

communications, and Dr. Hunt is quite entitled to make the most of such a blunder, if he considers it will support his views; at the same time I trust that he will also be equally candid in cases where he may be found tripping.

Dr. Hunt alludes to a rough sketch of some of my views contained in the *GEOLOGICAL MAGAZINE*; but as I have already accepted the invitation of the Council of the Chemical Society to give a lecture on Chemical Geology (20th February next), Dr. Hunt will thus be enabled to take my views into full consideration, and after comparing them with his own I trust he will give us the benefit of his scrutiny; for as I regard the ultimate object of all my labours as being the attainment of scientific truth, I am as fully prepared to be corrected in points where I may be proved to be wrong as to defend those which I hold to be right.

THE BOULDER-CLAY AT WITHAM AND THE THAMES VALLEY.

SIR,—Mr. Dawkins has spoken of the occurrence of a Boulder-clay at Witham as affording a presumption that the valley there is older than the glacial drift. I am able to give a rough section of the boring for the well in which it occurred, where I saw it in 1865. I obtained the depths from the men at work, in answer to questions regarding the stuff which I saw to have been brought up.

SECTION OF ARTESIAN WELL AT WITHAM STATION, ESSEX.		<i>Feet.</i>
Coarse gravel.....		20
Greyish Glacial clay, with large flints and chalk pebbles		150
Fine clayey sand, brown and green, with green-coated flints at the bottom, (Thames sand)		10
Chalk, in which the water was obtained.		

The spot is more than 20 feet above the stream, so that the gravel is a terrace gravel; and, in what is probably the same bed, I found a short time previously a good specimen of an oval flint implement: I picked it off a heap in the gravel-pit, at the entrance of the lane which leads to the Goods' Dépôt.

Now, as regards the glacial clay in this section, there is a peculiarity which at the time surprised me much. I allude to the entire absence of anything like the "middle drift" beneath it. This drift occurs in full force along the high ground to the south, by Danbury and Wickham Bishops; and Mr. S. V. Wood, jun., has shown it in section 9 of his paper on the Essex valleys,¹ as underlying the Boulder-clay at Little Braxted close by. A glance at that section will show that the position of the Boulder-clay at Little Braxted has no analogy with that at Witham Station, where it extends many feet below the bottom of the valley. These circumstances, to my mind, throw a considerable doubt upon the clay at the station being the true Boulder-drift; and if it be not, we cannot argue from it that the valley is older than the Boulder-drift.

We are told of the existence of several Boulder-clays—and I can myself speak to a Boulder-clay occupying a valley in Essex which is clearly newer than the true Boulder-drift. It is to be seen on the shore, beneath the terrace, at Walton-on-the-Naze. It contains Chalk pebbles, large flints, London clay septaria, and Crag sand, and is full of mammalian bones. In hard specimens it could not be distinguished from the older Boulder-clay.

I have not a sufficiently minute acquaintance with the neighbour-

¹ *GEOL. MAG.*, Vol. III. p. 348, map.

hood to be able to contribute many observations to the elucidation of the question at issue regarding the age of the Thames valley. But, as I have already stated in your pages, I cannot admit the presence of the re-arranged material, which I call "trail," to be any proof of geological antiquity; regarding it, as I do, as an accompaniment of the last general denudation of the surface. When Mr. Wood says that he does not admit the existence of this deposit (though it is not strictly a deposit) as "a formation,"¹ I understand him to mean that he thinks that peculiar condition of the sub-soil to be of various geological ages, from the glacial drift upwards, instead of referring it to our period, as I do. Thus, although we disagree upon the age of the trail, we are in accord as to its existence, and also as to its having no bearing on the question in hand, viz., the antiquity of the mammaliferous deposits of the Thames valley.

