a piece of tracing paper draw two straight lines crossing each other at right angles; place this on the graticule in a position such that one of the lines shall cut the two radii representing the given directions of dip at points corresponding to their respective angles, and the other lie over the origin, then the point of intersection will give the direction and amount of the true dip. This method is represented by the dotted line in Fig. 2.

(b) When both the given dips are less than the maximum angle on the scale of tangents; the said scale to be used throughout. Take two pieces of paper whose edges are truly square, and lay one with its edge along the radius representing the direction of one of the given dips, and its corner at the point corresponding to the dip in that direction, and lay the other in a corresponding position on the radius representing the second direction of given dip, then the intersection of the free edges will give the direction and amount of the true dip. This method is represented by broken lines in Fig. 2.

It will be seen that neither of these methods are applicable in every case, but only when both the dips fall on to a single scale; but as the scale can be extended so as to embrace 70° of the quadrant without becoming cumbrous, one or other method will be applicable in every case likely to occur in practice.

(3) Given the dip of a bed and the slope of the ground, to determine the direction of its outcrop. The methods given under (2) are to be employed, but in the reverse manner, viz. that described under (2 b), where the scale of cotangents has to be used, and that under (2 a), where the scale of tangents must be used.

If the direction of outcrop and of the slope of the ground be given, the true dip can be obtained by first determining the respective angles of slope in the given directions of outcrop as described under heading (1), and then combining these by methods (2 a) or (2 b) as may be most suitable. Any other modification of these, which are all that ordinarily occur in practice, are too obvious to necessitate a detailed description.

As regards problems falling under heading (4), viz. those connected with the tilting of already inclined beds, Mr. Harker's method can be followed, on the graticule I have described, by means of a piece of tracing paper, but this method is cumbrous, presents no advantage whatever over a direct and purely graphical solution, a matter of the less consequence, as the interest of these problems is rather fanciful than practical, the data required for their solution being seldom or never obtainable.

VI.—THE RHÆTIC SECTION AT WIGSTON, LEICESTERSHIRE.

By E. WILSON, F.G.S., and H. E. QUILTER.

ALTHOUGH Rhætic rocks have already been noticed at one or two points in Leicestershire, viz. at Leicester by Mr. W. J. Harrison and between Barrow and Sileby by Mr. Etheridge,¹ the complete sequence of this series has not hitherto been observed in that county. Very recently our attention has been directed to a

¹ Quart. Journ. Geol. Soc. vol. xxxii. p. 212; GEOL. MAG. 1874, p. 480.

section at Wigston, near Leicester, which exhibits, not only the whole thickness of these beds, but also clearly shows their relationship to the overlying Lias and underlying Triassic rocks, and which for an inland section must therefore be considered as quite unique in this country.

At the large brick and tile works of Messrs. Healey & Co., close to the new London and N. W. Railway Station of Glen Parva (about four miles south of Leicester), the Rhætics are exposed in two contiguous clay pits, both of which are in work at the present time. The more westerly of these pits—the one we purpose specially to refer to, and of which we give a detailed section—shows, Keuper marls 30 ft. succeeded by Rhætic shales 40 ft., and Lias limestone 1 ft., with a capping of Boulder-clay which varies at the expense of the underlying rocks from 8 to 27 feet in thickness.

SECTION OF RHÆTICS, ETC., AT WIGSTON, NEAR LEICESTER.

