

At about the same level as these caverns, but nearer to the town of Llandudno, we find several large masses of rock, known as rocking stones, or cromlechs, but which may have been formed by the waves washing away the softer portions of the stone, and leaving only those parts which were hard enough to resist their violence; in the same manner as that by which Mr. Mackintosh describes the Brimham rocks to have been formed.¹

A much larger cromlech may be seen in the grounds of the Marquis of Anglesea, at Plas Newyd, on the Menai Straits.

NOTE.—During the last few centuries, the ocean seems to have regained some of its lost dominions. At the base of the Great Orme's-head, on the Conway shore, being that least exposed to storms, a bed has been formed of angular fragments of Mill-stone Grit and earth. Similar beds are found in several parts of the mountain. This bed, which was probably then of considerable extent, was chosen by the ancient Bishops of Bangor as the site of a palace (Gogarth). It has, however, been gradually undermined and carried away by the waves, until the ruins of Gogarth are now situated upon the edge of a precipitous bank, washed by the sea, and in a short time will be themselves carried away. In like manner, what was the old town of Pensarn, in Denbighshire, is now reduced to a few fragments of stone wall, which are daily overflowed by the tide.

II.—ON TRACES OF GLACIERS IN THE ENGLISH LAKES.

By Rev. T. G. BONNEY, M.A., F.G.S.

ALTHOUGH the causes of the configuration of the Lake district have been discussed by Mr. Mackintosh in some interesting communications to this Magazine, and the distribution of the granite blocks from Wastdale Crag formed the subject of an able paper read by Professor Phillips to the British Association at Birmingham, 1865, the glaciation of this region seems scarcely to have attracted the attention which it deserves. In the hopes, then, that some one may be induced to do for Cumberland and Westmoreland what Professor Ramsay has done for North Wales, I venture the following remarks; although, owing to want of time and other causes, they are far less complete than I could wish them to be.

To commence with Windermere; two valleys unite near the head of this lake; the one, that in which lie Grassmere and Rydal Water; the other, that which is drained by the river Brathay, and is also bifurcated. The extremity of the mass which divides these two valleys is called Loughrigg Fell. The general contour of this hill and most of the others near Ambleside and in the neighbourhood of Rydal Water is very suggestive of glacial action, but I sought for some time without finding any satisfactory proofs. At last, however, I fell in with a most unmistakeable boss of ice-worn rock,

¹ GEOLOGICAL MAGAZINE, 1865, Vol. II, p. 154.

on the north side of St. Mary's Churchyard, Ambleside. On following up the right-hand branch of the Brathay Valley (Great Langdale), I found, near Chapel Stile, a mass of debris which very probably is part of an ancient moraine. Near the same village are a considerable number of well-defined roches moutonnées. Throughout all parts of the district at the head of Windermere, which I examined, there appeared to be a remarkable scarcity of both moraines and perched blocks. It is possible, indeed, that these may have been swept away by subsequent denudation, but the very perfect state of the above-mentioned roches moutonnées seems to render this improbable. I am, therefore, inclined to think that the nature of the rock in the neighbourhood must have rendered them always unfrequent; it being a splintering slate, which rarely forms cliffs of any height, or large masses of screes. To the same cause may be attributed the effacing of the glacial marks on the hillsides. The contour, however, of Loughrigg Fell leads me to think that it must have once been almost covered by glaciers. During a short excursion to Patterdale, I observed rounded rocks at the head of it and Ulleswater.

The road from Ambleside to Keswick, as is well known, passes through the gap of Dunmail Raise, and descends by the right bank of Thirlmere. On the left bank of the stream, opposite to the little inn at Wythburn, a very fine rounded rock can be seen from the high road. On each side of Thirlmere traces of ice-action are very distinct, especially on the right bank; first on the right hand, and then on the left of the road. The green slates and porphyries of Borrowdale and the head of Derwent Water, have retained the marks of nature's ice-chisel better than those described in the preceding paragraph.

Following the right bank of Derwent Water we come to the Lodore Fall, where a stream which drains an upland glen some three miles long descends to the lake. This glen appears to have been once occupied by a glacier, perhaps to a height of 300 feet above the present bed. The main outlet of the ice was not by the chasm of the Lodore Fall, but by an opening which leads down to the main valley some distance higher up. This is shown by the extensive tracts of ice-worn rocks in the opening, and by some perched blocks high on its left bank.

At the little hamlet of Grange there is a magnificent smoothed rock, just on the left bank of the stream. Above this a rocky barrier extends nearly across the valley; over it the glaciers which have descended from the Stake and Styhead Passes have forced their way, rounding and scoring its crags in their passage, and leaving their traces high up on the hills on either side. Beyond this barrier the valley opens out into a level plain, which I have little doubt was once, after the retreat of the glacier, occupied by a lake. After crossing the ridge of Borrowdale the Haws similar traces of ice-action may be seen near Buttermere.

Returning to Grange in Borrowdale, and taking the road on the left bank of Derwent Water, one meets with constant traces of

the glacier, extending, I think, not less than 400 or 500 feet up the hill-sides. Near a farm-house, about half a mile from Grange, are some scratched and rounded blocks, with several *blocs perchés*. On one of the former, a smoothed boss of slate, by the road side, the glacial *striae* may be seen arranged in parallel flutings pointing down the valley. These are crossed at an angle of about 45° by the cleavage planes, and the whole mass is traversed by two systems of joints, which intersect one another at about the same angle.

The soft slate of Skiddaw is unfavourable to preserving marks of glacial action, and, besides this, its southern face is too steep to have allowed of any great accumulation of snow. The ice-stream from the Derwent Valley would probably sweep under its cliffs, then no doubt streaked with *coulloirs* of snow, towards Bassen-thwaite. The glacier, indeed, may possibly have divided, and an offshoot have extended some distance up the Greta, where it may have met the ice-stream from the vale of St. John. Near to Threlkeld station I saw, when leaving the district, a number of large blocks scattered over the slopes adjoining the railway, which, I think, could only have been deposited by means of ice. They may, perhaps, denote the position of the terminal moraine of the glacier which, after passing over Thirlmere, descended the vale of St. John.

These are all the notes which I was able to gather during my stay in the Lakes, but I have little doubt that a more careful examination would make it possible to map out approximately the glaciers which once filled the greater part of many valleys in the mountain districts of Cumberland and Westmoreland.

III.—THE TERRACES OF THE CHALK DOWNS.

By G. POULETT SCROPE, Esq., M.P., F.R.S., F.G.S., etc.

MR. MACKINTOSH (Vol. III., p. 69, and p. 155, of the *GEOL. MAG.*) adduces the preservation of numerous terraces on the hill-sides in the Cretaceous districts of 'Wilts. and Dorset,' as "evidence of limited subaerial denudation since those terraces were formed," for that they are "raised sea-beaches," he says, admits of no doubt.

I venture to say that a more preposterous idea has seldom been started for the confusion of geologists.

Being a Wiltshireman I am well acquainted with these terraces, which are not confined to the Chalk-hills, but are found also among the Oolitic Cotswolds, and many other formations, where the hill-slopes and the nature of the subsoil are favorable to their formation. And I have no hesitation in declaring them without exception of artificial origin, worn by the plough, at a time when these slopes were, if they are not still, under arable cultivation.

I had supposed this to be the generally received opinion, and, as such, hardly worth sustaining by argument, until the doctrine of