water, by its greater specific gravity, remained in the bottom of the sea of Marmora, so that, while the upper portion of the water and that on the shores were diluted to the Black-Sea density, Mediterranean conditions existed in the deep centre of the sea. If, therefore, the Black Sea had been pure fresh water, the upper portion of the Sea of Marmora would have been fresh also, with its fresh-water fauna, whilst the deeps of that sea would be marine.

Dr. DUNCAN mentioned that in certain coral reefs intersected by freshwater currents, the corals still continued to be formed; so that the existence of dwarfed forms of corals in ancient times was quite consistent with modern facts.

Mr. FORBES commented on the chemical features of Prof. Ramsay's views, and could see no reason why the beds containing iron should not have been deposited in the open sea. Many beds, for instance the Gault, contain more iron than those which are now red, though they may be grey or blue. In sands the grains are often coloured only superficially with iron, probably derived from sulphates. In other cases the sands consist of fragments of rocks already red. There was, in fact, no reason why the beds deposited in the open sea might not subsequently, by oxidation, become perfectly red.

Prof. RAMSAY replied to the remarks of the various speakers, and summed up by contrasting the usual colour of marine fossiliferous beds with that of the thick, almost non-fossiliferous rocks of which he had been treating.

MARCH 22, 1871.

A. R. Selwyn, Esq., Director of the Geological Survey of Canada; J. Bridges Lee, Esq., B.A., of Sidney Sussex College, Cambridge, and 115, Ledbury Road, Westbourne Park, W.; the Rev. Thomas Robert Willacy, B.A., of Corpus Christi College, Cambridge; and James Putnam Kimball, Ph.D., of 20 Union Square, New York, were elected Fellows of the Society.

The following communications were read:—

1. *On the "PASSAGE-BEDS" in the neighbourhood of Woolhope, Herefordshire, and on the discovery of a NEW SPECIES of Euryp-terus, and some NEW LAND-PLANTS in them.* By the Rev. P. B. BRODIE, M.A., F.G.S., Vicar of Rowington.

THE "Passage-beds" between the Upper Silurian rocks and the Old Red Sandstone, on the outer area of the Woolhope valley of elevation, although they have been already noticed by Sir R. Murchison, Professor Phillips, Strickland, Symonds, and myself, at Hagley, Tarrington, Ledbury, and Perton have not in this district received the full attention they deserve; for although they are of comparatively limited vertical thickness when compared with the finer and more complete sections at Downton and the Ledbury tunnel, they occupy a larger extent round the valley of Woolhope than has been previously recognized, and contain some new and interesting fossils

At Putley, near the road from Ledbury to Woolhope, to the N.E. of the latter village, a remarkable bed of very hard horizontal sandstone, composed mainly of small pieces of quartz in a sandy matrix, overlying a stratum of white and yellow clay, used for making tiles, may be seen in a brickyard to the depth of about 3 or 4 feet, the blocks of sandstone averaging about 2 feet in thickness. I could find no fossils in it, and it had very much the aspect of a volcanic rock; but my friend Professor Phillips, to whom I sent a specimen, recognized it at once, and states that he believes it to have been derived from Trappean and other Plutonic rocks, though it may be presumed to be one of the bands of sandstone belonging to this series. About two miles to the south of Putley, at a farm called "Chandler's," there is a sandstone quarry, which yields large blocks $1\frac{1}{2}$ feet square, having a dip to the north-east, a portion of which is of a very dark colour, almost *black*, similar to the peculiar igneous-looking rock just referred to; and at one place the strata are much contorted, being thrown up in a small anticlinal. From the top of Marcle Hill, for at least three quarters of a mile, in a lane leading to this quarry, on each side of it, there is a thin band of sandstone, running parallel with the road; but no "olive shales" appear above it. Three miles to the north, on Putley common, near Maine's wood, other beds of a close-grained more or less quartzose sandstone occur, in which I found the cast of the larger form of *Lingula cornea*. This seems to correspond with the hard micaceous grit (though there of a purple colour) at the Tin Mills, Downton, which immediately overlies the "olive shales," and contains the large *Lingula cornea* in abundance. The beds were much disturbed, and more or less inclined, as most of the "passage-beds" are here, dipping from the older Silurian rocks of Woolhope, and in the same direction, for the most part on this side. The partial opening was of no great depth, and therefore the thickness of the sandstone visible was of limited extent; but judging from the relative position of the Ludlow formation on the west, and the Old Red Sandstone on the east, the thickness would perhaps be considerable if fairly exposed. A mile or two towards the north-west, near Lower Hazle, between this spot and Tarrington, is a small quarry of thick-bedded variable sandstones, charged as usual with carbonaceous remains, but finer-grained than those already described. On the same line, still further towards the north-west, on the brow of the rising ground called "Hillfoot," similar bands of sandstone are exposed, more or less disturbed, dipping towards the north-east, and underneath them the "olive shales," 3 or 4 feet thick, passing into, and resting on, a thin stratum of sandstone, similar to the section at Perton. The shales are horizontal, and contain in the lower part abundant fragmentary relics of plants, among which are the seed-vessels of *Lycopodium*, and larger fruits (or sporangia) which seem to be quite distinct. I could find no Crustacea; but a longer and careful search would no doubt detect them. I also obtained one specimen of the smaller form of *Lingula cornea*, supposing this species to be identical, which Mr. Symonds thinks it is

