

ORDINARY MEETING, JULY 7TH, 1871.

Professor MORRIS, F.G.S., H.M.G.A., Vice-President, in the Chair.

The following Donations were announced :—

- “Journal of the Quekett Microscopical Club,” from that Club.
- “Abstract of Proceedings of the Geological Society,” from that Society.
- “The Thirty-Seventh Annual Report of the Royal Cornwall Polytechnic Society for 1869,” from that Society.
- “The Thirty-Eighth Annual Report of the Royal Cornwall Polytechnic Society for 1870,” from that Society.

The following were elected Members of the Association :—

John Gould Avery, Esq., M.A.I.; John Barber, Esq.; William Bartlett, Esq., F.R.C.S.; Ralph Augustus Busby, Esq.; Lieut.-Col. Capel Coape; Henry Monk, Esq.; George Staley Mosse, Esq.; John E. L. Shadwell, Esq., M.A.; George William Spawforth, Esq.; and Mrs. Peter Taylor.

The following Papers were read :—

1. ON THE UPPER LIMITS OF THE DEVONIAN SYSTEM.

By S. R. PATTISON, Esq., F.G.S.

I am not about to revive the controversy in which the late lamented Mr. Jukes maintained with distinguished gallantry for so many years that the Upper Devonian had no existence. This dispute is settled. Devonian has conquered. The careful work of Mr. Etheridge, crowning the labours of a band of distinguished Devonians, has demonstrated that the Devonian System is a great triple natural history division. It was dragged out of the ocean of Grauwacke in 1836, after having been seen by Mr. Lonsdale, held up to public view by Sedgwick and Murchison, at the British Association of that year, and has duly passed into the literature of Continental and American geology.

I have a few words to say this evening on the district in which it was first determined.

Referring you, then, to North Devon, and reminding you that the opening of the new railway from Taunton to Barnstaple will render the country more accessible than it is at present, I take you

down by the old route. From the rich red marl of the Taunton Valley, going south, we first encounter a set of coarse schistose sandstones, the Foreland, extending over the hill to the picturesque gorge of Lynton; next, and from there, a range of rocks, somewhat less coarse, including the limestones of Coombe Martin, the thin representation of the great Eifelian, Plymouth, and Torbay calcareous masses. Here we have a good horizon, and we call it Middle Devonian, having thrown the series just passed through, with a southerly dip, into the category of a Lower Devonian. The Ilfracomb Series ends upwards in another set of hard sandstones (Pickwell Down), and upon these lie an uppermost series of shales, and lumps of limestones, and grey beds, extending to the base of the carbonaceous rocks, and these we term Upper Devonian. Thanks to the discrimination of the late Mr. Salter, we are at no loss as to the Upper Devonian in North Devon. They may be called the "Barnstaple Beds," by way of distinction. They extend from the town to the edge of the carbonaceous series, and thence outward to the cliffs at Crouch Bay. The section runs thus, in ascending order. 1. Purple slate and sandstones. 2. Pale slate with a few bivalves. 3. Grey grit, a thick series. These three form the Marwood beds. Then 4, an alternating series of greenish-grey grits, or grey cleaved slate—the Pilton Beds. The Upper Devonian is both stratigraphically and palæontologically here divided into two groups, the upper, Pilton; the lower, Marwood. The uppermost beds touch the carbonaceous limestone, which, however, overlaps different beds on its line. The Marwood Group is a shallow sea accumulation; it displays a distinct Devonian fauna. I do not trouble you with lists of fossils. They will be found admirably arranged by Mr. Etheridge, but were also well characterised by Mr. Salter. In the green slates of this series plants occur. The Pilton Group contains an analogous fauna, sufficiently distinguished. These are the typical displays of the Upper Devonian. This stratigraphy has been well established, and the fossils render the matter certain. Mr. Salter's memoir, *Quart. Journ. Geol. Soc.*, vol. xix., p. 480, will give all that is needed for the discovery, identification, and collocation of these beds.

If we now resume our progress southward, and cross the wide and dull expanse of lower carbonaceous clays and grits, with its thin fringe of limestone at the base, we find a rough basin of these overlying rocks, of which the lower or southern edge extends into

Cornwall, and runs east and west, a little north of Launceston. Emerging from under these, finding our latitude by the basement beds of grit and Carboniferous Limestone with coal plants, we first encounter a lower limestone with fossils, at South Petherwyn. Sedgwick and Phillips, and also De la Beche, placed these roughly on a parallel with the Barnstaple Beds. The fossils, they considered, though not identical as a whole, yet had a common facies. Salter did the same, though he considered them to form a lower group of the Upper Devonian, and treated a small intervening inlier near Yeolmbridge as the exact parallel of the Barnstaple Beds. If this be correct, we have a third series of the Upper Devonian, viz., the lowest, Petherwyn; the middle, Marwood; the uppermost, Pilton. I do not know the Pilton Beds from observation save from one very short morning's walk, and should be inclined to place the Petherwyn and Pilton as synchronous. But this is a matter of little importance in a formation so notoriously patchy as the Upper Devonian.

