

24. *On the Occurrence of the Rhætic Beds in Leicestershire.*

By WM. J. HARRISON, Esq., F.G.S., Curator of the Town Museum, Leicester. (Read March 8, 1876.)

Good inland sections, exhibiting the junction of the Triassic and Liassic beds, are rather scarce in this country. I wish, therefore, to describe an exposure of the Rhætic beds near this town, which is of interest as proving the continuity of that formation and the remarkable persistence of lithological conditions in its strata; whilst the occurrence of some new species of fossils shows that our knowledge of the life of that period is, as yet, very incomplete.

These Rhætic beds are to be seen in three brick-pits situated at the northern extremity of the Spinney Hills, a low range forming the eastern boundary of the town of Leicester and the Soar valley (fig. 2).

The Rhætics form a capping to the hills at this northern end; but southwards, as the ridge rises, they are overlain by a thick covering of drift to the depth of at least 20 or 30 feet.

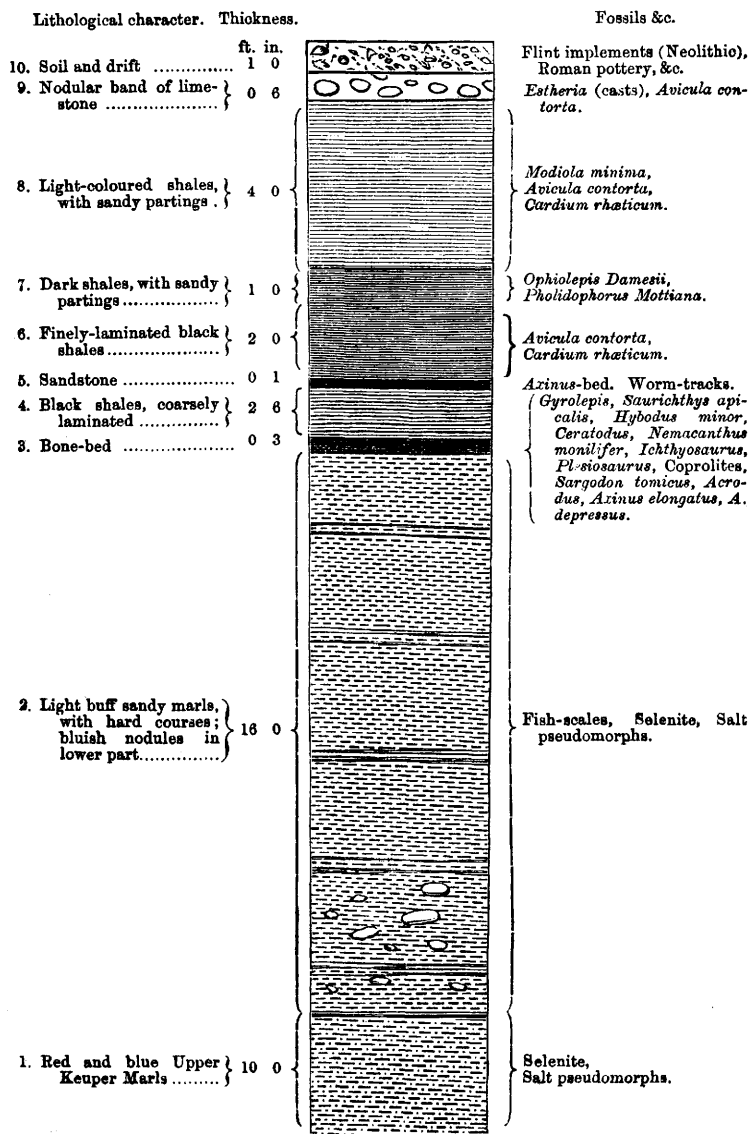
Eastwards the upper members have been denuded by a little stream, the Willow Brook, although the lowest bed (the Grey Marl) is nearly, but not quite, continuous right across to Crown Hill, where Lower Lias beds (yellow fucoidal limestones) first put in an appearance (see fig. 2).

The floor of the brick-pits just mentioned is about 10 feet deep in red Upper Keuper Marls. Descending sections in neighbouring pits and in the railway-cutting near the station show an alternation of Red, Grey, and Blue Marls to a depth of from 80 to 100 feet. It is noticeable that the relative thickness of the red bands becomes less as we approach the top. Selenitic crystals and salt pseudomorphs occur in these beds; but they have as yet exhibited no traces of life. A thick nodular band of gypsum occurs about 60 feet down.

