NOTES ON THE TRIAS, RHÆTIC, AND LIAS OF WEST SOMERSET.

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I HAVE been asked to give a few notes on the New Red and Lias in that portion of the district which we shall visit on the first two days of the long Excursion in July. The route followed will be from Bridgwater to Watchet, skirting the east side of the Quantock Hills, and then along the valley between those hills and the Brendons to Taunton, and is included in sheet 20 of the Geological Survey Map. There are not any sections, probably, in the West of England showing more interesting exposures of the Lower Secondary Rocks than these in question. I need only refer to the writings of Prof. Boyd Dawkins, Messrs. Etheridge, Woodward, and Ussher, in confirmation of this—and it is to these workers in the field that I am indebted for a large portion of these notes. It is not my province to describe the Palæozoic rocks of this district, but to understand its physical features we must picture to ourselves the Devonian rocks of the Quantocks and the Brendon Hills, standing up more or less in their present position as islands, against which the waters of Triassic times washed, depositing their burden of silt, sand, and gravel in the deeper valleys and shallower creeks running up into their recesses. One is reminded of similar conditions prevailing at the time that the Dolomitic conglomerate was laid down around the Mendip Hills. In both cases the denudation must have been very great; the results in the latter consisting of Old Red Sandstone and Carboniferous Limestone, in the former of the Grits, Sandstones, and Limestones of the Devonian series. The best exposures of these Triassic rocks will be visited on Tuesday in the Stogumber Valley, between Williton and Sampford Brett; but owing to the many complicated faults, it will be almost impossible to give any detailed description (see Fig. 1). When the patient labours of Mr. Ussher appear in the new one-inch map these will be all worked out in detail. It must suffice to state that he gives the following order of succession:

Trias	Keuper or Upper Trias	Upper	{ Marls, Marginal Sands, and Breccias.
		Lower	{ Sandstones, local intercalation, with Marl at base. Conglomerate, Breccia, Gravel.
	Middle Trias		{ Marl.
	Lower Trias		{ Sandstone (local) at base. Breccio-conglomerate and Breccia. Sand, more or less brecciated in places.

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FIG. 1.—SECTION ACROSS THE VALLEY BETWEEN THE QUANTOCK AND BRENDON HILLS.—*W. A. E. Ussher.*
Length of section about $4\frac{1}{2}$ miles.

<i>d</i>	Triassic Upper Marls.	<i>g</i>	Triassic Lower Marls.
<i>e</i>	" Upper Sandstones.	<i>h</i>	" Lower Sandstones with Breccia.
<i>f</i>	" Pebble Beds and Conglomerate.	<i>m</i>	Devonian Grits and Shales.
		<i>F</i>	Fault.

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After these preliminary remarks on the general features of the district to be visited during the two days that I am to have the pleasure of being your director, let me describe what we shall see on our first day (Monday). Leaving the alluvial flats of Bridgwater, celebrated for the manufacture of the well-known "Bath bricks," we shall drive over the New Red marls of Wembdon Hill to the village of Cannington, about half a mile from which is the celebrated patch of Limestone at Cannington Park. Opinions have been much divided as to the age of this Limestone, and for some time the pendulum swung between Devonian and Carboniferous. Lithologically the disturbed highly crystalline beds dipping at about 27° S.S.W. put on now a Carboniferous, now a Devonian aspect; but the list of fossils given by Mr. H. Cossham* is pronounced as decidedly Carboniferous on the authority of Mr. Etheridge. The dense character of the rock renders it difficult to get good specimens; during a recent visit there, in a dark-blue bed about 2 ft. 6 in. thick at the western corner, many sections of brachiopods and turbate corals could be seen. The specimens, however, which I forwarded to Mr. E. T. Newton were so poor that he could only hesitatingly name them as *Capulus*, *Athyris*, *Productus*, *Bellerophon*, and a Turbate coral, at the same time adding that he did not think there was any room for doubting their Carboniferous age. During my visit instructions were given to the workmen to preserve all they found for your inspection, so that you may have an opportunity of forming your own opinion on this question.

