnital* trails of Canada, and whose abiding place was really the muddy sea-bed on the geological horizon of the Potsdam sandstone, in all probability crawled over these littoral sands, just as the *Limulus* frequents the existing sandy beaches in spring and summer; and (like *Sulcator* and *Kræyera*, *loc. cit.* pp. 131, 138, 139) it may have burrowed in them, with much longer burrows than *Limulus* makes, and in that case the in-fallen galleries would supply the raised ridges of the *Climactichnite*.

We need not suppose the presence of *Limulus*, or of any unknown Limuloid animal, in the primordial sea; for there is little doubt, if any, that *Paradoxides*, known to have then existed, can have made the trails in question (as Dr. Dawson allows, p. 277), if they had the usual crustacean locomotive apparatus; and "it seems almost certain, from analogy, that they must have possessed such organs" (Dawson, *loc. cit.* p. 277). Nor does the trail of *Limulus* correspond exactly with the fossil tracks; the edges of its carapace produce, in crawling, side-furrows not seen in *Protichnites*; and its subaquatic trail has but a general resemblance to *Climactichnites*, as far as we can learn from the published observations.

Dr. Dawson, in his interesting paper before me, also notices (p. 275) the occurrence, at Orchard Beach, of "small *Climactichnite*-like tracks" that were made, as he ascertained, by a large beetle (*Melolontha (Polyphylia) variolosa*?), "which occasionally settled on the wet sand and crept for

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*, *Cocosteus*, 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.