

from the Weald and from the district around Bagshot, from the Hampshire Basin and its bounding hills (with the exception of the extreme south), and from the highest and presumably oldest gravels north of the Thames.

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CORRESPONDENCE.

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SUB-OCEANIC PHYSICAL FEATURES.

SIR,—I take up my pen with unusual pleasure on this occasion, as it is for the purpose of welcoming an adherent, and removing misapprehension from the mind of a supposed opponent. I welcome the adherence to my views of so able a physicist as the Rev. Osmond Fisher, and I hope to be able to remove misunderstanding as to my meaning from the mind of Mr. Jukes-Browne.<sup>1</sup>

Let me assure Mr. Fisher that I am well acquainted with the paper by the late Mr. Godwin-Austen, which he quotes at length, and that in the paper on the sub-oceanic physical features of the coast of Western Europe (at present only in manuscript) I commence my statement by calling attention to Mr. Godwin-Austen's remarkable communication to the Geological Society. I wish also to add that, in speaking of the subaerial origin of 'the grand escarpment,' he is correct in inferring that I included 'wave-action' along a coastline, as Professor Spencer has also done in his article in the *GEOLOGICAL MAGAZINE*, January, 1899, p. 17. There is one point, however, in Mr. Fisher's letter, towards the end, which I would ask him to reconsider. It is quite true that the physical features on opposite sides of the Atlantic, now submerged, do possess a remarkable similarity (though not identity) of form; but I can scarcely suppose him to mean (as his language seems to imply) that it is in consequence of their original union on two sides of a 'rent'; an impossible hypothesis.

I shall now endeavour to reply, as concisely as possible, to the three points which have called forth rather severe criticism on the part of Mr. Jukes-Browne.

(1) As regards the term 'escarpment,' as applied to the descent leading down from the platform to the abyssal regions of the ocean, I quite admit that the term is not strictly geological as usually understood. For, although there may be portions of this long line of slope where the strata may be in such a position, and of such a character, as to constitute a true geological escarpment if under the air, yet we know so little of the rocks otherwise than by inference that we cannot pretend that this is the case. Under the circumstances, therefore, and notwithstanding the support of Professor Spencer for the term 'escarpment,' I am quite willing to recognize the force of Mr. Jukes-Browne's objections, and to drop that term in favour of 'Declivity.' This term, therefore, I intend to use, with the retention of the word 'Grand,' in my paper when published.<sup>2</sup>

<sup>1</sup> Letters, *GEOLOGICAL MAGAZINE*, Sept., 1898, p. 429, and Nov., p. 527.

<sup>2</sup> An abstract of the paper will be published by the Royal Geographical Society in March; but the full paper later on, by the Victoria Institute.

(2) Next, with regard to the formation of the Grand Declivity by subaerial action, I now see where the obscurity of my language led Mr. Jukes-Browne to misunderstand my meaning when he says, "How the existence of river-made valleys can possibly prove the declivity to have been made by subaerial agencies passes my comprehension." But Professor Spencer,<sup>1</sup> as also Mr. Fisher, have recognized that under the term 'subaerial agencies' I included the erosive action of waves and currents along lines of cliff, whether of emerging or subsiding land, just as we see along our own coasts at the present day. In endeavouring to maintain, against some objectors, that these sub-oceanic features were produced under the air rather than under the waters of the ocean, I lost sight, for the moment, of the very obvious fact that rivers and waves were the chief agents in their formation. I hope I have now made my meaning clear; but before leaving this point, I wish to add that, although both during emergence and subsidence the action of the Atlantic waters in cutting back the coast was doubtless in operation, it seems most probable that the greatest amount of work was done during the doubtless prolonged pause which intervened when the change from the one direction of movement into the other was taking place; during this period, also, river-erosion was probably most active.