Resuming our drive we pass over the Keuper Marls and Sandstones which fringe the eastern base of the Quantocks, running into the little coves and round the promontories of that ancient land, in the same manner (as De la Beche writes) that the alluvial flats near Bridgwater run into coves and round promontories formed of these red deposits themselves, and turn off to the left to Adcombe, S.E. of Over Stowey. A good section here shows Middle Devonian limestones and slates faulted against the usual grits† of these hills. At the junction a compact fragmentary rock occurs, considered by Mr. Rutley to be a Volcanic Ash. The beds of dark-blue dense Limestone show numerous corals on their weathered surfaces, but other fossils seem scarce. A dip taken on the greasy mottled slates gave 30° N.N.E.

Descending to Nether Stowey and taking the high road to Holford, we leave the copper mines at Doddington, formerly worked in the Keuper Marls, on the right (there is an outcrop of Devonian Limestone here, but it is hardly worth visiting), and pass through some charming woodland glades, the haunts of Wordsworth and Coleridge when living at Alfoxden, to the village of

* *Proc. Cotteswold Naturalists' Field Club*, vol. viii, p. 20.

† Ussher considers these grits to be equivalent to the Hangman grits.

Holford. A good section on the left before reaching the Plough Hotel shows the usual reddish-grey Devonian grits.* Inter-calated bands of rotten earth contain encrinital impressions, but so badly preserved that they are difficult to recognise. On a former occasion when I visited this section (Woodlands quarry) the following note occurs: "The bottom beds, which have been worked down somewhat below the level of the road, are close-grained purplish-grey sandstones, with greenish-coloured marly partings; in these traces of plants occur. Succeeding them in ascending order is a series of thicker beds of a dense siliceous texture of a lighter grey colour, also very fissile. In the middle of a section made in these beds, close to the road side, about 5 ft. in depth, in a thin rotten band, occurs abundance of encrinital plates, casts of Brachiopods, *Tentaculites* and Corals. At the back of the quarry, which had then been worked down some 20 ft. or 30 ft., about half-way up in an almost black arenaceous band (drying red), was a similar series of fossils to those below." Should time permit another section ought to be visited. It lies to N.W. of Woodlands quarry, and nearly opposite the gate leading to Alfoxden. Here some mottled, coarse-grained siliceous sandstones, reminding one of the Hangman grit series, contain casts of a gasteropod (probably a *Natica*) and *Petraia*.

Returning to the main road, we come to Putsham, on the Keuper sandstone, and, if possible, make a *détour* of a mile to the Lower Lias, *Bucklandi*-beds, which form the coast-line at Kilve Pill, and dip landwards; numerous characteristic fossils can be obtained on the foreshore. The only other feature of interest to detain us before reaching St. Audries is the Perry quarry at the left-hand side of the road, a short distance this side of the Stowey or Fairfield Lodge, consisting of similar compact grey and purple sandstones, dipping about 30° N.E., becoming more fissile and micaceous in the upper beds.

We now leave the N.W. prolongation of these older rocks, and turn aside to visit the coast sections. A drive of about a mile, by the kind permission of Sir A. Acland-Hood, through his picturesque deer-park, takes us to "St. Audries Slip," a private road leading down to the shore. After enjoying the fine view from the edge of the cliffs we descend to the beach, and have before us probably one of the finest exposures of Keuper Marls, Rhætic, and Lower Lias to be seen in one continuous section in the West of England. To the east of the Slip onwards to Quantockshead is one successive series of the New Red Marls; a fault then brings down the Lower Lias beds against the former, conspicuous in the distance by the change of colour in the cliffs. The road passes over the upper beds of the New Red, and to the west we see a conformable sequence of New Red Marls, Rhætic,

* *Proc. Bath. Nat. Hist. and Antiq. Field Club*. Vol. ii, 1870-73, p. 430.

FIG. 2.—SECTION OF THE RHÆTIC, OSTREA, AND PLANORBIS BEDS AT ST. AUDRIES SLIP, EAST OF WATCHET.—*R. Etheridge.*

and Lower Lias dipping uniformly to the S.W., thick beds of Lower Lias limestones forming the western horn of the bay. The blue limestone bed, 18 in. thick, resting immediately on the beach, dips 15° S.W.

