sections exposed on the south flank of the Himalayas, and suggests a parallelism between them and those exhibited in the Alps. The clays, sands, and conglomerates of the Sivaliks are very like those of the Molasse; and in both regions the coarser deposits prevail towards the top. In the Himalayas also the younger Tertiary deposits almost invariably dip towards the mountain-range which they fringe,—the plane of contact inclining in the same direction, and thus producing actual, though not parallel, superposition of the older rocks. All the arguments which have been used to prove prodigious faulting in the case of the Alps would therefore, the author states, be quite as applicable to that of the Himalayas. But, as regards the latter range, Mr. Medlicott brings forward evidence which appears to him sufficient to prove that the present contact of the Sivalik formation with the mountains is the original one, modified only by pressure, without relative vertical displacement; and that the *sinking* of the mountain-mass is the proximate cause of the contortions of the Tertiary strata. He then endeavours to show that this explanation is equally applicable to the Alps, especially as it seems also to account for collateral phenomena which appear difficult of explanation consistently with the ordinary hypothesis; and he concludes by discussing the current theories of the formation of lake-basins, in relation to the more immediate subject of his paper.

2. *On some STRIKING INSTANCES of the TERMINAL CURVATURE of SLATY LAMINÆ in WEST SOMERSET.* By D. MACKINTOSH, Esq., F.G.S.

CONTENTS.

1. Introduction.	4. Transportation of Blocks.
2. Sections in a Quarry near Wiveliscombe.	5. Apparent Reversal of Dip near Gupworthy.
3. Terminal Curvature of Laminæ near Raleigh's Cross.	6. Concluding Remarks.

1. *Introduction.*—During the last two years I have been making a series of observations in the West of England and in Wales, with the hope of being able to throw some fresh light on the relative nature and extent of oceanic and atmospheric denudation, and on the origin of superficial accumulations. In some parts of Siluria, during the spring of last year, I supposed I had met with a proof of tranquil marine deposition in horizontally arranged chips of slate resting on the edges of highly inclined laminæ, until I found that I had been looking on a continuation of these edges in a curved-back position, instead of seeing the curvature in profile.

In the autumn of 1866 I noticed several instances of the above phenomenon, which have not yet been described by geologists*. On the *nearly level* floor of one of the valleys which indent the southern slope of the eastern part of the Quantock range of hills, I found the

* For an instance near Ashburton, noticed by Mr. Godwin-Austen, see Trans. Geol. Soc. 2nd series, part ii. vol. vi. p. 437.

laminæ of the Devonian (Carboniferous?) slate very regularly and distinctly bent or curved backwards, or towards the south. The idea of a more powerful agency than rain or frost then seemed to suggest itself; but it was not until I had examined more extensive sections further to the west, on the east Exmoor hills, that I became convinced of the necessity of having recourse to a more uniformly efficient cause than even the most exaggerated form of what is commonly called atmospheric action. The object of this paper, however, is not so much to theorize on the precise nature of this cause, as to state several important facts.

2. *Sections in a Quarry near Wiveliscombe.*—In a quarry about a mile and a half from Wiveliscombe several very instructive sections of the terminal curving-back of laminæ are exposed. The slates (which have a southerly dip) appear to be very flexible; and this may be partly the reason why they have been so little broken. But the wonderful continuity of the curvature here exhibited must, I think, be partly due to an extreme uniformity in the movement. The bed of curved slates (represented in the figure), on the western

Sections of curved laminæ near Wiveliscombe.

A. The profile of the laminæ.

B. Their face.

side of the entrance to the quarry, is from three to four feet thick. The line of demarcation between the commencement of the curving back and the undisturbed mass of slates below is remarkably distinct and straight on looking along the strike of the cleavage; but on looking at nearly right angles to the strike, the surface formed by the edges of the laminæ beneath, though equally distinctly marked, is very uneven, as if the once superincumbent moving agent had exerted considerable inequality of pressure, so as to give rise to irregular grooves and ridges. The upper surface of the bed of curved laminæ, which is very uniform, is overlain by a layer, nearly two feet thick, of reddish loam, containing fragments of quartz &c. On the opposite side of the entrance to the quarry the curving back for some distance is on a nearly level plane. Here the bed of displaced laminæ is from two to three feet thick. It exhibits a double curvature, approaching the shape of the letter S. Over it there is a layer of about two feet of loam, with many quartz fragments, chiefly angular, but occasionally a little rounded.

