

be met at all. Passing over his travesty of my argument, which I suppose is not to be taken seriously, I find nothing in his article that does not evade the point. He first suggested that the records of Norwegian boulders on our East coast were due to observers having been deceived by material artificially transported. Thereupon I pointed out the well-known fact that such boulders are found imbedded in the Holderness clays, as well as on the beach. Of this he takes no explicit notice, but proceeds to shift his ground and throw doubt on the identification of the rocks in question. If Sir Henry will submit some of the disputed boulders to his eminent but anonymous petrological friend, the testimony of the latter will no doubt receive due weight; meanwhile, though a hundred witnesses may depose that they have *not* seen Scandinavian boulders in Yorkshire, the jury will listen rather to the evidence of one or two who *have* seen and investigated the matter.

ST. JOHN'S COLLEGE, CAMBRIDGE.  
August 18th, 1894.

ALFRED HARKER.

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GLACIAL GEOLOGY.

SIR,—In your issue for August last Sir Henry H. Howorth, replying to a short letter in which I criticized an article of his you had printed, remarks: "I hope Mr. Harker and Mr. Deeley will continue to face the issues between us, and not be content, as others have been, with fulminating more or less testy protests, and then retiring from the field." It is clear that your correspondent here refers to a discussion which took place in the pages of "Nature" between himself and Dr. Alfred Russell Wallace. In that discussion Sir Henry H. Howorth, to discredit his opponent's views, denied the correctness of a statement made by Dr. Wallace. In reply, Dr. Wallace showed that Sir Henry H. Howorth had, in his "Glacial Nightmare," taken the same view as Dr. Wallace; and as Sir Henry H. Howorth would not admit that he had played fast and loose with his facts, Dr. Wallace very properly refused to further discuss the matter with him. Is it proper to call this retiring from the field with more or less testy protests? In my letter I charged Sir Henry H. Howorth with having misrepresented the teaching of two letters, one written by Prof. Bonney and the other by Prof. Hughes. In his reply we have no word of explanation or apology for this, or even reference to it; but instead an attack, delivered quite beside the mark, intended to throw discredit upon me. He also sneers at "English official geologists" as a body, so I can, at any rate, congratulate myself upon being in excellent company.

In face of the discussions which have already taken place—discussions in which it has been pointed out that, as far as is known, ice in bulk is plastic (that it has no *yield-point* in the sense that steel or even clay has, and that, therefore, so long as there is an upper slope to the ice the ice must move)—it would be useless to try to make the matter clearer in a letter. However, I will quote *again* from Sir Henry H. Howorth by way of illustration. He requires

an "adequate *vis a tergo*," and says: "That such a *vis a tergo* can only, in the case of such ice-sheets, be obtained by postulating a considerable slope to the ice surface is equally plain and equally admitted." Will Sir Henry H. Howorth kindly express the necessary slope to produce motion in degrees, and give the *yield-point* of ice by which this slope is controlled?

I would have answered Sir Henry H. Howorth before, but have been for a short tour in Switzerland with Mr. G. Fletcher, F.G.S. Shortly we hope to be able to put together some notes we then made on the structure of glacier ice. During our stay I was able to examine many of the larger glaciers, and also to reach the summit of Mont Blanc and compare true *névé* with true glacier ice.

R. M. DEELEY.

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#### CHANGES IN OLD LAND-SURFACES AND COAST-LINES IN THE GLACIAL PERIOD.

SIR,—For some time past I have been attempting to represent, by coloured diagrams, the gradual changes of the level of the land above the sea, and the relative altitude of the Hills in the British Islands in Pleistocene times, and up to the present period. It was, in my opinion, a great and prolonged denudation which took place during the first Glacial epoch, and after the maximum of glaciation was reached, a period of land submergence was also effected, and then commenced a gradual emergence, in which a wearing away in depressed areas progressed by action of the sea, leaving high-level drifts on the surface of Chalk and other rock formations; but the channels which now divide the French and English coasts, and the Isle of Wight from the mainland of Hampshire, had not been cut, and did not prevent the migration of the terrestrial inhabitants, the temperature reverting to a condition similar to that now prevailing. The inter-Glacial period, which we now designate as Palæolithic and Prehistoric, ensued. It was a mild climate which then prevailed, and continued for about 15,000 years duration, when there existed a fauna composed of Elephants, Rhinoceroses, Hippopotami, Bison, Musk-Ox, Irish Deer, Elks, Red Deer, Beavers, Wild Boars, Bears, Cave Lions, Hyænas, and other Carnivora. These creatures ranged through vast forests of Oaks, Elms, Yews, Fir Trees, with peat-mosses separating Arctic plants beneath from a flora of warmer times above.

At this time a race of men appeared whose intelligence was sufficient to enable them to provide for their wants and to engrave figures of animals and make weapons of stone and bone. We find their relics in caves and under the shelter of rocks, which have resisted destruction during the subsequent submergence to which they were exposed, and which must have continued for a period of about 15,000 years.

An ice-sheet covered the land, whilst it was submerged, to the depth of many hundred feet, and of this we have records in Scandinavia, in Canada, and also on Snowdon.