The entire thickness of the beds exposed, as measured at right angles to their dip by Mr. Etheridge, some years ago, is 250 ft. At the base are alternating grey, green, red, and pale yellow bands of hard and soft Marls (called "tea-green" marls) to a thickness of 72 ft. Above these come about 66 ft. of grey, brown, and black shales, with bands of argillaceous limestone—the Rhætic series. Then follow the White Lias and *Ostrea* beds, about 28 ft. in all; and then 24 ft. of *Planorbis* beds. Finally the *Bucklandi* and *Lima* series which rest upon these are estimated as from 50 ft. to 70 ft. in thickness. Further details are given in the section opposite (Fig. 2).

The upper portion of the shales (26 ft.) between the White Lias and the Bone bed is rich in organic remains. The fossil-hunter will have an opportunity of collecting most of the Rhætic forms from the blocks lying on the shore, and from the reefs which sweep in graceful curves seawards. The fossiliferous Rhætic beds strike the beach about midway, and the reefs of alternating limestone bands and black shale run out seawards, and abound in *Pleurophorus elongatus* and other fossils. A landslide has brought down the *Pecten valoniensis* and *Avicula contorta* shale at this spot. The characteristic Ammonite of the *Planorbis* beds abounds, together with *Ostrea liassica*, and the following Rhætic forms may be obtained: *Avicula contorta*, *Pecten valoniensis*, *Cardium Rhæticum*, *Pullastra arenicola*, *Pleurophorus elongatus*, *P. angulatus*, *Lima præcursor*, *Myacites*, *Modiola minima*, teeth of *Saurichthys*, *Sargodon Tomicus*, *Hybodus*, etc.

On Tuesday, an early start by train from Taunton will enable the members to reach Williton in time to visit some of the sections of the New Red rocks in that district. It will be impossible in these notes to give any minute account of the various divisions of the Trias so carefully worked out by Mr. Ussher; for that purpose his various papers quoted in the References (p. 387) must be consulted. It would take many a traverse in the Stogumber Valley to trace the complicated faults of this district that render the relations of Marls, Sandstones, and Conglomerates so very obscure. When Mr. Ussher, who has kindly supplied me with a few notes, writes, "It is unquestionably the toughest piece of New Red work I know of," we must be content to accept this dictum, and merely see all we can in a hasty visit. Leaving the train, then, at Williton Station, we take the road to Sampford Brett. Passing through the town of Williton, which is on a River-gravel flat, the first exposure seen is on the hill to the west. On the right-hand side of

the road, just beyond some newly-erected houses, is a quarry, worked for building-purposes, showing, according to Mr. Ussher, the Marls and Sandstones of the Keuper or Upper Trias. The lowest bed exposed is a rather close-grained, quartzose, speckled sandstone (Keuper sandstone), succeeded by beds of Conglomerate more or less coarse, with marly beds intercalated. Towards the top of the hill the sandstones are much softer. Descending the hill to the railway, east of the village of Sampford Brett, and crossing the line to the opposite bank, a very fine section of Conglomerate is seen, forming the base of the Upper Trias. This section, about 15 ft. in depth, consists of very coarse Conglomerate, with finer beds intervening. A Breccia comes in near the top composed of angular and sub-angular *débris*, some of it mere splinters. The pebbles of the Conglomerate are coarser towards the base, and consist of purplish sandstone, quartzite of various colours (white and pinkish), large and small pebbles of a dark blue or black hornstone or Lydian stone, etc. The beds in the upper section dip, at an angle of 23° , towards the cutting, where they are exposed again to a depth of about 30 ft.

Returning, and taking the train at Williton, we pass through Watchet to Blue Anchor Station, noting just as we leave Watchet, in the railway cutting north of St. Decuman's church, a fine section of Rhætic beds, exposed to a depth of 75 ft. by the great east and west St. Decuman's fault. Leaving the train at Blue Anchor Station, we follow the flat shore-line to the rising ground on the east. The first half-mile has not any feature of interest except the indications of damage done by the coincidence of a N.W. wind and high tide during a recent November gale. At the back of the inn situated on the top of the cliff, a field is strewn with quartzite pebbles, which are turned up abundantly by the plough in the lands adjoining. Descending to the shore just below the cottages, we pass under the Red beds of Keuper Marl to Blue Anchor Point, where the pink and grey Alabaster beds first appear. Large masses fallen from the cliffs above picturesquely jut out on the beach, presenting good examples of the way in which the pink and white Gypsum occurs in beds and reticulated veins. This place, perhaps, exhibits the prettiest example of the latter in the whole coast-line. Turning the point, we come to the workings high up on the cliff, and possibly a schooner may be seen stranded between the reefs, loading with the mineral for Swansea or the paper-works at Watchet. The white variety is the most valuable for that purpose. About one mile beyond the point we come to the place rendered classical by the discovery of a tooth of the earliest known mammal, *Microlestes* (*Hypsiprymnopsis*) *Rhæticus*, by Professor Boyd Dawkins, in 1864.* The beds here have been much disturbed by slips and