not. In no other places where the sandstones are present have I observed these shales, except here and at Perton; but probably, though not exposed elsewhere, they extend for some distance in this district, and are to be looked for associated with the sandstones between the Old Red Sandstone and Upper Ludlow rocks. Owing to the very few exposures of rock hereabouts, it is exceedingly difficult to get any thing like a clear and consecutive section. Here and at Putley brickyard there is a want of conformity—the only two places I have noted this; for, as a general rule, the “passage-beds” are conformable to the Upper Silurians. About two miles further on is the better-known quarry at Tarrington. Six to eight beds of sandstone, varying in thickness, colour, and lithological character are exposed here, divided by thin partings of yellow and grey-coloured clay, having a total thickness of about 20 feet, with a rapid dip to the north. I could detect no “olive shales” here; and the only fossils are the usual carbonized fragments of plants, including the characteristic *Lycopodites*. Some of the blocks of sandstone are of large size, and no doubt form a useful building-stone. The next exposure of the sandstones, including the “olive shales,” is at Perton, which I have already referred to in a short paper published in the ‘Journal’ of this Society*; but as I was unable then to give a detailed section, it may be desirable to add it now in descending order.

	ft.	in.
1. Divided beds of sandstone in thin bands	2	0
2. Dark-coloured brownish shales	3	0
3. Yellow sandstone	1	6
4. Olive shales, brown and green, more or less indurated, but generally very brittle, sandy, and slightly micaceous, and having an irregular fracture	5	0
5. Thin-bedded sandstone	0	5
6. Olive shales, often arenaceous, with a thin sandy layer at the base, similar in structure to No. 4	4 to 5	0
Total	16	11

I was only able to make out this section satisfactorily by the aid of a ladder. The upper sandstones thin out rapidly to the south-west, the “olive shales” rising to the surface, but too high up to be reached.

The lowest stratum (No. 6) crops out at the north-west corner of the quarry; and, on the authority of a man who had formerly worked in it, there is a good, thick, serviceable bed of yellow sandstone underneath, though I could see no trace of it. If this should prove correct, it is probably the Downton sandstone. All the sandstones are more or less fossiliferous, and yield the usual remains of carbonized plants, and abundance of *Lycopodites*. The Crustacea appear to be confined to the “olive shales” (Nos. 4 & 6). I sent up all I procured to Mr. Woodward; and he informs me that the greater number belong to *Pterygotus Banksii*, with the exception of a small tail and three species of *Eurypterus*, viz. *E. pygmaeus*, *E. acuminatus*, and *E. abbreviatus*. One specimen of this genus consists of a con-

* Quart. Journ. Geol. Soc. vol. xxv. p. 235, March, 1869.

