

through some of the thick limestone bands of the district. Large masses of vertical and crumpled limestone beds, as well as quartzite, have been caught up in the agglomerate, together with abundant blocks of grit, fragments of shale, and pieces of a pale felsite<sup>1</sup> (five varieties again). Of the vent at Porth Cenal my own description is: "The most remarkable feature is the occurrence of great quartz lumps, which are of all sizes and shapes, and lie promiscuously in an agglomerate of slates, grit, and dust," and, "in the headland of Pen-y-parc we get another agglomerate of quartz lumps and ash"; and, after observing that these rocks (the limestone not being mentioned as being merely torn from the sides of the vent) are not those of the immediate neighbourhood, I added: "We cannot here refer [these agglomerates] to the action of a crush-fault,"<sup>2</sup> a remark which shows that I was not unaware of this alternative. These descriptions, with the interchange of "felsite" and "ash," are fairly consistent, but Sir A. Geikie's new description is: "The huge blocks of limestone, there to be seen isolated among fragmentary grits and slates, are referable to the disruption of some of the limestone bands which occur abundantly in the neighbourhood" (quite so). "A gradation may be traced from the slates and grits outside the areas of more severe dislocation into the intensely crushed and sheared 'agglomerate.'<sup>3</sup> Where is here the quartzite, and the felsite, and the drilling?"

The fact is that one main reason, amongst others, in my mind at least, for calling these Anglesey masses agglomerates, was the occurrence in them of a variety of rocks not like those of the immediate neighbourhood; while the main reason for believing the Manx rocks to be "crush-conglomerates" is that the rocks in them are of those kinds only which occur on either side of the area of crushing. The phenomena in the one case are, therefore, not the same as those in the other.

J. F. BLAKE.

November 4, 1896.

#### THE OLD RED SANDSTONE OF SCOTLAND.

SIR,—Regarding the statement of Professor Davis in last month's issue of this Magazine, it gives us great pleasure to receive his explanation that the terms Devonian and Old Red Sandstone had been used synonymously in his paper, and not as representing two distinctly different conditions of deposit. But he must be well aware that this loose application of these two terms has long fallen into disuse in British geology, and that they now stand for two different types of deposit. Hence it was quite natural for anyone reading his footnote to suppose that his "Devonian erosion" refers to his notice of Sir A. Geikie's plain of marine denudation given in the body of the paper; while his reference to the Old Red Sandstone stands for something quite distinct. Further, as he says himself, having been principally indebted to "English writings" for his knowledge of the structure of this country, we thought it

<sup>1</sup> Q. J. G. S., vol. xlvii, p. 134.

<sup>2</sup> *Ibid.*, vol. xlv, pp. 517-8.

<sup>3</sup> GEOL. MAG., Dec. IV, Vol. III, p. 462.

but fair to consider he had been led by Sir A. Geikie's description of the succession of physical events in Scotland after the plication of the earlier Palæozoic rocks, to infer that there had been two distinct periods of denudation, the one marine and the other fresh-water. We sincerely trust that this explanation will be acceptable to Professor Davis of the reading we placed upon his footnote.

But let us now turn to the much more important subject: Is there any evidence of two distinct periods of denudation—a marine, to which the plain of marine denudation is to be referred, and a fresh-water, to which the Old Red Sandstone deposits are to be assigned? Professor Davis, at least on this point, evidently believes that there must have been a vast denudation prior to the deposition of the Old Red Sandstone deposits, and that this denudation may have taken place without leaving any trace of its deposits. But he does not decide as to whether this denudation was subaerial or marine. If he believes that a vast subaerial denudation took place partly previous to, and partly contemporaneous with, the deposition of the Old Red Sandstone rocks of Scotland, then we are at one with him. But if, on the other hand, he believes with Sir A. Geikie, that a great marine denudation took place which has left not a "rack behind" in the shape of deposits, but is only represented by a plain of marine denudation, then we beg to express our dissent.