If either of these be correct, we have, as we go southwards through Cornwall, and pass over a set of beds having a general dip to the north, a triple series like that of North Devon :—the Petherwyn, or an approximate parallel to Barnstaple, Upper Devonian; the Plymouth, undoubted Middle Devonian; the Looe rock, Lower Devonian; and in addition the Gorran quartzites, Silurian.

But a recent and competent observer exclaims "*Nous avons changé tout cela.*" Dr. Holl, of Malvern, who in his youth explored these regions, has in his maturer age given them careful revision. He has embodied the results in a memoir "On the Older Rocks of South Devon and East Cornwall," Quart. Journ. Geol. Soc., vol. xxiv., p. 400. After much good work, he concludes that there is no Upper Devonian in Cornwall, and that the whole series is Middle Devonian, and thus he alters the received notions concerning a great part of Cornwall.

Mr. Holl's proposition is that the fossiliferous rocks of South Petherwyn have been erroneously assigned to the Upper Devonian, and that, on the contrary, they are Lower Devonian. He adduces two arguments in support of this. 1. That it is contrary to the actual section, as the rocks have a general north underlay at Petherwyn which, travelling southwards, is soon exchanged for a general south underlay as far as Plymouth, and therefore that the Plymouth Middle Devonian should come in south of the Petherwyn if this

latter are Upper, which they do not, and therefore they are below the Plymouth Beds.

But this is by no means conclusive in so broken a country, and with so spotty a formation as the Upper Devonian. Especially as the intervening axis is the great granitic axis of Devon and Cornwall, which has faulted and disturbed the beds at some date subsequent to the deposition of the Carboniferous, and therefore we may have any amount of denudation as well as fracture exhibited in the old country. There are therefore five hypotheses, all of them true causes which may have prevented this:—1. The great granitic uplift. 2. Minor faults on the line of strike. 3. Denudation which has stripped off much of every bed. 4. Non-continuance of the Plymouth in the arch southwards; or 5thly, that the Petherwyn Beds are mere local patches in a synclinal trough of the Middle.

Mr. Holl's second reason is that the palæontological evidence of their being Upper Devonian is not conclusive, but capable of being used for either. Now this is a remarkable assumption, as Phillips, Salter, Etheridge, and others, who were fully alive to the distinction, have written, and spoken, and published otherwise, and that repeatedly. But of course authority is not argument. There are 73 good species found at Petherwyn, deducting three duplicates. Mr. Holl, for the purpose of comparison, first takes off 21 species peculiar to this formation. I demur to this proceeding, unless he gives the facies of these, and shows that it differs from that of the deposit to be identified. Amongst these 21 species which he eliminates occur eight *Clymenia*, a *Goniatite*, and a *Nautilus*, all peculiar to Petherwyn. Why, for purposes of identification should these be left out? If they have no brothers elsewhere, they have cousins. The family likeness of the 21 does not point downwards into Lower Devonian, but upwards to the continental uppermost Devonian, and even aspires to the Carboniferous. The very circumstance which induced the Irish Survey to put them up, leads Mr. Holl to sink them down. Then he excludes 10 others not found in British Devonian, viz—*Cypridina*, *Pterinea*, *Cardiola*, *Natica*, and *Loxonema tumida*. The same remonstrance must be offered against this extradition. The comparison becomes incomplete if these are left out. *Nascitur e sociis* is good for man and beast, especially with the Cephalopoda. The palæontologist gathers his impression from the group as a whole. On Mr. Holl's arrangement there are 40 species common to Petherwyn and Middle Devonian against 27 com-

mon to Petherwyn and Barnstaple. True, but the items omitted are precisely those which establish the difference—the Hamlets, which are the making of the play.

It would be tedious, and indeed improper here, to weary you with details. Speaking from the recollection of many years ago, I would characterise the Petherwyn as a deposit of some half dozen beds of impure limestone and slate, characterised by these 73 good species, all found in a small space. The beds are not now worked for lime, nor are any other quarries opened in them, and hence the opportunity of making fresh investigation is gone. A very few shattered and imperfect fossils may be found among the *débris* of the old quarries and in the beds along the line of strike.

These beds dip under the carbonaceous beds, which are close to them on the north, and strike, with the general run of the country, round the base of the granite. Towards Plymouth they are succeeded by lower barren sandstones, and the latter support them also on the opposite line of strike, north and north-west.

In trending round a larger development of some of the Petherwyn Beds may be occasionally traced to Tintagel, and by Delabole southwards to near Bodmin, whilst outside of these and below them occur at Padstow feeble representations of the Plymouth Series, and lower down, at Newquay, we are on the track of the Lower Devonians of Looe and Fowey. The great Eifelian limestone of Plymouth does not come in at all to the northward, until we come to the second great fold at Barnstaple. This brings the whole of that broken country into regular sequence, continued by the Silurian quartzites at Gorran, and everywhere on a north and south line crowned by the Carboniferous.