siderable portion of the body ; the others are chiefly fragments of the body, heads, tails, claws, and swimming-feet. I was fortunate enough to discover an almost entire specimen of a new species of *Eurypterus*, which Mr. Woodward has named *E. Brodiei*, and described at the meeting of the British Association at Liverpool. He pointed out that it “differed slightly from all other well-known species in the form of the swimming-feet, in the palpi, but most of all in the form of the thoracic plate”*. It is perfect from the head to the apex of the sharp-pointed tail, and measures $2\frac{1}{2}$ inches in length, and 10 lines in the broadest part of the body, and has a portion of one of the swimming-feet attached”†. These shales contain a species of coral (*Actinophyllum*), not very common ; but I could observe no shells, nor the *Beyrichia*, and only a few of the *Lepeditia*, which characterize them elsewhere.

In addition to the Lycopodites, there are other plants, which I sent to Mr. Carruthers for determination ; he informs me that, “although very interesting, they are rather fragmentary, and, like most fossil plants, difficult to determine. The best-marked is a dichotomously branching plant, which would be referred to an *Alga* by most botanists. I believe, however, it is a true *land*-plant, which has had vascular tissue in its composition, and a sufficiently indurated structure to resist decomposition. It may belong to Dawson’s genus *Psilophyton* ; but more specimens are necessary before this can be decided. There are several bodies which look like seeds, but are more probably sporangia. They are certainly *land*-plants”‡.

I have not been able to find any traces of the numerous fish discovered at Ledbury and Ludlow ; but it is possible that a closer and longer search would detect them§. At Prior’s Court, about a mile south-west of this spot, there is a small exposure of the sandstones, showing nearly 2 feet of divided beds of yellow sandstone, with carbonaceous remains, resting on the Upper Ludlow, but no “olive shales.” At none of these places could I discover the “bone-bed,” which has been long since noticed at Hagley, not far from this point on the north-east, first by the late Mr. Scobie, an active member of the Woolhope Naturalists’ Field Club, and afterwards by my lamented friend H. E. Strickland, where, many years ago, in company with the latter and Sir R. Murchison, we found the “bone-bed” and numerous remains of *Pterygotus* ; but these were in the Ludlow rock, and not in the passage-beds which occur there, according to my friend Mr. Symonds, who states that they are present

* There are in my collection at least three swimming-feet, and two or more thoracic plates, of this new species.

† It is imbedded in a yellow, somewhat soft, micaceous sandstone, connected with the “olive shales.”

‡ It need scarcely be remarked that the occurrence of terrestrial plants, some of which may very possibly be new, besides those curious bodies long ago described by Dr. Hooker, and referred by him to *Lycopodium*, is a matter of much interest in strata of this age.

§ Mr. Symonds informs me that he has found a *Pteraspis* there, which is now in the possession of Lord Enniskillen.

