

Dumfriesshire, and their contained fossils), who both examined my specimens, and himself collected a number, in a visit which he paid with me to Moffat last summer.

Leaving the subject of the ovarian capsules, Mr. Carruthers appears to think that the *Diplograpsus Whitfieldii* of Hall is identical with the *D. tricornis* described by himself. This, however, is certainly not the case, the two being distinguished, amongst other differences, by the obvious character that the former is provided with but a single mucronate radicle, whilst the latter is furnished with three. I have found *D. Whitfieldii* at Glenkiln Burn, in Dumfriesshire, but I am not aware of its occurrence having been noticed elsewhere.

It seems to me that Mr. Carruthers is likewise wrong in the assertion, that *Diplograpsus pristis*, Hisinger, is provided with spinose or mucronate cellules. I should speak more positively on this point, but I am not able to refer to the original figures by Hisinger, and can only judge from the various figures in Hall, and from McCoy's description. Certainly I have myself never seen a single specimen in which this was the case, and I should be inclined to suggest (not having seen the specimens upon which Mr. Carruthers has founded his statement), that he has probably mistaken for *D. pristis*, specimens of the *Diplograpsus quadri-mucronatus* of Hall. I have found this beautiful species not uncommonly in the Moffat shales, and when compressed in certain directions, it presents but a single row of spines, thus coming closely to resemble the ordinary form of *D. pristis*, and differing chiefly in the mucronate cellules.

I am, Sir, Yours, etc.,

HENRY ALLEYNE NICHOLSON.

EDINBURGH, February 6th, 1867.

MR. MAW, PROFESSOR JUKES, AND OTHERS ON DENUDATION.

To the Editor of the GEOLOGICAL MAGAZINE.

DEAR SIR,—Since the appearance of my articles on the origin of Escarpments and Valleys (GEOL. MAG. April and July 1865; Feb. and Sept. 1866), you have given insertion to an array of contributions more or less in favour of subaërial denudation. As I find a full reply would not come within any reasonable compass, in your Magazine, and as several observations have been made which render silence on my part no longer desirable, would you kindly find room for a few brief remarks.

Planes of Marine Denudation.—As on this point I have been misunderstood, permit me to remark that in asserting that the sea is not a levelling agent, I, of course, meant that the sea only planes down its bed to an extent proportionate to the amount of flat surface presented by the land at any given time. This planing down process is far from universal. It is nearly absent in Archipelagos, and on continuous coast-lines it requires a very slow, uniform, and unintermittent rise or fall of the land. Table-lands, with surrounding *declivities* or escarpments, are planes of marine denudation, and so are plains surrounded by *acclivities* or escarpments, unless a mere

difference of level can give a claim to a different origin. Mr. Wynne (*GEOL. MAG.* Jan. 1867, p. 10), admits the marine denudation of plains. Mr. Maw goes much further, and agrees with me in attributing all straight and level surfaces, including terraces with adjacent cliffs or escarpments, to the planing action of the sea. I venture to proceed a step still further, and ask why should an extensive level surface be called a plane of marine denudation, while a flat-bottomed vale (not the effect of deposition) is excluded from the designation? Mr. Maw, in admitting that all, or even the majority, of hollows, with terraced cliffs or uniformly scarped sides, have been *modified* by the sea, concedes, as could easily be shown by sections, that the sea, in many cases, has had a considerable, if not the greatest, share in the process of denudation. The extreme sub-aërialists, who attribute all inland *strike-following* cliffs¹ and escarpments to the atmosphere, are consistent in referring the formation of planes to the same agency.

Transverse Gorges and Longitudinal Valleys.—Professor Jukes, in a truly philosophical spirit, sets limits to his theory by admitting that *undulating surfaces* (*GEOL. MAG.*, May 1866, p. 234), *sea-ward or outside hill-slopes* (*Exp. to Irish G. S. Maps*, sheets 124 and 125, p. 6), and *gaps or passes upon the crests of ranges of hills*² (*Quart. Journ. Geol. Soc.*, June 1862, p. 391), are the result of marine denudation. I have lately been led to agree with this distinguished geologist, in attributing long and narrow river-valleys on the sides of table-lands and mountain ridges, to fluvial erosion. I likewise think it probable that the transverse gorges, which connect longitudinal valleys, may have been partly excavated by streams flowing down *once* continuous slopes, though the abruptly commencing and fresh-looking sides of these gorges would seem to point to a farther and more recent excavation by marine currents. These longitudinal valleys and basins, which are not open plains, and which often occur in what must once have been land-locked situations, appear the more mysterious the more frequently they are contemplated. Their outlines are generally so smooth, and horizontally continuous, and their recesses so curvilinear, as to preclude the idea of any process of rutting down by pluvial runlets which must have conformed to the slightest local variation in the denudability of rocks, while in many instances they appear to have been swept so clear of all detrital traces of the excavating agent,³ as to forbid our referring them to rain and frost, which must have left numerous indications of their slow, intermittent, and irregular mode of action. It must have been a wholesale denudation, and not a denudation by instal-

¹ Mr. Topley (*GEOL. MAG.*, Oct. 1866), makes some statements in reference to the escarpments and sea-cliffs of E. Yorkshire, which, if necessary to the support of the sub-aërial theory, show that this theory is not applicable to many parts of the S.W. of England and other districts, where the sea, in making cliffs shows a tendency to follow the strike, and where many inland cliffs run obliquely to the strike. Numerous instances might be brought forward did space permit.

² Professor Jukes clearly includes *ravines and narrow winding valleys* crossing watersheds.

