

water-courses, and following in the footsteps of their pre-glacial pioneers.

With these facts before me I see no escape from the inference, that, *in this district at least*, the Glacial Sea, so far from *forming* the "primary" valleys, in which it left the Boulder-clay, had not even the power to *obliterate*, in those valleys, many *minor* features formed by previous subaërial action.

R. H. TIDDEMAN.

GEOLOGICAL SURVEY OF GREAT BRITAIN,
CLITHEROE, December 12th, 1867.

SEA-CLIFFS AND ESCARPMENTS.

SIR,—In combating the notion that escarpments have been originally sea-cliffs, Mr. Whitaker has stated so fully and forcibly the well-known fact that their bases are rarely or never at the same height above the sea-level for any distance, that there would at first sight seem to be little room for anything more on the subject. Mr. Whitaker's observations, however, having been confined to the Tertiary and Secondary rocks of the South-East of England, it may perhaps be well to shew that his remarks apply equally to the escarpments of other districts. I also note that one of your correspondents still holds that depression would convert most of the principal escarpments of the Centre and North of England into sea-cliffs; and another, while he admits that the bases of escarpments are not strictly horizontal, seems to think that their deviations from a level line are either so small, or so very gradual, that they might be converted into sea-cliffs by inequalities of depression by no means beyond the limits of probability. Vague statements, like the latter, are easily made; but, before they can carry any weight with them, they must undergo the test of facts, and figures; and for this end I have drawn up the following table shewing the details of two cases.

ESCARPMENT SURROUNDING THE RIVELIN VALLEY NEAR SHEFFIELD.

NORTH SIDE OF VALLEY.			SOUTH SIDE OF THE VALLEY.		
Height of base above sea-level in feet.	Distance from starting point in miles and chains.	Difference between height of base at each point and mean height of base.	Height of base above sea-level in feet.	Distance from starting point in miles and chains.	Difference between height of base at each point and mean height of base.
1000		+ 300	1000		+ 300
1075	0·40	+ 375	1075	0·42	+ 375
1000	0·60	+ 300	1000	0·76	+ 300
900	1· 0	+ 200	900	1·35	+ 200
800	1·15	+ 100	800	1·72	+ 100
775	2· 0	+ 75	800	3·50	+ 100
700	2·45	} *	700	3·65	} †
600	2·48		600	4· 5	
500	3·40	— 200	500	4·18	— 200
400	3·60	— 300	400	4·25	— 300
325	4· 0	— 375	325	4·36	— 375

Let us now see what will be required to make this line a sea-cliff, or, if it were once a sea-cliff, to convert it into the present escarpment.

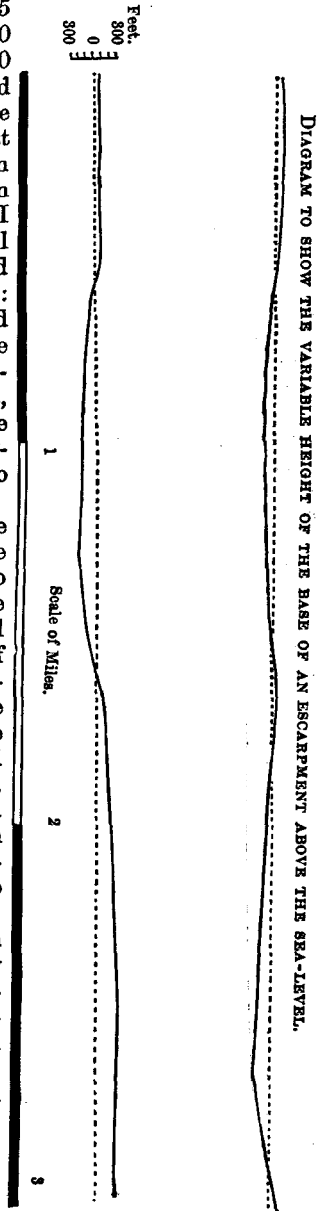
* Fault between these points.

† Between these points the base is up and down between 800 and 850.