Close to the eastern foot of the Spinney Hills a boring for coal has reached the depth of 741 feet (fig. 2). This commences just below the Rhætic Grey Marl, and passes through 690 feet of Keuper Red Marls containing much fibrous gypsum, and in the lower part thick red clays, and then enters a bed of sandstone, through which it is now passing. It would thus seem probable that these Triassic beds thicken in this direction; and as we are receding from Charnwood Forest (a Triassic island), this would be a likely consequence. Of the 51 feet of Lower Keuper Sandstone, the first 20 feet is described by Mr. J. A. Bosworth, F.G.S., the engineer, as a perfect quicksand, no solid cores being obtained. At Hinckley, twelve miles to the S.W., the Red Marls are of the same thickness, as proved by a borehole for water, of which a good supply was obtained, but too much impregnated with mineral matters for use; the same thickness of marl was also proved at Rugby, where the water was equally bad.

In the brick-pits the Rhætics are seen to rise nearly vertically for about 30 feet above the Red Marl, to which their stratification is

Fig. 1.—*Vertical Section of Rhætic Beds, Spinney Hills, near Leicester.*



parallel. The upper surface of the Red Marl, however, is somewhat uneven, being hollowed out here and there in long curves. There is a slight dip to the south-east. The bed which I consider to be the lowest member of the Rhætics is No. 2 in the accompanying section (fig. 1). It is a light buff-coloured hard sandy marl, some 16 feet in thickness, often of a greenish tint, with blue nodules here and there in the lower part. It is very much fissured, and has a conchoidal fracture. It is traversed by three or four courses of harder, whiter stone, which weather out from the rest, and are more laminated. Crystals of selenite are plentiful in this bed; and I have also specimens from it of pseudomorphic salt-crystals, and a slab showing ripple-marks. Small fish-scales are numerous, and dark brown markings as of vegetable matter. I have obtained a single insect-wing from this bed. Pittings, as of rain-drops, occur in all parts, and the upper surface is very uneven. This lowest Rhætic bed extends for some distance to the north and east of the Spinney Hills.

On the uneven upper surface just mentioned rests the bone-bed, a stratum not more than 2 or 3 inches in thickness. This bed is not easy to note on the "face" of the working, which is usually in a very "mashy" soft condition; and I had much difficulty in finding it. On digging back some distance it becomes comparatively hard; but its contents are then so brittle as to be very difficult of extraction. For the detection of the numerous small teeth, scales, &c. which it contains I have found the best plan to be to take home baskets full, which can then be sorted and examined at leisure with a lens. From this bone-bed I have obtained large vertebræ of *Ichthyosaurus*, numerous fragments of rib-bones, one probably of *Plesiosaurus*, about 18 inches long, together with numerous undetermined bones, some of which have a Labyrinthodont character.

Spines of *Nemacanthus monilifer* and *Hybodus minor*, teeth, scales, &c. of *Hybodus*, *Acrodus*, *Saurichthys apicalis*, *Sargodon tomicus*, *Gyrolepis*, *Ceratodus*, large Saurian teeth, worn and rolled bones, phosphatic nodules, coprolites containing fish-scales, &c. are all of more or less frequent occurrence in this bed. I have found in some coprolites small quartz pebbles, and fragments of sandstone precisely resembling the Upper Keuper Sandstone of the Dane Hills, on the opposite side of the Soar valley.

Pebbles of all sizes are numerous in this bone-bed. They are mostly quartzose or slaty, and rounded; many are 3 or 4 inches in length; and I should refer them all to our Charnwood-Forest rocks. All the bones are highly mineralized, being heavy, and of a brownish colour. Small concavo-convex bodies are common, much like *Discina* in appearance; these are probably the ends of bi-concave vertebræ, of which the central part has decayed away.

Two small bivalve shells (*Axinus elongatus* and *A. depressus*) occur loose in the bone-bed; they also occur in the "flinty bed" at Beer Crowcombe*.

Next above the bone-bed come about 2 feet 6 inches of coarse black shales (No. 4 in section), very pyritous, the fossils being

* Quart. Journ. Geol. Soc. vol. xvii. p. 503.

decomposed; and these are overlain by a thin irregular band of hard reddish sandstone from $\frac{1}{2}$ an inch to 1 inch thick, whose surface is covered with casts of *Axinus* (formerly called *Pullastra*).

