rhyolite, with banded structure, comparable in type to the "mill-stone-porphyry" of Hlinik in Hungary, but of somewhat coarser character. At the west end, on the airy summit of the moor, rhyolite of the Tardree type crops out; and in between, near a hollow of the road, its glassy representatives abound. The banded and fluidal pitchstones of Skleno are here beautifully repeated; and dull-brown spherulitic aggregations also occur, their cracks and hollows being filled, as in Hungary, with chalcedony and common opal.¹ No continuous mass of glass is visible, and in one pit the obsidian boulders resemble blocks that became included in a more crystalline flow, the latter having now decomposed to form a sand. A resisting layer of pale pink rhyolite occurs a few yards farther north, and no doubt extends down into the hill; and above it, and in contact with it, is an agglomerate of glassy and dark hemi-crystalline fragments of rhyolite, embedded in a firm yellowish ground. This can hardly be anything but a true tuff; and many of the sands containing obsidian boulders in this district may have been formed by the breaking up of similar layers. The exposure is a small one, and this interesting relic may disappear under a few weeks' quarrying. It became revealed, however, between two successive visits made in 1894 and 1895; and at any time further evidence of explosive action may be met with in the surface-diggings of Sandy Braes.

Nothing short of deeper trenches or more serious quarrying can show us the real wealth of the material on the heights north of Tardree Mountain; but I trust I have said enough to sustain my main contention. I regard the Tardree dome as the neck formed by the upwelling of a viscid rhyolite, which occasionally flowed out over the Chalk, and perhaps over some of the earlier basalts, round about it. A considerable volcano was in time built up, its flanks formed of true lava-flows and even of tuffs; glassy crusts were developed freely by the rapid cooling of these flows, and various types of obsidian were spread out over some four square miles. The lava-flows have been much reduced by denudation, and are now obviously crumbling away on the high moor of Sandy Braes; but both here and under the later basalt of Carneary we have evidence of the former complexity and variety of the rhyolitic volcano of Tardree.

V.—PRELIMINARY NOTES ON THE LATE CONNECTION AND SEPARATION OF THE PACIFIC OCEAN AND GULF OF MEXICO.

By Prof. J. W. SPENCER, M.A., Ph.D., B.A.Sc., F.G.S.

HAVING recently returned from another season's work in the West Indies and Mexico, where I was collecting additional data bearing upon the stupendous changes of level of land and sea which have lately affected the American continent, I find the review of the "Reconstruction of the Antillean Continent" by Mr. Jukes-Browne in the *GEOLOGICAL MAGAZINE*, April 1895, p. 173, a few points of which may be further explained at the same time

¹ Compare Berger, *op. cit.*, p. 190.

that I furnish some advance notes concerning recently observed phenomena which greatly strengthen the theory of stupendous changes of level in the Pleistocene period. Many months must elapse before I shall be able to complete the studies for publication, so that my papers on Cuba, Jamaica, and Mexico shall be published.

It may be said that the date of the recent continental elevations are based on the extent of the erosion of the Miocene and later deposits. In the south-eastern states but little of the Upper Miocene (American equivalent) has been preserved from erosion. In Cuba and Jamaica the Miocene limestones have suffered enormous degradation, so that probably only the lower strata remain, yet these are of immense thickness, although they are often completely incised by great valleys. The same phenomena hold good for regions south of the Mexican Gulf. The determination of the ages of the beds is based upon palæontological as well as stratigraphical and lithological evidence. The lists of fossils will be submitted in forthcoming papers. In the southern states these deposits are not disturbed to any great extent, but beyond they are everywhere upturned and often occur at high angles. Overlying and occupying portions of the great valleys, there are the widespread loams and gravels of the Lafayette formation of the southern states, which extend also over the coastal plains of Mexico. On the islands, apparently, the same formation occurs, but in part represented by marls, with some included gravel (the Matanzas formation), and these contain fossils of mostly modern species. With the oscillations of land and sea, the perfect synchronism between the eastern and western beds is not claimed, but only the general equivalency, as the continental movements passed from east to west and back again. These Lafayette and Matanzas beds have a remarkably wide distribution, and present a wonderful degree of uniformity, so that the geology of the vast region is greatly simplified. These formations have been provisionally regarded as belonging to about the close of the Pliocene period, and whether a little earlier or a little later is of no material difference. It is the sequence of events which forms the importance of the study, for the palæontological boundaries are somewhat ill defined at present. The surfaces of these Lafayette and Matanzas accumulations have been greatly denuded, so that in many places they are found only in fragments, which have nevertheless been most important in the investigations concerning the "Reconstruction of the Antillean Continent." In these valleys, again, we find later mid-Pleistocene formations which have been traced to the regions of northern drift accumulations. The great continental elevation reached its culmination in the post-Lafayette or early Pleistocene epoch, so far as the eastern part of America is concerned. But at that time I have recently found upon the Tehuantepec isthmus, where the drainage of the eastern plateau was hypothesized to have passed to the Pacific Ocean, that the country was so low as not to permit the formation of deep valleys such as were being formed to the east, and are now drowned beneath the sea or buried along the Atlantic or Gulf coast.

The edges of the Mexican table-lands (a term more correct than elevated valleys) show the counterparts of the submerged valleys to the east—an analogy not found in the valleys of the eastern part of the continent—for the now unsubmerged portions of the continent were too far from their margins to have been incised by the growing *cañons* of the period of great elevation. Yet these Mexican examples represent a shorter duration of time than the drowned Antillean valleys.

In Mexico youthful terraces occur to an elevation of 6,500 feet above the sea, and base planes of erosion upon the margins of the Mesas to an elevation of 8,000 feet. With this enormous elevation the terrace materials in the older valleys have not been removed by denudation except in part, and the youthful *cañons* have not yet reached far into the plains. Thus it appears that Mexico has risen to this great altitude in very recent times, and, when we correlate the geological foundations, it would appear that Mexico and Central America have risen to almost as great an elevation as the late altitude of the Antilles and eastern part of America, while the floor of the Mexican Gulf has been sinking.

Across the floor of the divide between the Atlantic and the Pacific, in the Isthmus of Tehuantepec, there were recent shallow straits, succeeded by natural canals covered with level gravel floors continuous with the terraces on the Atlantic side. The importance lies in the admittance to the Gulf of the sparsely-distributed Pacific littoral types of molluscs. But the gravel floors of the channels over the divides form a most important analogy. Such floors over the watersheds of the Great Lakes of North America have been regarded by some glacialists as evidence *per se* of glacial dams confining the waters of the lake basins at high altitudes. Against this view there are many considerations, but now that the same phenomenon is found within a few degrees of the Equator, and at low elevations, the value of this test for glacial dams disappears.

While no phenomena observed in the Antillean region have weakened the hypothesis of the great changes of land and sea in recent times, yet there is much detailed evidence supporting the theories set forth in the "Reconstruction of the Antillean Continent," of which the points mentioned have a most important bearing, as filling important gaps in the chain of evidence, concerning which we had not the direct observations before the present time.

VI.—SECOND NOTE ON THE EXPANSION THEORY OF MOUNTAIN EVOLUTION.

By CHARLES DAVISON, M.A., F.G.S.,
Mathematical Master at King Edward's High School, Birmingham.

IN a note published four years ago,¹ I pointed out a fundamental objection to the principle of the expansion theory. That objection has been clearly expressed as follows by Prof. Leconte,² who, like myself, considers it fatal to the theory: "Sedimentation

¹ GEOL. MAG., Vol. VIII, 1891, p. 210.

² Journ. of Geol., vol. i, 1893, pp. 570-571.