			ft.	in.	ft.	in.
BOULDER-CLAY.		Red Clay, Sand, and Boulders	8	0 to	27	0
8	0	Limestone, thinly laminated, with <i>Am. planorbis</i> , <i>O. Liassica</i> , <i>Gryphæa arcuata</i> , <i>Lima gigantea</i> , etc.....			1	0
LOWER LIAS.	1	Limestone, nodular, yellow, blue-centred.....			1	0
	0	Shales, blue, thickly laminated, earthy			5	0
RHÆTIC		Shales, ,, ,, sandy and micaceous with scattered pyritic nodules...			4	9
		Shales, ,, ,, earthy, with sandy partings			1	9
UP. RHÆTIC		Shales, ,, ,, break up into thin laminae			1	4
SHALES OR		Shales, ,, thinly laminated, with lenticular pyritic seams			2	4
WHITE LIAS		Shales, ,, ,, with thin seams of sandstone, and band of limestone nodules at base.....			0	10
22	5	Shales, ,, thinly laminated, with thin seams of sandstones			3	0
		Limestone, ,, nodular, light-coloured, septariform			0	5
		Shales, ,, ,, passing down into			2	0
		Shales, black, with thin sandstone seams and sandy shales below, with <i>Axinus cloacinus</i>			4	10
		Shales, black, thickly laminated: limestone nodules, dark blue, septariform. at wide intervals			6	0
LOWER		Shales, black, thinly laminated, sandy, with <i>Axinus cloacinus</i>			3	8
RHÆTIC, OR		Shales, black, thickly laminated, with <i>Cardium Rhæticum</i>			1	0
<i>A. contorta</i>		Shales, black, thinly laminated, with <i>Cassianella contorta</i> , <i>Axinus cloacinus</i> , <i>Gyrolepis</i>			0	7
shales.		Shales, black, thickly laminated, with <i>Cardium Rhæticum</i>			1	9
17	10	Sandy seam, thin, local or sandy pockets, with <i>Aerodus minimus</i> , <i>Hybodus minor</i> , <i>Gyrolepis</i> , <i>Saurichthys</i> , <i>Nemacanthus</i>				
		<i>Tea-green Marls</i> , light grey Marls—breaking up into cuboidal pieces. with three or four harder bands of marlstone, passing down into			15	5
KEUPER		<i>Red Marls</i> .—Red and grey marls			2	11
15	5	Red, grey and mottled marlstones.....			3	4
		Red marls with gypsum			3	0
		Grey marlstone with thin seam of gypsum			1	5
14	6	Grey marl and gypsum			1	0
		Red marl and gypsum			2	0

A feature that will at first glance strike any one familiar with

the Rhætic rocks of the adjoining counties of Nottingham and Lincoln, or of Warwick and Gloucester, is the great apparent uniformity in mineral character of these beds in this unweathered section, and the absence of any hard beds, either of sandstone or limestone, with the exception of a band of nodular limestone at the top, and two or three seams of limestone nodules in the lower portion of the series. Closer examination, however, enables us to divide this mass of dark laminated shales into two groups: (1) a Lower Series, *A. contorta beds or Paper Shales*, consisting of some 18 ft. of black thinly-laminated, more or less fossiliferous shales; and (2) an Upper Series, *Upper Rhætic Shales or White Lias*, consisting of about 22 ft. of blue thickly-laminated earthy unfossiliferous shales, with occasional seams or scattered nodules of limestone; and to subdivide each of these members into the several beds indicated in the above section. There is no true "Bone Bed," but at the base of the Paper Shales we notice a thin, evanescent seam of white sand, containing scattered teeth, scales, coprolites, and pebbles, which may represent a Bone Bed occurring at a similar horizon elsewhere. Comparing the lower portion of this section with the incomplete Rhætic section at the north end of the Spinney Hills, Leicester, described by Mr. Harrison about eight years ago, we note a general agreement in lithological character and organic remains, except that at Wigston the Rhætic Shales have apparently a somewhat greater development.¹

Although, at several horizons in the Paper Shales, we find the dwarfed shells which specially characterize these rocks present in numbers, the variety in species is hardly so great as might have been expected, considering the ample facilities here given for their examination. The "White Lias," as usual, at any rate in this part of the country, is almost entirely destitute of organic remains. The presence of that interesting little starfish *Ophiolepis Damesii*, first found at Leicester by Mr. Harrison, was indicated by the cast of a single ray; but we have not been able to determine its exact horizon. We have found several fishes, chiefly in weathered shales, and badly preserved. They occur at a distinct horizon, viz. from 3' 6" to 3' 9" above the base of the Paper Shales. Their identification has not yet been made out.