Then come about 2 feet of finely laminated black shales (No. 6). It was this bed which, in February 1874, yielded me the first fossil evidence (*Cardium rhæticum* and *Avicula contorta*) by which I was enabled to prove these beds to be of Rhætic age.

From the next stratum (No. 7) in March 1874, I got a Starfish, the first found in British Rhætics. Curiously enough, the same species occurred, about that time, to Professor F. Römer in the Rhætic beds of Hildesheim*, whilst it has since been found by Mr. G. Embrey at Westbury-on-Severn. It has been determined by Dr. Wright to be his *Ophiolepis Damesii*. I have recently found a thin band in the shales almost made up of the remains of these beautiful Starfishes, their joints occurring by thousands. There are apparently at least two distinct species.

This bed (No. 7) consists of rather dark shales with sandy partings. Here I also found a new species of *Pholidophorus*, which I propose, provisionally, to name *P. Mottiana*, after my friend Mr. F. T. Mott, President of the Leicester Literary and Philosophical Society. *Avicula contorta* and *Cardium rhæticum* also occur. There are, too, some curious oval markings, with fine striæ radiating from the centre; but these may be inorganic. Worm-tracks are numerous. A white amorphous mineral, Kaolinite, with a little bitumen, fills many fissures in these beds of shale; and the cavities left by radiating selenite crystals cover the surfaces in great abundance. Flakes of mica spangle many of the sandy partings which occur in the upper part.

The uppermost shales seen in the section (No. 8) are very light in colour, and about 4 feet thick. All the shells already mentioned occur in them, together with *Modiola minima*.

Indications of a bed of hard rubbly limestone are to be seen capping the brick-pit sections. Drainage-operations higher up the crest of the Spinney Hills, in connexion with new streets to be built there, have, however, lately offered a good opportunity of examining beds somewhat higher in the series than those already noticed.

The bed of limestone (No. 9) is nodular, the nodules occurring at intervals of a foot or more. They are intensely hard, but soon break up into cubical masses on exposure to the air, being traversed in all directions by cracks filled with calcite. I have recognized this limestone as entering into the composition of Roman pavements found in Leicester; it would, in fact, present ready-made tesserae to the hand of the artisan. It has a conchoidal fracture, and is of a bluish tint, but grey on the outside. Fossils are very rare in it; but I have found casts of *Estheria minuta* and *Avicula contorta* on the outer surfaces.

A second nodular bed of limestone exists, I believe, about 2 feet above the one just mentioned, and then beds of light-coloured clay and sand; but here the drift obscures the section, and, as it thickens

* Zeitschr. d. deutsch. geol. Ges. 1874.

rapidly along the crest of the hill, prevents further investigation. The existence, however, of beds higher in the series is shown by the occurrence of blocks of limestone in the drift, with *Monotis decussata* and *Anoplophora musculoides*.

I have found further traces of the Rhætics at a point about a mile north of the Spinney Hills, near the site of the Borough Asylum; and I believe Mr. R. Etheridge, F.R.S., has noted their occurrence at a spot about 9 miles further north between Barrow and Sileby. I noted them here during the widening of the Midland main line in 1873, and the section is mentioned by Mr. H. B. Woodward (Geol. Mag. 1874, p. 480).

Still further to the north-east the same beds have been cut through near Stanton by the railway now in course of construction from Nottingham to Melton; but here, again, the higher Rhætic beds seem to have been much denuded. The nearest southern exposure seems to be at Copt Heath, near Knowle, in Warwickshire, as noted by the Rev. P. B. Brodie (Quart. Journ. Geol. Soc. vol. xxx. p. 746).

In the deep boring for water at Rugby the Rhætics were reached at a depth of about 450 feet. The black shales were there 8 feet thick, and the hard sandy marls beneath about 10 feet.

Although good sections of the Rhætic beds are rare in Leicestershire, yet the line of outcrop of the strata can be clearly traced from Leicester northwards, forming the eastern boundary of the Soar valley, and varying from a quarter to about half a mile in width. Southwards the great thickness of drift makes an exact tracing difficult.

