

ation of roots of trees with the waters of a streamlet, in undermining and removing the banks. If you examine almost any one of the little tumbling rills among the mountains of the Upper Carboniferous formation, you will find it buried in trees. The fibres of the roots insert themselves in the smallest crack, and push themselves between the layers of rocks; and by degrees they thicken and grow strong, and lift huge masses of stone, with a seemingly irresistible force, loosening the earth at the same time above and below and around. The action of the rain easily washes away the earth, the little tree becomes a great tree, and, either because it is undermined beneath, or because the weight above becomes too much for its hold, it is sure to come down with a crash into the brook, carrying with it a large portion of the bank in its fall. The next flood removes all trace of the ruin. The sand and soil and the small stones are swept away, while the larger stones keep their places peaceably in the channel where they fell, to make fantastic waterfalls and still hollows for the minnows.

Yours, etc.,

T. ASHE.

LEAMINGTON COLLEGE, May 7th, 1866.

DENUDATION.—REPLY TO MR. G. POULETT SCROPE AND
MR. J. B. JUKES.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—The appearance in your Magazine of two communications on Denudation renders it necessary that I should again trouble you with a few remarks before the completion of the series of observations on which I am now engaged.

Not having visited the localities described in your last number by the eminent author, Mr. G. Poulett Scrope, I can offer no opinion relative to the conclusions at which he has arrived. I should not think of underrating the power of temporary as well as permanent torrents, to excavate channels in the gravels of the Tyrol, Cumberland, Wales, or any country subject to waterspouts and heavy falls of rain; and I could agree with all that Mr. Scrope has advanced concerning the denudation of Auvergne, without requiring to recant any opinions I have advocated. The facts on which Mr. Scrope's reasonings are based, namely, the resistance offered to the atmosphere by the *basaltic cappings* of the mountains of Auvergne during an immense period of time which can scarcely be exaggerated, furnishes, perhaps, *the most convincing proof which can possibly be adduced, of the impotence of rain as a denuding agent on hard rocks*,¹ and ought to prepare our minds for believing that many of the inland sea-cliffs and rocks of England and Wales have retained their wave-worn shapes since the Glacial submergence, if not since a much more

¹ The phrase "impotence of rain," I have applied only to the action of mere rain on compact rocks and grass-covered land, and not to torrents, charged with solid abrading matter, and acting on exposed gravel, loose stones, or soft materials. When using the phrase, I was not alluding to volcanic or alpine districts where conditions are, or have been, *exceptionally favourable* to atmospheric denudation.

ancient occupation of the land by the sea. The same fact furnishes a presumption, in the absence of very strong evidence to the contrary, that those hollows and portions of valleys in Wales and the Lake district, which have been scooped out in rocks as hard, if not harder than the basalt of Auvergne, have not been excavated by any process of atmospheric denudation which is not admitted to involve such an enormous lapse of time as to allow the sea to outstrip it in its march, and take the work out of its hands. The sea has, comparatively, little difficulty with hard rocks. It insinuates itself into joints and crevices, undermines, detaches, and carries away the largest blocks in a wholesale fashion; whilst atmospheric agents, unless very powerfully assisted by gravitation, have to grind down, or break up, before they can effect that *transportation* which constitutes the main part of denudation. I have only farther, in reply to Mr. G. Poulett Scrope, to state that I have not denied the power of rivers to form cliffs, but asserted that there are many inland cliffs which the sea only could have formed.

The letter of Mr. J. B. Jukes displays the modesty of a true philosopher, animated solely by a desire to arrive at truth. Though, apparently, widely differing, I think we are more or less agreed on the following great fundamental points:—First, that in certain areas the sea forms plains and table-lands; that there cannot be plains without surrounding escarpments or acclivities, or table-lands without declivities or cliffs, in both cases more or less indented, and here and there shaped into bays and combes. Second, that in other areas the sea produces smoothly-swelling elevations and depressions, now and then varied by projecting rocks, or rocky knolls. Third, that if certain lands continue a long time above the sea, their coasts must be long exposed to the action of waves, tides, and currents, and that in this way great inequalities must be produced. Fourth, that in partially-submerged areas, sounds or straits must be excavated by tides and currents; and that these, on their being elevated, must become mountain gaps or passes (see Mr. Jukes's own admission in *Quart. Journ. Geol. Soc.*, vol. xviii., page 391). I cannot therefore understand why Mr. Jukes should not admit that many escarpments and upland rocky cliffs (which are not the immediate sides of river-valleys); all our smooth curvilinear combes (which rain-torrents only tend to furrow, disfigure, and destroy); and many of our mountain passes, are not the result of marine denudation. Since I commenced making systematic observations in Central Wales, I have gradually been convinced of the necessity for allowing that ravines on the sides of table-lands have been mainly excavated by streams but these ravines are generally of the V form. A continuation of the process would, undoubtedly, wear down very deep valleys; but that wide and flat-bottomed valleys, and connecting gorges or passes, have been excavated by rivers, appears to be contradicted by the fact that, in those I have examined, there is an absence of true river shingle at any great height above the present river level. In many parts of the upper valley of the Wye, especially between Builth and Rhayader, I have found river-shingle running up to heights, varying from a few feet

to 150 feet above the river, and either gradually or suddenly succeeded by the angular drift of the neighbouring mountains, and that with little or no change in the inclination of the acclivity.

Mr. Jukes, in attacking the great seeming objection to the fluvial origin of valleys, namely, the necessity for believing that a river must have wandered over, and excavated a large plain during the time that its action, in a contiguous area, was limited to the wearing down of a narrow gorge, endeavours to explain the disparity by reference to the more easily eroded rocks composing the area of the plain. In Ireland he believes that the Carboniferous limestone was the easily denuded rock, and the Old Red Sandstone, or some other silicious formation, the comparatively resisting rock. But, I think, in many districts, this explanation would not hold good. In the case of the plain of Herefordshire, and the narrow gorge of the Wye between Ross and Chepstow, it would require to be reversed; for there the plain is Old Red Sandstone, and the sides of the gorge Carboniferous limestone. Farther up the Wye, I do not think Mr. Jukes' explanation would apply; though on this point I would wish to speak with deference, and with the greatest willingness to be corrected.

The gorges or passes connecting the vales of Central Wales look as if they were more *recently* excavated than the vales themselves. They cut abruptly, and without any warning, through the ridges by which the vales are separated. Their commencement is as sharply defined as if they had been sliced out of the ridges, and I cannot help thinking that they have been widened, and their sides rendered more precipitous, by the action of the sea during the glacial period of submergence. At the same time, probably, the cliffs of Abereddw (which, in many respects, are perfect fac-similes of cliffs now washed by the sea on the Cardiganshire coast), were formed and upheaved in succession. It is quite true that all this implies the previous existence of the valleys on a smaller scale; but on this subject I cannot enter farther at present. Its elucidation would require a re-examination of the nature and distribution of the various kinds of drift by which a great part of Central Wales is covered from the mountain top to the lowest depression.¹—I am, Sir, yours truly,

D. MACKINTOSH.

DOLGELLY, 9th May, 1866.

*LEPIDOSTROBUS BROWNII.*²

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In the interesting paper by Mr. Carruthers, which appeared in the October number of your Magazine, I was glad to see that he distinguished the beautiful specimen of Dr. Robert Brown (who had shown it to me during his lifetime,) from the *Lepidostrobus* described

¹ There are several very important points in Mr. Jukes' letter, the consideration of which I must reserve for a future, and more systematic communication.

² See *ante*, p. 271. Report of the Manchester Geological Society.—This letter was accidentally omitted from our last number.—EDIT.