3. *Terminal Curvature of Laminæ near Raleigh's Cross.*—There are several facts connected with the foregoing sections which obviously point to a powerful and uniformly operating cause; but the belief in such a cause becomes irresistible as one surveys the nume-

rous sections exposed in the mineral-railway-cuttings near Raleigh's Cross, on the summit of Brendon Hill. Here the bending and curving back of the slates is seen to prevail over a large area, with a uniform direction nearly S.S.E.* The laminæ in many places are much broken, and shattered to a considerable depth; but still the line of separation between the bent masses and the slates *in situ* can generally be traced. The most important fact in connexion with these sections is this:—*the bending and curving-back over extensive areas has taken place on perfectly level ground, with a depression instead of an elevation on the side whence the movement must have come.* There are, indeed, instances in which the curving-back has been forced up a slight acclivity. I could find no indications on the northern slope of Brendon Hill† of the movement under notice; and should this prove true with regard to all the northern slopes of the Great Exmoor tableland, it will clearly point to a wide-spread agency operating in a southerly direction, and affecting only the summit-levels or southern declivities. At the same time the possible discovery of local variations, or even reversions, in the direction of curvature, would prove nothing further than a deflection of the course of the moving agent.

4. *Transportation of Blocks.*—The cause of the displacement of slaty laminæ on Brendon Hill (or a subsequently operating cause) must have been capable of driving forward or carrying large blocks of quartz to considerable distances from their native veins‡. Many of these were pointed out to me in the cuttings by Mr. Morgan Morgans (Captain of the mines), not only near the surface but imbedded at depths of from three to five feet, in the more shattered parts of the curved-back laminæ. Overlying and intermixed with the slaty débris and transported fragments, there is a considerable thickness of reddish loam §.

5. *Apparent Reversal of Dip near Gupworthy.*—In the neighbourhood of Gupworthy, about three miles from Raleigh's Cross, a horizontal adit was excavated some years ago, in search of copper. It passes through a rich iron- "lode," which at the time was apparently overlooked. This tunnel reveals a section of the uniform curving-back of laminæ on a very gigantic scale, the vertical extent of curvature amounting to at least twenty feet. The direction of the curvature, as elsewhere in this locality, is about south-south-east.

* During these visits I had not the means of very accurately determining the dip of the slaty cleavage or the *precise* direction of curving-back of the laminæ in different sections.

† On the sides of the very steep railway-incline to the north of Raleigh's Cross, the edges of the slates in many places come within a few inches of the surface, and exhibit no sign of disintegration.

‡ These veins run along one side of the "lodes" of iron-ore, and often present a considerable thickness.

§ That the descent of matter by atmospheric action could never have given rise to a great part of the angular detritus, with its loamy matrix, which forms so general a covering of the earth's surface, was long ago clearly shown by Sir Roderick I. Murchison. See chapter on Drift in 'Silurian System,' and more especially a paper on the "Flint Drift" of the South-east of England, Quart. Journ. Geol. Soc. vol. vii. p. 349.

Any one not prepared to find a curving-back on such a scale, might easily mistake the superficial dip for the real dip. I confess I was at first disposed to look on the dip as the result of a fault in the adjacent valley, or as a part of a denuded or truncated anticlinal fold; but further inspection convinced me that it was only an exaggerated continuation of the general curving-back above described; and this conclusion was corroborated by Mr. Morgans, who is familiar, from daily experience, with the internal structure of the district.

6. *Concluding Remarks.*—I think all will admit that the sections to which attention has been directed present indications of a cause to which the term “stupendous” may be justly applied. Was it a southerly progression of a crust of land-ice filling up the basin of the Bristol Channel, and levelling the area between the Black Mountains of Wales and the Exmoor tableland? Was it a grounded iceberg? or floating ice in any other form*? Was it a swift oceanic current exerting a pressure on the underlying slates by means of a forcible drifting forward of detritus? Or was it a still more violent rush of waters caused by a sudden upheaval or depression of the land†?