* During the recent visit of the British Association to Oxford, I looked in vain for this molar tooth to the Oxford Museum, where it had been deposited by the discoverer.

faults, which render their true succession rather puzzling, but at the same time very interesting to work out. Two main faults are the key to the geology of this part. One runs west of Watchet harbour, nearly parallel with the coast-line, and disappears seawards at Blue Anchor. By this the Lower Lias (*Am. planorbis*) beds are thrown down to the south. The other, taking the same course, runs farther out near low-water mark, bringing the *Am. planorbis* beds down to the north. So that you get the beds in the cliff on the south again repeated on the foreshore on the north (Fig. 3). A little west of Chapel Cliff—so called from a Chapel which once existed on the Cliff—or “Grey Rock,” as the workmen now name it, from the masses of Grey Marls and Lias rock which stand upon the shore, the collector may revel in fossils. Whether in the blocks strewn along the beach, or in the reefs which dip away seawards, fossils abound. Conspicuous on the large, grey slabs are the *Am. planorbis** and *Am. Johnstoni*, the former nacreously iridescent, some as large as 6 in., many 2 in. and 3 in. in diameter. Enthusiastic hammerers may here try the reefs in succession for another mammal tooth. Taking Prof. Boyd Dawkins’ section as their guide, they will start from soft, slate-coloured marl, black at base of cliff 4 ft., then come to dark-grey and black slaty beds containing flesh-coloured and white fibrous gypsum 4 ft., then dark, slate-coloured marlstone with flesh-coloured gypsum 4 ft., then coal-black shale, a marked feature, also containing gypsum 10 ft., then indurated gypseous, grey sandy marls 10 ft.; the grey, ripple-marked fissile sandy marlstone (6 ft. thick) next above this is very fossiliferous: *Modiola minima*, *Pecten valoniensis*, *Gervillia præcursor*, *Pullastra arenicola* (with their shells), *Cardium Rhæticum*, &c., and fish teeth. It was in this bed that the celebrated tooth was found, but owing to the wearing away of the cliff since then, the distance of this grey fissile bed from the soft, slate-coloured marl (*i.e.*, 32 ft.) may be considerably increased. If the tide be sufficiently low, a mass of Lias limestone, called, “Tor Point,” from which I was informed many hundred tons of stone had been taken for burning, may be seen; otherwise, the farthest rocks visible seawards are the Red and Grey Keuper Marls. At the base of the cliffs at this point a landslip has brought down a mass of Lower Lias and Rhætic beds, the grey fissile slabs of the former containing *Am. planorbis* and *Am. Johnstoni*; numerous bivalves and fragments of the bone-bed also occur.

Passing eastwards, the Red beds with gypsum set in with numerous step faults. About midway comes the great north and south Warren fault, causing a great disturbance in the cliffs at this point, and wedging in the Lower Lias and Rhætic series in a V-shaped mass. After passing the boundary stones marking the

* Now called *Ægoceras planorbis*. The original of Sowerby’s two figures came from Watchet.

FIG. 3.—SECTION WEST OF WATCHET.—*R. Etheridge.*

Figs. 2 and 3 are reproduced by the kind permission of R. Etheridge, F.R.S. L. and E., F.G.S., etc.

division of property between Mr. Luttrell's on the west and Lady Egremont's on the east, there is a good example of a fault having been subsequently filled in by a vein of Gypsum. The Red Marls capped with Grey beds continue onwards to Watchet. Should time permit the section east of Watchet can be visited before taking train to Taunton.

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