(3) The last important point on which I shall touch is with reference to the geological age of these sub-oceanic features. I have assumed that it was during the prolonged period extending from the close of the Eocene into the Post-Pliocene. Mr. Jukes-Browne asks, "Is there any reason why the formation of the escarpment and the union of Great Britain with Iceland should not have taken place in the Eocene period?" (*GEOL. MAG.*, 1898, p. 430). Doubtless, there was an incipient uprising and shaping of our coasts at this epoch, as indicated by the discordant relations of the Lower Tertiary to the Cretaceous strata. But, while admitting with Mr. Jukes-Browne the probability of an incipient uplift, I strongly hold that it was not till the succeeding Miocene stage that the great elevatory movement of the Atlantic bed determinately set in. The powerful terrestrial movements during this and the succeeding Pliocene age, all over the European area and beyond, accompanied by denudation, need not here be insisted on. But the point which concerns our present inquiry is this: that the courses of the existing British and Continental streams having been mainly determined during these later Tertiary periods, we have a clue to the age of those now under the ocean, as they were once in physical connection with them. The subject is, however, too wide and intricate to be fully dealt with here; and I must hasten on to my last point, namely, the epoch of maximum elevation; and in answer to the second part of Mr. Jukes-Browne's question (quoted above), I reply, that whether or not this connection was established in the Eocene period, it is clear that it was continued (or repeated) in Pleistocene times, inasmuch as

<sup>1</sup> *GEOL. MAG.*, January, 1899, p. 17.

the fauna and flora are identical, and both are of Recent age; a physical connection would necessitate an uplift of the ocean bed to a *minimum* extent of 550 fathoms.

As regards the epoch of *maximum* elevation, I have already given my reasons for holding that the extreme cold of the Glacial Epoch was the direct result of land elevation on both sides of the Atlantic (see my paper on "Another Possible Cause of the Glacial Epoch," *Trans. Vict. Inst.*, 1898); under this view, it follows that the intensest cold would probably occur during the epoch of maximum elevation, namely, the early stage of the Glacial Epoch. I need not further dwell on this point, which I have attempted to deal with in the paper referred to.

But this communication has extended far beyond my original intention, and I must bring it to a close. It seems to me that this correspondence has "cleared the air," and that between the views of Professor Spencer, Mr. Jukes-Browne, and myself there is but little difference; or the difference is unimportant.

EDWARD HULL.

#### THE HORIZON OF *DINOCYSTIS BARROISI*.<sup>1</sup>

SIR,—Professor G. Dewalque, writing in your February number (n.s., Dec. IV, Vol. VI, p. 94), gently turns the Famennian beds of the Condroz right way up again from the reversed position into which an annoying slip on p. 543 of my paper had thrown them. For this friendly intervention he has my thanks, but with his main thesis I am unable to agree. The question at issue is the horizon of *Dinocystis Barroisi*; to this all the rest is subsidiary. Let us make the question clear by printing the list of the horizons of the Famennian, in descending order, as given in "Légende de la Carte Géologique de Belgique, etc.," 8vo, Bruxelles, 1896.

#### DEVONIEN SUPÉRIEUR.

##### *Famennien supérieur.*

Assise de Comblain-au-Pont [=Etroeungt Limestone].

Assise d'Evieux.

Assise de Monfort.

Assise de Souverain-Pré.

##### *Famennien inférieur.*

Assise d'Esneux.

Assise de Mariembourg.

Assise de Senzeilles.

This list does not imply an absolute vertical succession: it appears, for instance, that the Assise d'Evieux, with its rich flora, may be a more littoral facies of the Assise de Monfort, while the Assise

<sup>1</sup> See *GEOL. MAG.*, n.s., Dec IV, Vol. V, pp. 543-8 (December, 1898). Footnote 1 on p. 547 explained the name *Dinocystis* as derived from *δεινός*, *terrible*. Although this seemed peculiar, it did not occur to me that Dr. Jaekel must have intended to derive it from *δινεῖν*, *to whirl round*, in allusion to the marked curvature of the radial grooves. Thus regarded, the name is highly appropriate.