³ This was long ago shown by Sir R. I. Murchison.

ments. Large bodies of water in the shape of marine currents, or "waves of translation," caused by sudden elevations,¹ ought not, I think, to be rejected as a cause, until their inadequacy has been clearly shown.² Should the theory of great bodies of water be ultimately found untenable, then equally great bodies of moving ice would, I think, furnish a more satisfactory explanation than rain.

Water-worn cliffs, pillars, and rock-surfaces.—Since I first directed attention to traces of sea-action on certain inland rocks, several geologists have shown an increasing disposition to limit their confidence in atmospheric denudation. Admitting that rain acts powerfully on arable fields, roads, exposed beds of sand and gravel, and soft rocks, I asserted that pure rain-water has little or no influence on hard rocks (in this, I now find, I was forestalled by Colonel Greenwood); that the preservation of glacially smoothed and striated surfaces demonstrates the inadequacy of mere rain to denude hard rocks: that if ice-marks have endured, it is reasonable to look for marks left by the sea; that they may be found on inland cliffs, and rock-pillars, which present smoothed³ and rounded forms, or which have been left with angular projections, where the adjacent blocks (of equal hardness) have been displaced or removed;⁴ that the summits, ridges, and sides of many hills, present marks which are facsimiles of those now in course of being formed by the sea; that these marks may be distinguished from the effects of glaciation, by their consisting of a succession of small hollows, ridges, round, oval, or elongated pot-holes, or short grooves, indicating the gyratory or *to-and-fro* action of stones in water. I have found these phenomena not only on Mynydd Gader, at a lower level than the glaciated surfaces lately discovered by Mr. Wallace (Quart. Jour. of Sc., Jan., 1867), and on elevated natural pavements of limestone near Minera, but on the Mendip Hills, where the smooth and almost polished pot-holes are very numerous and striking. Mr. Plant (GEOL. MAG., Feb., 1867, p. 81) has lately discovered an old sea beach on the lime-

¹ Such as must have resulted from these *sudden* upstarts of the sea-bottom, which are indicated by the *transverse horizontality* of many systems of terraces now at considerable altitudes above the level of the sea. (See account of Raised Beaches near Llangollen, in GEOL. MAG., Sept. 1866, Fig. 13, in the plate, which furnishes a very inadequate representation.)

² It is remarkable that such submarine troughs as Captain Beechey's "Ditch in the North Channel" should not have been more particularly examined with reference to denudation.

³ In GEOL. MAG., Nov. 1866, p. 518, Dr. Lindström thinks I have mistaken glacial grooves for wave-marks. An inspection of the locality would, I think, convince any unbiased geologist that they occur in situations, and are associated with phenomena, such as shallow pits and caves, which furnish a strong presumption against a glacial origin.

⁴ Mr. Wynne, in asserting that it is impossible to distinguish between rock-pillars formed by the atmosphere, and those formed by the sea, unintentionally ignores the validity of that dualogical reasoning on which geology is founded. Even dynamically considered, there can be no doubt that the effects of a slow vertical agency can be easily distinguished from phenomena produced by the lateral undermining, and *to-and-fro* action of the sea. Mr. Kinahan, in answer to Mr. Wynne, has brought forward a convincing illustration of the marine origin of rock-pillars (GEOL. MAG., Feb., 1867, p. 89).

stone moors, near Buxton, with similarly-worn rock-surfaces, and with the addition of loose shingle, and a covering of clay, *not* derived from the limestone rock, which rock, he tell us, has suffered *no* decomposition since the sea left the locality. Since I first wrote on this subject Mr. Pengelly has announced his discovery of *Pholas*-borings in limestone cliffs, at considerable altitudes above the present sea-level, and others have brought forward facts, which not only show the absence, or limited extent, of subaërial disintegration, but prove that the sea was, at least, the last denuding agent to which the surface of the land has been subjected, ice at high altitudes excepted.

D. MACKINTOSH.

DENUDATION OF VALLEYS.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR.—Every one who lives amongst the hills, as I do, on the Cotswolds, who has his eyes open, must discover parallel cases to those described by Mr. Hull, in your October number; *i.e.*, valleys commencing on high ground and descending to the sea, some having rivers, others being dry. Being only a field-geologist I have no theory to support, but study facts, and have my opinion, which I am ever ready to alter when truth requires it.

The valleys in the Cotswold Hills that I am acquainted with are depressions in the Oolitic beds, they have a basement of clean Oolitic gravel, with the edges taken off, but not formed into pebbles, proving that it has never been subjected to coast or tidal action, or long continued attrition. Some of these valleys begin at the crest of the Oolitic range, now elevated one thousand feet above the sea, and gradually descend the south-east slope of the Cotswolds until they reach the summit level of the Thames, four hundred feet above the sea; others are more local, descending from ground, five to six hundred feet above the sea.

It is clear that the dry valleys cannot owe their origin to river-action; and the river-valleys are only channels, which receive the springs of the Fullers-earth or local clay beds. The action of these rivers is never a denuding one, even when in flood, little solid matter being carried off. It is, therefore, impossible to conceive that these extensive valleys are the result of river-action. We know that the Oolitic matter once formed a sea bottom, nearly, or quite level, and that it is now elevated one thousand feet above the sea-level. It may be assumed to have been lifted up one thousand five hundred feet, and it is impossible for this to have taken place without cracks in the surface, and being unequally elevated, and tilted to the south-east during its elevation, sea currents must have run in these cracks, and here we have an enormous power at work, quite sufficient for the denudation that has taken place; and action of this kind and degree will account for the cleanness of the gravel bottoms of these valleys.

In the great estuary of the Thames, all these Cotswold valleys, wet