POSTSCRIPT.—Since writing the above, I have seen other instances of the curving-back of slaty laminae. Within half a mile of Union Street, Plymouth, in a cutting of the Exeter and South Devon Railway, the edges of the slates are slightly but uniformly curved on nearly level ground, in a southerly direction, or in the direction of the cleavage-dip. On the left-hand side of the road leading from Torquay to Bishopstowe and St. Mary's Church, and at no great distance from the Torquay Post Office, an artificial excavation (April 15th, 1867) reveals an instance of terminal curvature on a rather extensive scale; and here, as in West Somerset, the line of demarcation between the undisturbed slate and the regular bed of curved laminae is very distinctly marked. The direction, as in all the other instances, is southerly, or nearly so, and the ground in that direction is only very slightly inclined. I believe that in most parts of Devon, West Somerset, and Cornwall, if not in other districts, where the slates are *flexible*, and where the cleavage-laminae dip at a considerable angle to the south, or where they are vertical with an approximately east and west strike, similar appearances might be discovered, irrespective of the outline or inclination of the ground. It is not difficult to conceive how the uniform curving-back would only occur where the laminae leaned towards the moving agent (or at least did not lean away from it), so as to offer a certain degree of resistance to its action. In other places the planing-off of the edges

* See a notice of supposed ice-marks on the Mendip Hills by the author, in the ‘Geological Magazine,’ vol. iii. p. 574.

† The Rev. Maxwell H. Close, in a very elaborate paper on the “Glaciation of Ireland,” read before the Royal Geological Society of Ireland, March 14, 1866, and just published, has expressed his belief that the “broken and bent over” edges of mica slate, in a quarry near Innishowen, cannot be explained by the “weight of the hill,” but are the result of a flow of land-ice. (See Journ. Roy. Geol. Soc. Ireland, vol. i. part 3, p. 207.)

of the laminae would either leave them cleanly cut, or very irregularly shattered. The edges of the strata of the limestone hills of South-east Devon, where they have not been left as cliffs or rocky projections, have either been planed down to a level surface, or smoothly rounded off, the solid rock being often covered with only two or three inches of loam or vegetable soil (excepting in fissures, grooves, recesses, or valleys), as may be seen in the quarries near Torquay, and on the line of railway between Newton and Totnes.

Whatever theory of denudation one may previously have entertained, on coming to contemplate such phenomena it is sometimes difficult to resist the impression that a great weight of *solid* matter, powerfully propelled in a southerly direction, must have curved back the slaty laminae, and, with an almost geometrical exactness, rounded the forms of the limestone and other eminences of the South-west of England. But so far as South-east Devon is concerned, the mode of occurrence of perfectly preserved *lithodomous perforations* up to at least 240 feet above mean tide, as discovered by Mr. Pengelly, and lately examined by myself, clearly shows that the sea has been the last modifying agent to which the land has been subjected *.

JUNE 19, 1867.

William T. Lewis, Esq., Aberdare, South Wales, was elected a Fellow.

The following communications were read :—

1. On CYCLOPHYLLUM, a new genus of the CYATHOPHYLLIDÆ, with remarks on the genus AULOPHYLLUM. By P. MARTIN DUNCAN, M.B. Lond., Sec.G.S., and JAMES THOMSON, Esq., V.-P. Geol. Soc., Glasgow.

[PLATE XIII.]

CONTENTS.

1. Introduction.
2. Description of the genus *Cyclophyllum* and its species.
3. Description of the species of *Aulophyllum*.
4. The geological position of the Corals.

1. *Introduction*.—A very fine series of specimens of the Palæozoic corals usually classified under the genus *Aulophyllum* †, Milne-Edwards and Jules Haime, has been submitted by us to careful examination. Numerous sections of the specimens have been made, and especial attention has been given to the anatomy of weathered fossils of the genus. Our examination has resulted in the determination that the corals called *Aulophyllum fungites* ‡ and *Aulophyllum Bowerbanki* cannot remain in the genus *Aulophyllum* as established and defined by Milne-Edwards and Jules Haime. Numerous specimens were examined which had their calices perfect; and these gave evidences of a columella, whose structure was revealed both by transverse and longitudinal sections. One form, however, had no columella; and

* See a paper by the author in Geol. Mag. vol. iv. p. 296 (1867).

† Brit. Foss. Corals, Introd. p. lxx (1850).

‡ Hist. Nat. des Corall. vol. iii. p. 406.