It seems to us Professor Davis takes but a partial and limited view of the structure and relationship of the Scottish Old Red Sandstone to the older Palæozoic mountain-chain. He states that the Old Red Sandstone lies unconformably upon the floor of ancient rocks. This is doubtless correct so far as the Moray Firth area, and all Old Red Sandstone areas north of the Grampians, are concerned; but had he extended his traverse of the Old Red Sandstone to the boundary fault between Ayrshire and Midlothian he would have found that the Old Red Sandstone conformably succeeds the Silurian of these districts. It is here, in our view, where the *missing link* is found. With Ramsay, Geikie, and others, Professor Davis seems to overlook the significance of this important fact. In this connection a feature of some interest may be referred to. In Lanarkshire a band of shale about 5,000 feet above the base of the Old Red Sandstone contains *Orthoceras dimidiatum*, *Spirorbis Lewisii*, and a graptolite. These being unquestionably Silurian fossils, may not this band of shale and underlying sandstones, conglomerates, etc., be the equivalents of the Downton Sandstones? Again, we have shown that the Caithness rocks must be assigned to a higher horizon than those of Strathmore, while we think we have given strong evidence, both physical and palæontological, for believing that the whole of the series from the passage beds of Lanarkshire, through the middle series of Strathmore, into the highest members of the group in the Orkney Islands, are of marine origin; and it is to this age we would refer the plain of marine denudation seen in the Highland mountains.

Professor Davis advances two objections to the plain now seen

in the Highland mountains being of such high antiquity as we have given it—first, that it could not have survived the subsequent deformation, as seen in the angles to which the Old Red Sandstone has been tilted; and second, that it can hardly have been longer exposed to dissection than since the latter part of Mesozoic time. Now if Professor Davis takes a geological map of Scotland and examines it, he will find two great faults running across Scotland: within these faults he will find the later Palæozoic rocks tilted and crushed at considerable angles, this being an area of faulting and corrugation; outside these faults, however, the later Palæozoic rocks lie at low angles, showing little evidence of disturbance, and we believe not enough to destroy the old marine peneplain. On these areas the later Palæozoic rocks, including both the Old Red Sandstone and the Carboniferous series, lay piled in their almost normal horizontal position, to the height of thousands of feet, and so preserving the old marine peneplain from the action of the subaerial forces which otherwise must have destroyed it; and presenting it as we see it at the present day. It was upon this cover of horizontal rocks, we believe, the river systems of the Highlands were first traced.

P. MACNAIR and J. REID.

#### THE STRUCTURE OF GLACIER-ICE.

SIR,—When at Chamonix on September 24, 1896, I visited the Glacier des Bossons. At the termination of the glacier, where the stream was flowing out, the ice was melting in a most interesting manner, which fully bears out the description and drawings of the structure of glacier-ice (by polarized light) given by Messrs. Deeley and Fletcher in the *GEOLOGICAL MAGAZINE*, 1895, pp. 152–162. The ice was disintegrating into separate pieces of irregular form, each an inch or thereabouts in diameter (there may have been larger and smaller pieces), and fitting exactly together, with interlocking projections and cavities, so that the structure reminded one of a toy dissected map. Here, then, we have the glacier-ice dissected for us by nature and its structure displayed to the naked eye, without the aid of a polariscope. As I had no polariscope with me I cannot say whether each piece consisted of a single crystal or of an aggregate of crystals.

BERNARD HOBSON.

P.S.—Perhaps by immersing blocks of glacier-ice in hot water the structure might be brought out artificially.

#### THE JUBILEE OF THE PALÆONTOGRAPHICAL SOCIETY: A SUGGESTION.

SIR,—On reading the interesting account of the work of the Palæontographical Society that appeared in your valuable Magazine, it occurred to me that the jubilee of this Society might well be commemorated in some way more useful and more permanent than the eating of a dinner. The practical proposal that I now beg to offer is the outcome of considerable use of the volumes issued by the Palæontographical Society; for that has led to the discovery