

examples; but has it not occurred to the author, that towards the close of the Drift period, most of the principal escarpments of the centre and north of England which run along the strike, must have been sea cliffs when the land was from 200 to 400 feet lower than it is.

(4) "If escarpments have been formed by the sea, there ought to be at their foot some resultant, a beach or other marine deposit; but this is not the case (except where masses of Boulder Drift end near the bottom of a ridge)," etc. To this I reply that these "masses of Boulder Drift" are very often level terraces of marine origin, and to all intents and purposes sea-beaches, or beds; but besides this, there are true sea-beaches at the foot of escarpments, as for example, in the Vale of Gloucester, at the foot of the Cotswold Hills.

I would also remark, that it is surprising to me, how any one who believes in the formation of Professor Ramsay's "Planes of Marine Denudation," can question the power of the sea to produce escarpments, as some escarpments are only the lines along which the sea left off its work in the formation of such planes.

In conclusion, I will only express a very strong conviction that we shall never arrive at true views of the operation of nature in sculpturing the surface of the earth, unless we take into consideration the effects of all possible agencies, and give them their due place in the great work. I remain, yours truly, EDWARD HULL.

3, HAMILTON PARK TERRACE,  
GLASGOW, 18 Nov., 1867.

#### ON CLIFFS AND ESCARPMENTS.

*To the Editor of the GEOLOGICAL MAGAZINE.*

SIR,—I know very little about escarpments in the soft newer formations, but as I have seen a fine cliff cut by the Atlantic in the hard, older rocks that occur in the west of Ireland, and also in the Boulder-drift, perhaps I may be allowed to make a few remarks on Mr. Whitaker's notes on cliffs in his "Comparative table of the distinctive features of Escarpments and Cliffs."<sup>1</sup>

##### "CLIFFS."

(a) "Rarely run along the strike,<sup>2</sup> but at all angles to it, and cut through many formations in succession."

##### REMARKS.

(a) It rarely happens that a sea-cliff can keep to the out-crop of a bed, for it is highly probable that the beds were not raised to their present position horizontally. However, it does occur sometimes, although the beds may not be perfectly horizontal; as, for instance, on the westerly coast of Aranmore, Galway Bay, where a bed of shale for miles forms the base of a perpendicular cliff: also on the coast of Clare, where a thin bed of limestone in the Coal-measure shales acts in a similar way. At the base of a drift-cliff, there is often a bed of stiff clay; just as it will often occur at the base of a drift-cliff formed by a stream.

<sup>1</sup> GEOL. MAG. November, 1867. Vol. IV. p. 491.

<sup>2</sup> Ought not this to be out-crop, or basement?

## "CLIFFS."

(b) "Tops mostly very uneven."

(c) "Rarely through the highest ground of a country, but mostly backed by higher ground."

## "ESCARPMENTS."

(d) "Very rarely have the sea at their foot, but often springs and watercourses."

(e) "Often run in more or less winding lines."

## "CLIFFS."

(f) "Mostly a beach at their foot."

(g) "Bases at the sea-level."

## REMARKS.

(b) In the west of Ireland the tops of the escarpments are also "mostly very uneven," except, perhaps, some of those limestone escarpments in the Barony of Burren, Co. Clare; but these are very similar to the cliffs now being formed by the sea in the limestones along that coast.

(c) If (for argument sake) we allow that *all* cliffs were formed by the sea, it would be nearly impossible that the present sea-cliffs should run through the highest ground of the country. For if the land rose gradually the sea-action would form a slope, a period of rest being necessary for the formation of cliffs; and, therefore, to allow of the cliff being in the highest ground, each succeeding rest must, at least, be of twice the duration of the previous one. However, in spite of these conditions, many of the headlands extending into the Atlantic *slope from the cliff inland*.

(d) Most, if not all, of the drift-sea-cliffs have springs at their base; so have the previously mentioned cliffs in Aranmore and Co. Clare. There are, also, usually springs at the base of a cliff which rise from a horizontal, or nearly horizontal, master-joint.

(e) The sea-cliffs on the west of Ireland are very irregular, never in anything approaching a straight line or a wide curve.

(f) On the west of Ireland there is rarely a beach at the base of a cliff, except, perhaps, when it is of Boulder-drift, and even then not always.

(g) Not always. If there is a horizontal, or nearly horizontal master-joint, either above or below the sea-level, the cliff is nearly sure to spring from it; or it may spring from a soft bed that occurs under similar conditions.

From the above remarks may it not be suggested that sound conclusions cannot be drawn from observations made only among peculiar rocks. If an observer will compare the work done by the two dissimilar forces—marine and subaërial (including ice) denudations—he will be surprised to find the results so very similar in appearance. However, he should always bear in mind that the subaërial agencies may work alone, when the marine agencies must always be helped from above.

Yours, etc.,

G. H. KINAHAN.

CONNEMARA, Nov. 10th, 1867.