at this quarry. He says that the passage of the Upper Ludlow rock, with its "bone-bed," may be observed here into the yellow Downton beds, succeeded by red marls, precisely similar to those in the Ledbury Tunnel. On my first visit to this spot they were not exposed, and were not visible at a later one; and the pit has not been worked now for many years. I cannot, therefore, say decisively whether the "olive shales" are present there *in situ* or not. The "bone-bed" here and at Gamage Ford probably belongs to the lower "bone-bed" which, in Shropshire, is present in the higher portion of the Upper Ludlow, not far below the thicker mass of the Downton sandstone; while another and upper one occurs about the middle of the "olive shales," but it is apparently wanting here. I searched in vain for these "passage-beds" more to the south, near Soller's Hope, where they might be expected to come in, unless a sandy marl, of which a section may be seen in places along the brook which traverses the lower ground, belongs to them. It contains a small *Orthis* and *Beyrichia*, but it most likely belongs to the Ludlow formation. They may or may not be continuous round the whole of the outer limit of the Silurians in the district under review, and I think it probable that here and there they might be detected in road-side cuttings throughout the whole of this area; I hope, at some future time, to be able to investigate this more closely. At any rate, a more considerable extension has been shown, especially to the east of Woolhope; and the presence of the "olive shales," exactly identical lithologically and, to a certain extent, zoologically with the "olive shales" near Ludlow and other places in that neighbourhood, is distinctly proved. On the west, north-west of Woolhope, and south towards Fownhope, there is less chance of observing those "passage-rocks," if they occur there, because there is a very considerable quantity of drift, which would overlie and conceal them. This larger mass of drift, derived mainly from the denudation of the Silurians adjacent, was first noticed by my friend the Rev. F. Merewether, Vicar of Woolhope, who, in a short paper read to the Woolhope Naturalists' Field Club, in October 1870, has shown a thicker and wider extension of drift in this direction, which had not been before noticed. In many spots these "olive shales" are not exposed, though they may be present *in situ*; but, from their soft and friable nature, a considerable quantity has no doubt been denuded, unless protected by the overlying sandstones. As they pass downwards into a more sandy stone, it is probable that there is some sandstone below; to what extent or thickness, it is impossible to ascertain; but it cannot be very thick in the only two places where I have observed them, as at Perton they rest almost immediately on the Upper Ludlow, and at Hillfoot, though not directly overlying it, at least not shown in the section there, the Ludlow shales crop out not far from them. The subordinate sandstone would then seem to be of far less thickness than the more massive sandstone at Downton, Shobden, and elsewhere. The "olive shales" are, no doubt, the equivalents in time of the

red and blue marls and greenish shales (No. 12) at the Ledbury tunnel, described by my friend the Rev. W. S. Symonds*, who remarks that "nowhere else could be seen such a view of the 'passage-beds' between the Silurian and Old Red systems;" but, though at no great distance, they are apparently much less developed along the Woolhope border. I visited this fine section when the tunnel was being made, with several members of the Warwickshire Naturalists' Field Club, and I recollect being much struck with it at the time. Formerly these "passage-beds" were classed by Sir R. Murchison with the Old Red Sandstone; but latterly he has denominated them "passage-rocks," which seems altogether more appropriate, as showing their intermediate character between the Old Red and Silurian. Some geologists, however, I believe, still desire to have them restored to their original position in the Old Red. This is a question which I do not pretend to decide, but which future discoveries of other organic remains may definitely settle, if it is not already satisfactorily determined, my object being rather to point out a greater extension of this series around the Woolhope elevation than had been previously recorded.

There are many interesting and important questions connected with all "passage-beds"†, of which several are known to occur between two great epochs of geological time. It is not impossible that certain old defined lines of demarcation will ultimately have to be remodelled or removed, since such transition-periods may be shown to prove a continuity of the geological record; thus all such "passage-beds" may, in fact, be connecting links between one great geological epoch and another, rather than breaks in the continuity of succession.

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2. *On a New Species of EURYPTERUS (E. BRODIEI), from PERTON, near STOKE EDITH, HEREFORDSHIRE.* By HENRY WOODWARD, Esq., F.G.S., F.Z.S., &c.

IN March 1869, the Rev. P. B. Brodie, F.G.S., communicated to the Geological Society a short account of the occurrence of remains of *Eurypterus* and *Pterygotus* at Perton (see Quart. Journ. Geol. Soc. xxv. p. 235). Mr. Brodie stated that the specimens collected at that time and submitted to me were not considered to be new; in fact they consisted, for the most part, of fragments of *Pterygotus*‡ (*P. Banksii*) and *Eurypterus*§ (*E. pygmaeus*, *E. acuminatus*, *E. abbreviatus*, &c.), already noticed by Mr. Salter elsewhere.

Since that communication was read, Mr. Brodie has again explored this locality, and has forwarded to me several parts and an almost entire example of a *Eurypterus*, which differs considerably

* Quart. Journ. Geol. Soc. May, 1860, pt. 2. no. 62.

† This question was ably treated by Mr. Judd, in a paper lately read at the Meeting of the British Association in Liverpool.

‡ See Mem. Geol. Surv. Mon. I. 1859, pl. xii. figs. 22-46, p. 51.

§ Quart. Journ. Geol. Soc. 1859, vol. xv. pl. x. p. 229.