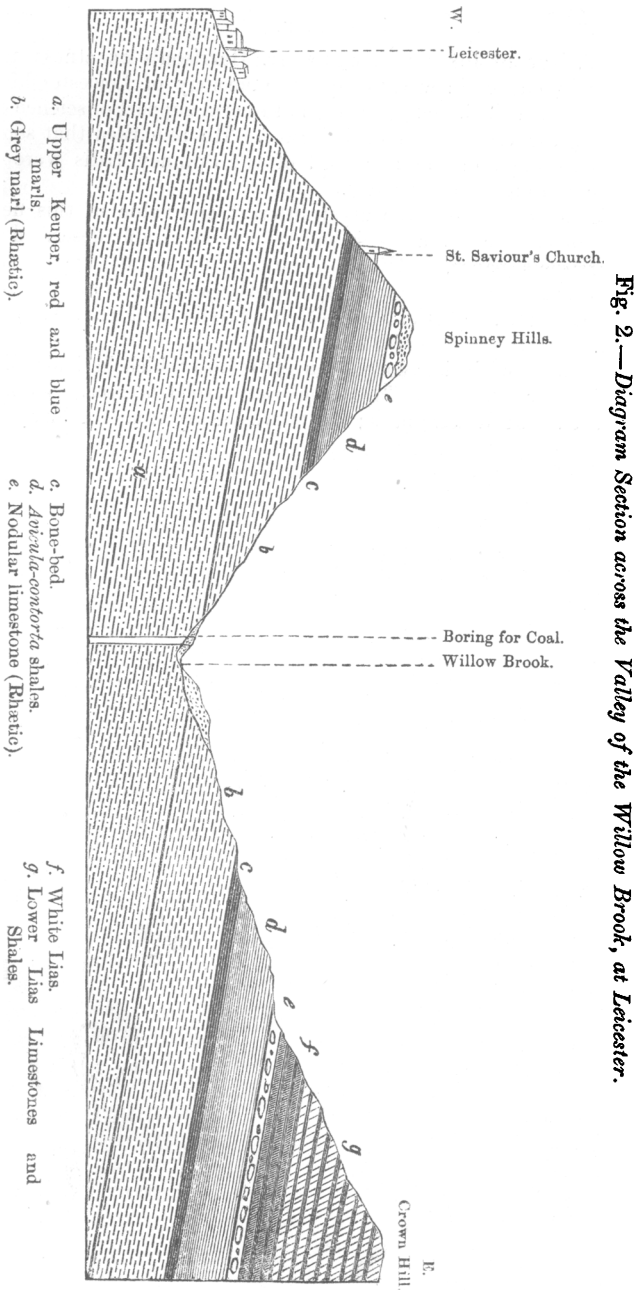
At Crown Hill (fig. 2) I have lately detected, in the preliminary works for the Great Northern line from Melton to Leicester, certain beds of limestone, called in Warwickshire the "Firestones" and "Guineas," which mark the passage of the Rhætics into the Lower Lias, together with a thick bed which is probably true White Lias. The cutting here will, I believe, exhibit a very interesting series of beds, and enable us to trace the succession for a long way up.

Wherever the true junction of the Lias and Trias is exposed in this country, the Rhætic beds appear to be invariably present. In 1874 I examined a fine section exposed in widening the Midland main line between Leicester and Wigston, which seemed to contradict this; Lower Lias Shales and Limestones, with *Ammonites planorbis*, appeared to be resting on Upper Keuper Marls. A close examination of the latter, however, showed them to be recomposed stuff; the Rhætics had been eroded, probably by glacial action, and their place filled with transported material.

I am much indebted to the Rev. P. B. Brodie, Messrs. W. H. Hudleston, W. Davies, L. C. Miall, C. Moore, and others, for their kind assistance in the determination of specimens.

The students in my science classes, especially Messrs. J. E. Elgood, J. R. Plant, L. H. Llewellyn, and W. J. Harrison, jun., have rendered valuable aid in searching the beds.

OF RHÆTIC BEDS IN LEICESTERSHIRE.



218 ON THE OCCURRENCE OF RHÆTIC BEDS IN LEICESTERSHIRE.

DISCUSSION.

Prof. T. RUPERT JONES referred to Mr. Harrison's exactness and praiseworthy energy in working out the geology of Leicestershire, and also alluded to the enlightened and liberal support of science on the part of the Corporation of Leicester. He remarked that some of the bones found in the Bone-bed of the Spinney Hills were of large size and apparently perfect.

Mr. JUDD pointed out the great interest and value of this new exposure of Rhætic strata which had been so admirably described in Mr. Harrison's paper. Hitherto we had no knowledge of any sections of the beds of this age between those of the Warwickshire outliers described by the Rev. P. B. Brodie and that seen at Newark.

Prof. SEELEY wished to correct an error into which he had fallen in describing a species of *Tanystropheus* from Leicester. He had ascribed it to the Rhætic beds; but it was really from the Keuper.