

The diminution of the island has taken place almost entirely from one direction, the sea having encroached 30 miles on the N.E. side, and 1 mile only on the S.W.; this is probably owing to the south-westerly set of the current, and to the harder (? *volcanic*) rocks forming that portion which now remains as an island.

A series of soundings over the N.E. area would be valuable, as showing the form of surface presented by this modern "plain of marine denudation."

W. H. PENNING.

#### APPARENT AND TRUE DIP.<sup>1</sup>

SIR,—The wording of Mr. Penning's ingenious paper involves one or two unfortunate slips of the pen.

In the first rule, instead of "the number of degrees of dip," write "the tangent of the angle of apparent dip."

In the second rule, proceed as before; but measure the length along one of the lines produced backwards.

The truth of the principle so modified is obvious from the following considerations.

If, along the line *b*, the rise is 1 in 20; and, along the line *a*, 1 in 10; then, taking 20 units along one line, and 10 along the other, we arrive at the horizontal line in the plane, *i.e.* at the line of strike.

ST. LEONARD'S HOUSE, LUDLOW.

HENRY GEORGE DAY.

#### PHYSICAL GEOLOGY OF EAST ANGLIA IN THE GLACIAL EPOCH.

SIR,—When the abstract of Mr. Penning's paper, "*On the Physical Geology of East Anglia during the Glacial Period*," read before the Geological Society in December last, with the report of the discussion thereon, appeared, I addressed the following letter to the author, in the hope that so much of it as consisted of an explanation of the views I held upon the subject of the East Anglian valley system might be allowed to be printed at the end of his paper. This, I believe, Mr. Penning was willing should be done, but the Council of the Society refused to allow it. I therefore, in order to prevent further misapprehension of my views, ask of you the favour of giving the letter a place in your columns.

SEABLES V. WOOD, jun.

[Copy letter.]

"Dear Sir,—So far as the abstract of it affords information, the principal fact brought to notice in your paper, 'On the Physical Geology of East Anglia during the Glacial Period,' is that the Middle Glacial gravels do not generally range in East Anglia above an altitude of 300 feet, that they are at about this height overlapped on the south side of the Cambridgeshire Chalk escarpment by the Boulder-clay, which ranges to the top of that escarpment, resting on the older formations; and that this Boulder-clay recurs on the opposite side of the escarpment, similarly resting on the older rocks, without any Middle Glacial beneath it.

"You will find that this limit of the elevation of the Middle Glacial in East Anglia is expressly pointed out by me in a paper in the

<sup>1</sup> See *GEOL. MAG.* for May last, p. 236.

GEOLOGICAL MAGAZINE for February, 1870; and that the range of that formation on the south side of the Cambridgeshire escarpment, its overlap by the Boulder-clay resting direct on the older rocks and spreading up to the top of the escarpment, and the recurrence of the Boulder-clay without any Middle Glacial beneath it on the opposite side of the escarpment, are most clearly shown by me in section 7 of my paper in the Quart. Journ. Geol. Soc., read June 19th, 1867 (p. 402), which crosses the Cambridgeshire valley (*i.e.* the great valley which, beginning about Hitchin, and stretching eastwards past Royston to Cambridge, has its south side formed by the Chalk escarpment) at about its central part, at Royston.

“The section just referred to is one of several sections illustrating the position of the Glacial beds relatively to a series of curvilinear escarpments (forming concentric arcs), of which that of the Cambridge Chalk is one. In your paper you also point out prominently that the great valley whose south side is formed by this escarpment is of Pre-Glacial origin; and, from the report of the discussion, it appears that Mr. Jukes-Browne was induced by it to remark that your views were in opposition to those of Mr. Harmer and myself, who would place the excavation of *all* the valleys in the Glacial period; while you considered them pre-glacial. Now in the long foot-note at page 14 of my paper in the Quarterly Journal, read November 9th, 1870, you will find, in reference to this and other similar curvilinear escarpments, the following observation, *viz.*:— ‘I formerly supposed that these curved groups were equally with the rectilinear ones of post-glacial origin; but an examination of the glacial beds of Bedfordshire and Northamptonshire showed these beds in such a position relatively to the Chalk and Oolitic escarpments (which form concentric curves of the Canterbury group) as necessitated the inference that these curves were of pre-glacial origin.’