It was asked during the discussion on Mr. Dawkins' paper, why the Boulder-clay did not cross the valley of the Thames. I then offered the suggestion that the cause might be found in the elevation of the Weald. *Denudation is a function of altitude.* In a given district it requires a certain amount of coherence in the constitution of a deposit to enable it to resist destructive influences of altitude. Hence, if the Boulder-clay was once spread over the North Downs—and they have been raised higher since—we need seek no other reason for its disappearance in that area. There is, I believe, a parallel case in Hants and Dorset. The elevation of the southern part of the Isles of Wight and Purbeck, and of the Weymouth district, south of the uplifted chalk, is probably of the same date as that of the Weald. Now, in the south-western counties, the Boulder-clay, as I believe, is represented by the thick bed of coarse flint gravel which forms the capping of most of the tabular hills of the New Forest and of the Tertiary country of South-east Dorset. But this bed of gravel does not cross the Chalk Downs. It appears to have been lifted up and carried away together with all the other deposits which once lay upon the Chalk; and, in passing, I may mention that the Tertiary strata which cap Ridgway Hill near Weymouth are vertical, being just as much affected by the disturbance as those of Alum Bay.

Now the Thames valley is so near the northern boundary of the Weald that we may well conceive the local disturbance to have been felt in it. And, indeed, the occurrence of a fault bringing up the Chalk against the London clay near Purfleet is probably part of the same movement. Again, the altitude attained by the Middle Drift along the hills south of Chelmsford and Witham is almost in itself sufficient proof that the disappearance of the Boulder-clay in that direction is due to denudation.

My impression is, that the mammaliferous bed of Grays Thurrock is of the same age as that of Clacton. It is possible that species may be present in the Clacton deposit which have not been collected, for it is most difficult to obtain specimens there. The late Mr. John Brown, by a combination of assiduity and good fortune, obtained a good many; but although I watched the place for nine years I never

¹ *Geol. Mag.*, Vol. V. p. 43.

got a single bone, and am persuaded that the bed during that time was not once laid open by the tides. On the other hand, the excavations in the Thames valley are very extensive, and continually worked, so that, probably, most of the species have turned up which are there buried. There is certain proof of the depression of the Clacton area subsequently to the period when the mammalia were entombed, for the bed in which they lie is purely freshwater, and it is covered with several feet of brackish water beds, with small *Serobicularia*; and at the top of the section occurs a seam in which I found *Cyrena fluminalis*, associated with dwarfed *Cardium edule*, and a *Paludina* undistinguishable from *lenta*. Now a similar depression of the area seems to be shown at Grays, by the false bedded sand, No. 5 of Mr. Dawkins' section,¹ overlying the mammaliferous gravel.

The Clacton deposit is a true valley deposit, cut out of the London clay, and an overlying gravel which Mr. Wood calls the "East Essex Gravel." This gravel, as I understand him, he supposes much newer than the Boulder-clay; but at any rate it cannot be older than the Middle Drift, and in either case it throws the Clacton deposit into Post-glacial times,

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BOS LONGIFRONS.

SIR,—Owing to my absence from England, I have only just enjoyed the pleasure of reading the memoir which my friend Mr. Boyd Dawkins has contributed to the "Quarterly Journal of the Geological Society," and which appears in their 91st No., p. 176. There are some passages in this to which I may reasonably be allowed to demur, and I therefore, while giving Mr. Boyd Dawkins the utmost credit for the ability with which the case for the plaintiff has been stated, will at once proceed to open the defence.

The characters of *Bos longifrons* are clearly described by Mr. Dawkins, with such lucidity, in fact, that he is "unable to assign any characters of specific value to the animal." But I cannot allow that he shows sufficient cause why two out of the three other species of fossil English Bovines should be abandoned. In a memoir of eight pages, exactly twenty-one lines are devoted to the examination of the claims of *Bos frontosus* to specific distinction; whilst *Bos trochoceros* is utterly ignored. Both these species were found associated with *Bos longifrons* in a refuse heap in London Wall, by my friend Lieut.-Colonel A. Lane Fox, F.S.A., and the circumstances of their *gisement* have been accurately described by him in the "Journal Anthropol. Soc. Lond.," Dec. 1866. Of their identification there can be no doubt, and the specimens will be gladly placed in Mr. Dawkins' hands for description.

Mr. Dawkins' argument is as follows,—“A very large number of skulls from the Irish turbaries in the Museum of the Royal Dublin Society show a marked gradation in size and form, and constitute

¹ Quart. Journ. Geol. Soc. vol. xxiii. p. 94.