The mean height of the base is about 700 feet above the sea, and it will give the minimum of oscillation if we suppose the land lowered to this amount. But even on this supposition we shall require the lowest point to be raised 375 feet, a point only two chains off 300 feet, a point seven chains further on 200 feet, and so on; while at the other end of the line additional depression will be necessary, and the heights of the first three points shew that this depression will not always increase uniformly in the same direction. I may add that I have neglected the gashes cut by small streams in the flank of the slope, and taken only the general line of the cliff: had all the lesser windings been followed the result would have been still more striking. This way of treating the matter is, I think, fairer to my opponents, because, according to their view, these gullies were formed after the termination of the process which gave rise to the escarpment itself.

In order to shew more clearly to the eye the facts I am insisting on I have thrown the details of another case into the form of a diagram given in the woodcut annexed. The dotted horizontal line there represents the average level of the base of the escarpment, and the distance between this dotted line and the hard black line at any point shews the difference in level between the actual base at that point and its mean height, and therefore the amount of additional elevation or depression required to turn the escarpment into a sea-cliff. The horizontal and vertical scales are each two inches to a mile.

The cases just given have been taken at random, and, I believe, represent very fairly the general state of the escarpments of the Carboniferous rocks in Lancashire, Yorkshire, Staffordshire, and Derbyshire; to turn these into sea-cliffs, sea-saw work like that described would be required for every one, alike in character but varying in amount for each; now, independently of the improbability



of Mother Earth ever having been afflicted with St. Vitus' dance to this extent, I do not see how it is possible that such startling inequalities in elevation or depression can have gone on in *solid rocks at the surface* without shattering them to pieces.

Will you also allow me to tell Mr. Mackintosh that I have tried to explain how subaërial agency *may* begin the work of escarpment-making on p. 87, of the Geological Survey Memoir on the country round Stockport, Macclesfield, Congleton, and Leek.—A. H. GREEN.

MONK BRETTON, BARNSELEY,
December 9th, 1867.

REPLY TO MR. W. BOYD DAWKINS, ON THE THAMES VALLEY DEPOSIT'S, &c.; AND TO MR. A. H. GREEN, ON THE OUSE VALLEY AT BUCKINGHAM.

SIR,—Before replying to Mr. Dawkins' criticism, I must acquit myself of any undue use of the letter to me to which he refers. I wrote him in reply to it, pointing out privately what I have now done publicly; and asking him, as I valued his palæontological evidence, to correct what I considered to be a hasty error in his geology. All that I received was a letter, refusing in indignant terms to do this, and challenging me to make out my case. Not the faintest intimation was given me of the mistake in places which Mr. Dawkins now says he made, notwithstanding that I had pointed out to him that Mountnessing and Ingatestone had nothing to do with the valley of the Blackwater, and the position of the Glacial clay near Witham had been shown by me a year previously, in sect. nine of my paper, at page 348 of your third volume.¹ He must have been hurried indeed, if he ran his finger up the Wid to Ingatestone and Mountnessing, instead of up the Blackwater to Witham, when the latter is not only fifteen miles distant from them, but is in another Ordnance Sheet. It was only upon this failure to get corrected, or even qualified, in an unobtrusive way, what I consider to be a fundamental error, that I sent in the note to my paper then awaiting its turn for reading at the Geological Society.

With respect to the brick-earths of Grays and Crayford, I have given so many sections in illustration of their position in the memoir that accompanies my maps in the Geological Society's library, that it would only be unduly occupying your space to endeavour to illustrate the subject here. They must await the investigation of impartial observers, who will study and master, not one, but the whole of the highly complex features of the Eastern Thames valley. All that I would invite Mr. Dawkins, and it seems Professor Morris also, to do, is to show that the gravel of the lower terrace, which, with a thickness of fifteen feet, *passes under the greater part of the Grays brickearth*, be not a part of the same sheet which occupies the valleys of the Darent and Cray, and to which

¹ See Little Braxted, which is in the Blackwater valley, and only one mile from Witham Station. As the Glacial clay comes near to Witham, it may very probably be at Witham station, but if so, is not visible, in the Railway section the only bed seen being the gravel.