“You will thus see that for several years I have regarded these curvilinear escarpments, and (*ex necessitate*) the valleys in any way formed by them, as of pre-glacial origin. I am not aware that Mr. Harmer has ever expressed any opinion at all as to such valleys; but both he and I did, and still do, regard the general valley system of East Anglia as of combined inter-glacial and post-glacial origin; but even to this there are some exceptions; as, for instance, the upper valley of the Little Ouse in Norfolk, and the valley of the Blackwater in Essex, which are of pre-glacial origin.

“One important error which I made (but which does not appear to have been detected) was in stating (page 417 of my paper in the Quarterly Journal read June 19th, 1867), that ‘every valley in the south-east of England in which the Upper and Middle Glacial deposits occur sufficiently near to afford evidence on the question, has been formed subsequently to the Upper Glacial Clay.’ My subsequent working out of East Suffolk and Norfolk in conjunction with Mr. Harmer showed that this was not the case, but that the East Anglian valley system, so far as the position of the Glacial series afforded evidence, originated after the Lower Glacial deposits,

and before the Middle and Upper; and a paragraph to this effect was inserted in the Introduction to the Crag Mollusca Supplement by Mr. Harmer and myself, which is published in the volume of the Palæontographical Society for 1871.

“With reference to the observation that all the great features of the country had come into existence before the Glacial period, I have already explained that several years ago I saw, and stated, that such of those great features as are connected with the curvilinear escarpments were of pre-glacial origin. What I have long contended for against the general opinion of geologists, and still contend for, is that such of these great features as are connected with the rectilinear escarpments and ridges of the south and south-east of England, as *e.g.* those of the Isles of Wight and Purbeck, and of the Portsdown and Hogsback hills, are not of pre-glacial origin; but that they originated at the close of the Glacial period, or rather at what I call earliest post-glacial, *i.e.* at the commencement of the emergence, as explained at page 21 of my paper in the Quarterly Journal, read Nov. 9, 1870.

“It would, I think, save much misapprehension and confusion, both now and in future, if you could manage to have this letter of explanation inserted at the end of your paper (if it is printed), and before the report of the discussion upon it. SEARLES V. WOOD, Jun.

“W. H. PENNING, Esq.”

#### GLACIAL ORIGIN OF LAKE-BASINS.

SIR,—It appears to me that stratigraphical evidence can most successfully dispute the verdict of “not proven” brought by Mr. Judd against Prof. Ramsay’s theory of the glacial origin “of certain lakes.” That subsidences of the crust *can* produce rock-basins is affirmed both by historical and geological evidence; but if the basins chance to lie among strata so regular and well exposed that the fact of subsidence could not have failed to record itself, and if the outcrops on the contrary tell only of erosion, theories of subsidence are fairly out of court; and it remains only to fix on the erosive agent.

The outcrop of the Carboniferous rocks of West Northumberland is so marked and regular, that on the Ordnance one-inch map the shading is disposed in bars alternately dark and light, representing linear escarpments with their interspaces; and among these, which may be said to dip at from  $6^{\circ}$  to  $12^{\circ}$ , and are clearly pre-glacial, lie rock-basins known as the “Northumberland lakes.” Obviously, if these were occasioned by localized subsidence, deviation from the average line of strike must have ensued in the beds, while concentrated erosion would leave an excavated outcrop not attended by any such change. By careful and repeated observations, I find the latter to be the case. Tracing the scarped outcrop towards the water, those on the *dipward* side of the basin are scooped back into a crescentic curve, those more central to it being obliterated altogether. No facts can be more certain than that (1) subsidence would have altered the dip appreciably, and that (2) it has not done so; but by simply projecting