

of these excavations caused general surprise, and it was felt that they deserved longer time for study and the assistance of a photographer. The sand is beautifully false-bedded, and overlaid in places by valley-alluvium, elsewhere by gravel, and in several of the pits by boulder-clay. In one case boulder-clay appeared to be intercalated in the gravel, as at Littleworth. The great variation in the thickness of these superficial deposits adds to the difficulty of working. Much of the sand goes to London and elsewhere for building purposes, but certain qualities are sent long distances for potting plants. In the fading light only a hasty examination of the many large pits was possible, and the return to London was made by the 8.35 train.

REFERENCES.

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 Geological Survey Map, Sheet 46, S.W.
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 1895. WOODWARD, H. B.—“Jurassic Rocks of Britain,” vol. v, pp. 159, 228. *Mem. Geol. Survey.*
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EXCURSION TO GRAYS THURROCK.

SATURDAY, MAY 18TH.

Directors: MARTIN A. C. HINTON AND A. S. KENNARD.

Excursion Secretary: A. C. YOUNG, F.C.S.

(*Report by* MARTIN A. C. HINTON.)

THIS was an excursion arranged to give the members of the Association an opportunity of examining some of the sections and features described by the Directors in their paper before the Essex Field Club, the first part of which has just been published. The party of twenty-two left Fenchurch Street by the 2.15 train. On arrival at Grays the members proceeded to a small section off the Orsett Road, which showed the deposits of the Middle Terrace. The lower part consisted of a series of very finely-laminated clays, containing few fossils, but from which the Directors have obtained bones of *Cervus Bos*, &c. The middle portion of the section was occupied by a lenticular mass of sand with thin seams of gravel. The sand was arranged in an alternating series of thin bands cemented by oxide of iron, and softer, incoherent laminae. The latter were crowded with land and freshwater shells, and contained also many bones and teeth of small vertebrates. Above this series was a thick mass of stiff

ochreous loam. Mr. Kennard explained the section to the party, and some time was spent in collecting fossils. The Directors have obtained many new palæontological records from the fossiliferous portion, including a fine series of fishes, the determination of which is due to Mr. E. T. Newton, F.R.S. The other vertebrates have been determined by Mr. Hinton, while Mr. Kennard is responsible for the mollusca. The Directors are greatly indebted to Messrs. J. P. Johnson and G. White for the kind way in which they communicated the specimens in their collections.

The following is the list of Vertebrata new to the Grays deposits, and those marked with an asterisk are new to the Pleistocene of the Thames Valley :

MAMMALIA	* <i>Microtus agrestis</i> .
	* " <i>glareolus</i> .
	" <i>gregalis</i> .
	* " <i>nivalis</i> .
	" <i>ratticeps</i> .
	* <i>Mus sylvaticus</i> .
REPTILIA	* <i>Tropidonatus natrix</i> .
AMPHIBIA	<i>Rana temporaria</i> .
	* <i>Bufo vulgaris</i> .
PISCES	* <i>Acerina vulgaris</i> .
	<i>Esox lucius</i> .
	* <i>Leuciscus rutilus</i> .
	* " <i>vulgaris</i> .
	* " <i>erythrophthalmus</i> .
	* <i>Anguilla</i> (?) <i>anguilla</i> (?)

The party next visited a gravel pit at Sockett's Heath, a little to the north of Grays. Here Mr. Hinton discussed at some considerable length the questions raised by some of the valleys in the district as to their history and origin. These valleys are uniformly covered with the High Terrace gravel which stretches over the surrounding plateau, but which in these situations is proved to descend some thirty feet below its normal level. The speaker urged two things, viz., (1) that the valleys were not the result of fluvial or subaërial denudation operating subsequently to the deposition of the drift, because none of the latter had been removed ; (2) that the valleys did not exist prior to the deposition of the gravel, because in that case they would have been completely filled up with the gravel, or else equally effectually effaced by the erosive action of the ancient Thames. The next point dealt with was that the Chalk and Tertiary strata of the Grays district form part of a small anticline. This folding has produced faulting at other places in the Thames Valley, but in this district it has only opened a series of fissures. As an

instance of this the report of a previous excursion to Grays, under the direction of Mr. Spurrell, was cited. (*Proc. Geol. Assoc.*, vol. xii, p. 194.) In the opinion of the Directors the valleys were formed through the dissolution of the Chalk along these lines of fissuring by acidic water. This solvent action had rounded off the edges of the fissures, and had thus graved in the surface of the Chalk a series of grooves into which the superincumbent strata had descended.