The junction of the Paper Shales with the underlying beds, the "Tea-green marls" of Etheridge, is sharply defined, though the line is level, and the two sets of beds are apparently conformable to each other. On the other hand, these "Tea-green marls" imperceptibly graduate down into gypsiferous red, green, and mottled Keuper marls, having similar lithological characters. We have, therefore, no hesitation whatever in adhering to the opinion here-

¹ We cannot, however, accept as correct Mr. Harrison's description of a band of septariform nodules with *Esteriæ*, in situ, at so little as 10 feet from the base of the Paper Shales. No such bed is now to be seen on the Spinney Hills and no analogous bed, or *Esteriæ*, occur at this horizon at Wigston. The Rhætics on the Spinney Hills are capped by glacial drift. We consider that the nodules referred to by Mr. Harrison (*loc. cit.*) must have been displaced by glacial action from a higher level.

tofore expressed by one of us on this point¹ and classing these "Tea-green marls" also as Keuper.

In the smaller pit a few more feet of Lias are shown than in the larger one. Resting on the Rhætic Shales, of which some 16 or 17 feet are here exposed, and sharply defined therefrom, come a few thin bands of alternating fine and coarse-grained flaggy limestones and fissile shales, 1' 9" in thickness, containing *Am. planorbis*, *Gryphea arcuata*, *Ostrea Liassica*, *Lima gigantea*, *Pecten* sp., *Serpula* sp., the coarser seams being entirely made up of shell-fragments, joints of *Pentacrinus psilonota*, and the plates and spines of *Cidaris Edwardsii*. Above the limestone there are exposed in this pit about 7 feet of thinly-laminated blue shales.

The dip of the rocks is about 2° in a north-east direction. A small fault with downthrow on the east crosses the larger pit near the foot of the tramway.

The Boulder-clay rests in a cavity worn out of the Lower Lias and Upper Rhætic shales. It consists mainly of recomposed Keuper Marl and contains boulders of quartzite slate and granite, Keuper sandstone, Rhætic and Lias limestone—beautifully smoothed and striated—also ironstone nodules, and an occasional chalk flint. As is usual in this district, the Boulder-clay contains pockets of ferruginous pebbly sand.

At the brick-yard the whole of the different clays are worked up together, viz. Boulder-clay, Upper and Lower Rhætic Shales and Keuper Tea-green and Red Marls, the coarser fragments of the Boulder-clay, and the Rhætic and Lias limestone having been previously picked out. This combination-clay is manufactured into bricks, drain-pipes, tiles and ornamental pottery.

Mr. Healey, to whom we are indebted for every facility for examining the above sections, informs us that it is probable that before very long the smaller pit will be deepened. If so, they will strike into the Paper Shales, and give geologists another fine section of these interesting rocks.

R E V I E W S.

THE BERLIN ARCHÆOPTERYX.

(PLATE XIV.)

I.—UEBER ARCHÆOPTERYX VON W. DAMES. PALÆONTOLOGISCHE ABHANDLUNGEN, zweiter Band, Heft 3. 4to. pp. 119—196. Mit. 1 Tafel und 5 Holzschnitten. (Berlin, 1884.)

THE announcement in 1862² of the discovery of a nearly entire skeleton of a most remarkable long-tailed Bird, clothed with feathers, in the Lithographic Stone of Pappenheim in Bavaria, named by Prof. Owen *Archæopteryx macrura*, produced a most profound sensation amongst biologists generally. A single feather had, it is true, been already discovered in this formation in 1860, and named by

¹ Quart. Journ. Geol. Soc. vol. xxxviii. p. 451.

² "On a Feathered Fossil from the Lithographic Limestone of Solenhofen lately acquired for the British Museum," by Henry Woodward, "Intellectual Observer," vol. ii. No. v. December, 1862, pp. 313—319, with a coloured plate. See also H. Woodward, "Intellectual Observer," 1863, pp. 443—451.