It will be useful in so rough a country geologically, so ill fitted for rapid conclusions, to inquire whether there are any analogous features in the Palæozoics elsewhere. The South Devon section I have not examined, but it is evident that the upper portion of the Newton limestones, though conformable to the lower, yet introduce a new set of organisms, and in a very thin way represent the commencement of Upper Devonian. This was Mr. Salter's opinion. In Pembrokeshire, in West Angle Bay, at the base of certain Old Red Sandstone beds, lie Carboniferous Slates, and in the lower portion of these, apparently quite conformable, are Upper Devonians.

In Ireland we have a largely developed series, with some charac-

ters differing—the Coomhola Grits, comprising both layers of the Upper Devonian., viz.—the Marwood and Pilton Beds.

On the Belgian frontier of France I have followed the Devonian from beyond Givet down the Meuse, and found small traces of anything above the Plymouth Limestone of Givet, until coming down to the district bordering the coal basin of Belgium. Then occur thin bands of intermittent limestone and heavy sandstones, called first by Dumont, “*Psammites de Condros*.” I was directed to these by Mons. Gosselet, the accurate and conscientious Professor and Curator at the Sorbonne. Near Avesnes, at Oetrungt, the black Carboniferous Limestone is found in the near neighbourhood of a grey, thin, many-bedded limestone, which contains *Clymenia*. This attracted my notice, and I went to Oetrungt to ascertain, if I could, its conditions and relations. I could not make out all the beds which my friend Gosselet had pictured, but in general the quarry is like a Devonshire limestone quarry, with Upper Devonian types, and even some forms attributed to the Carboniferous Limestone. I exhibit a section showing the marvellous number of beds. Some of the same fossils occur throughout. Generally on the borders of the coal district we have either a great slaty series, the Famenne, or a thick sandstone with a few limestones at the base, or both. The latter are characterised throughout the Belgian and French area by the occurrence of *Terebratula (Rhynchonella) cuboides*.

In the Boulonnais the same thing occurs. I have seen there the yellow sandstone—Marwood—resting on Eifelian, or Middle Devonian slates and limestone, the Clymenian or Petherwyn being wanting.

On the Rhine and in Nassau the Upper Devonians are in force and well marked. Here they are not accompanied by the presence of Carboniferous Limestone. They are the well-known Cypridian Schiefer, characterised by *Cypridina serro-striata*, found also at Petherwyn. Krammenzel-stein, or Ant-stone, Clymenia-kalk, the Petherwyn Group, and the Verneuilli-schiefer, together constituting the Marwood and Pilton Groups, the whole series of the Upper Devonians. Roemer divides it into 4 (“*Siluria*,” p. 372), the lowest of which is the *Rhynchonella cuboides* bed of the French frontier, next the Clymenia-limestone, and above these the Goniatile-limestone, capped by Receptaculite schists, the whole corresponding to our Petherwyn and Barnstaple series. So in West-

phalia there is Clymenia-limestone, and above it two beds compared to Marwood and the Pilton, or yellow-sandstone of Ireland.

In North America the Chemung and Portage Groups represent our Upper Devonian, and are well established; they are there, without question, held to constitute a good stratigraphical and palæontological division. There is no defined divisional plane between the Chemung and the Carboniferous Sandstone (Bigsby), *i. e.*, it is difficult to make out the division physically; but once *in* either, and you recognise the difference without doubt (Dana, 287).—See Dawson's picturesque, yet full and careful description in "Leisure Hour," May, 1871, p. 296.

From this sketchy review we have no hesitation in affirming the clear division of the Upper Devonian from the Carboniferous as a convenient natural history and stratigraphical division. The strata exhibit the sediments of deep sea bays, with occasional swamps and muddy shallows, and prove that this state of things was of long continuance, a kind of premonition of the Carboniferous. A new order of things was being gradually established, both physically and palæontologically, so that it is part of the case that the Upper Devonian should be the most transient and interrupted portion of a transition formation, the close of an era, not ending in storms, but in peace and mud.

It is hardly necessary to remind you that our so-called Systems have two artificial lines, viz., those which affect to separate them from the whole, and that it is the space thus artificially separated for examination that we call a System. Looked at in another aspect they are but parts of a whole; but for convenience we separate facts into collections and class together those which have general resemblances. The number of these resemblances augments towards a maximum by degrees, and descends by degrees; so that whilst the culminating line or point of these resemblances may be well and strongly made out, yet the edges will in the nature of things be shadowy and debateable.

2. ON A NEW SECTION OF THE UPPER BED OF THE LONDON CLAY.

By CALEB EVANS, Esq., F.G.S.

(Abstract.)

The author drew the attention of the meeting to an exposure of a very fossiliferous bed of the London Clay, near Childs Hill, Hampstead.