Mr. Hinton then went on to contest possible objections to this view. He said that the first item that would doubtless be brought against it was the opinion of Sir J. Prestwich as expressed in the memoir on "The Sand and Gravel Pipes of the Chalk" (*Quart. Journ. Geol. Soc.*, vol. xi, p. 71), but the only reply which the Directors had to make to this was that Prestwich's objections to the view that fissures promoted solvent action were restricted to the particular set of conditions which Prestwich had pictured in that paper, and were not applicable to the present case, which was quite distinct. It was now generally held that the "Terrace" structure seen in our river valleys was the product of an alternating series of short periods of rapid elevation and longer periods of slow subsidence. Adopting this view it was found that in High Terrace times the land stood 100 ft. lower in relation to the sea than at present. There followed from this the conclusion that the saturation plane stood then just so much higher, relatively, to the land than now. With these conditions, by which the fissures became completely immersed below the plane of saturation, such occurrences became of great importance in regulating and favouring the dissolution of the Chalk. Some experimental observations of Mr. F. Rutley were then cited upon cubes of chalk immersed in dilute acid, by which it was shown that the edges and solid angles were the parts most readily attacked by the solvent (*Quart. Journ. Geol. Soc.* vol. xlix, p. 377). The speaker went on to say that their views received further confirmation from the fact that, although the biggest fissures occurred on the top of the anticline, they had not given origin to the largest valleys. The reason for this was that their edges were soon placed by the elevation following the High Terrace period above the saturation plane, and so, by Prestwich's objection, beyond the reach of the solvent.

The party then examined the section, which showed in one part how the gravels had sunk in through the dissolution of the underlying Chalk. The President drew attention to the fact that in the garden of the house adjoining the pit a similar subsidence had occurred a few years ago.

The members then proceeded back through Grays to West Thurrock, and visited the Thames Works Quarry by the kind permission of the owners. The section is very interesting, showing the brickearths of the Middle Terrace banked against an old Chalk cliff. Several members obtained bones and teeth from the

brickearth, which were identified by Mr. Hinton as belonging to *Elephas primigenius*, *Bos* and *Equus*.

On the way back to Grays several fine sections exposing the High Terrace Drift, through the Thanet Sand to the Chalk were noticed. Tea was served at the "King's Arms," and the party returned to London.

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- Maps, Sheet 1 S.W. and 1 S.E. Geological Survey (Drift Ed.).
 1889. WHITAKER, W.—"Geology of London," Vol. I., *Mem. Geol. Survey*.
 1901. HINTON, M.A.C. and KENNARD, A.S.—"Contributions to the Pleistocene Geology of the Thames Valley, I.; The Grays Thurrock Area, Part I., with a sub-section on the Fossil Fishes by E. T. Newton." *Essex Naturalist* (Vol. XI., pp. 336-370) and works therein cited.

WHITSUNTIDE EXCURSION, 1901.

Directors: B. A. BAKER, S. S. BUCKMAN, F.G.S., Prof. C. LLOYD MORGAN, F.R.S., S. H. REYNOLDS, M.A., F.G.S., J. SCANES, and Rev. H. H. WINWOOD, M.A., F.G.S.
Excursion Secretary: A. C. YOUNG, F.C.S.

EXCURSION TO THE NEW G.W.R. LINE FROM WOOTTON BASSETT TO FILTON.

MAY 25TH TO 28TH, 1901.

Directors: Rev. H. H. WINWOOD, M.A., F.G.S., and
 B. A. BAKER.

(*Report by H. H. WINWOOD.*)

THE object of this excursion was to examine the important cuttings on the new railway, now in process of construction, between Wootton Bassett and Filton. Branching off from the former station, direct towards the Severn Tunnel, not only will a shortening of the mileage between South Wales and London be effected and the necessity of going round by Bristol, Bath, and Chippenham avoided, but, the gradients being less, the engines will be enabled to draw much heavier loads.

Saturday, May 25th—Seventeen members assembled at the Wootton Bassett station, and after a delay of 15 minutes for refreshment, started for their walk of $7\frac{1}{4}$ miles at 11.45. Under the grateful shadow of the first bridge that crosses the new line, the Director shortly explained the chief features of the geology of