

other, so that the Becke effect is mainly due to the relation between their indices of refraction. The author discusses in detail the effect of the refractive indices of the different directions of vibration on the result.

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### CORRESPONDENCE.

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#### SCANDINAVIAN ICE-SHEETS AND BRITISH GLACIAL DRIFTS.

SIR,—I thank Professor Bonney for the very kind way in which he refers to my letter on the Scandinavian ice-sheet. The question should, I agree with him, be approached without shirking difficulties. It would not be possible within the limits of this letter to discuss all the points he raises. I will, therefore, merely deal with the question as to whether, if sufficient ice passed off the Scandinavian Peninsula, it could flow across the deep Norwegian Channel and shallow North Sea and invade England. Professor Bonney says the main point for consideration “for our present purpose is the inadequate ‘ramming’ power of the ice from the Scandinavian upland, because by far the greater part of the journey to England would have been over land, not by water”. If glacier ice be really viscous, the flow would not be the result of ‘ramming’ from behind. The movement would result from the absence of support in front. Again, he says, “Thus it must either have been forced up and over an undulating floor for over 350 miles before it reached the English coast, or its movement have been practically restricted to the upper layers.” If such a form of flow took place, it would not be viscous flow. There would be a more or less steady gradient of the upper surface of the glacier rising from England to the Scandinavian uplands. The stresses due to the existence of this upper slope would act on every portion of the ice-sheet, and the bottom of the ice would drag the floor in the direction of motion even though the motion of the ice at the bottom were uphill. Ice will flow like water until its upper surface has become practically horizontal; but as the former has a viscosity of only  $0.01^1$  c.g.s. 793 units, whilst the viscosity of glacier ice<sup>2</sup> is about  $125 \times 10^{12}$  c.g.s. units, water—if we do not consider the effects of inertia—would flow *ceteris paribus* as far in one second as glacier ice would in about 200,000,000 years. Now, if the water in the Norwegian Channel were raised about 100 feet, as Prof. Bonney suggests, and then suddenly released, it would invade England and carry material along the sea bed with it. Ice is not ‘rammed’ forward any more than water is rammed along a river bed. The spreading out in great sheets over the Antarctic Seas of the glaciers coming down from the Antarctic uplands is proof, I consider, that glacier ice in bulk behaves as a viscous substance, i.e. that the rate of shear is proportional to the stress even when the stress is exceedingly small. A great many very capable field geologists hold that there is ample evidence that an ice-sheet did invade England from the east and north-east, and I always understood

<sup>1</sup> Phil. Mag., 1909, p. 518.

<sup>2</sup> Roy. Soc. Proc., vol. lxxxii, p. 251.

that the main argument of their opponents was that it did not because it could be demonstrated that it could not, a view which I consider erroneous.

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THE DISCUSSIONS AT THE GEOLOGICAL SOCIETY.

SIR,—Referring to the letters of Dr. Davison and Mr. Hobson, would not the case be fully met, in the circumstance of the author not being present at the reading of his paper, if the Assistant Secretary were to send the author a copy of the abstract containing the discussion *with a request* that he would return any reply he might wish to make to be inserted as a postscript in the Quarterly Journal? I have myself been permitted to avail myself of this privilege in the case of my paper on the “Dewlish Elephant Trench” (vol. lxi, 1905), and can appreciate its sufficiency. If the author is present there is no hardship, for if his cause is a good one he can strengthen it by replying to his critics there and then, and his reply will appear in the Journal.

O. FISHER.

April 3, 1909.

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OBITUARY.

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FREDERICK GEORGE HILTON PRICE, F.S.A., F.G.S.

BORN AUGUST 20, 1842.

DIED MARCH 14, 1909.

WE regret to record the death of Mr. Hilton Price, Director of the Society of Antiquaries, who, while distinguished as an archæologist, had also rendered important services to geological science. In 1860, at the age of 18, he entered the banking house of Messrs. Child & Co., Temple Bar, and eventually became head acting partner. With an intimate knowledge of business, of wide culture, possessed of a fine presence and of genial disposition, he was equally welcome on the council of the Bankers' Institute or on that of a learned society.

To the Geologists' Association in early years he gave much time and attention, and carried out the duties of treasurer from 1875 to 1881. He joined the Geological Society in 1872, and served on the Council for a short period in 1878–9. In later years his time, apart from business, was much occupied in archæological pursuits, including Egyptology and numismatics.

In his work upon the Gault Mr. Price was intimately associated with Mr. J. Starkie Gardner, F.G.S., and for many years they subsidized Griffiths, the well-known Folkestone collector, and made rich collections of the very finest Gault fossils. Mr. Gardner's collection was acquired by the British Museum, and Mr. Price's by his friend Mr. Hudleston, of which it still forms an integral part.

To geologists Mr. Price is best known through his detailed researches on the stratigraphy and palæontology of the Gault of Folkestone. He divided the formation into eleven zones, excluding