

18. *Further NOTES on ROCK-FRAGMENTS from the SOUTH of SCOTLAND imbedded in the LOW-LEVEL BOULDER-CLAY of LANCASHIRE.* By T. MELLARD READE, Esq., C.E., F.G.S. (Read February 20, 1884.)

IN my paper on the Drift-beds of the North-West of England, Part II. *, I gave certain identifications of granites from Criffel and the neighbourhood of Dumfries made by Mr. Patrick Dudgeon from specimens I forwarded to him in 1882, these being confirmatory of Mr. Mackintosh's previous discovery of Criffel granite in the Lancashire Drift. In August of this year I had an opportunity of travelling from Dumfries through Kirkcubright to Wigtownshire, when I paid special attention both to the rocks *in situ* and to the boulders lying about the country, with the following results.

In Kirkcubright there are two large and distinct masses of granite, rising through the Silurian strata, which generally rest nearly vertical and are repeated in fold after fold. The easternmost of these granite masses rises 1800 feet above the sea, and forms the grand isolated mountain called Criffel. The westernmost mass, occupying not less than 50 square miles †, rises to 2331 feet in the mountain called Cairnsmore of Fleet, which is also an isolated granite boss; but the surrounding Silurians rise to a higher level than at Criffel. The Cairnsmore granite is of a coarser nature than that of Criffel; though in a vein at Creetown, no doubt connected underground with the main granitic mass, is a quarry, belonging to the Mersey Docks and Harbour Board, which has supplied for many years the granite used in the construction of the Liverpool Docks, which is of a more compact nature and finer grain.

All round Criffel in the low country and near the coast are to be found numerous granite boulders, all of them more or less rounded, and none showing marks of glaciation either by plane surfaces or striations. At Kirkbean I took chippings of several, which were used in the building of a field-wall; among them were a dark granite and a reddish-coloured granite, no doubt all variations of Criffel granite, and such as I could match from the Lancashire Drift. Close by a road-stone quarry in the Silurian Greywackes, about 5 miles S.E. of Dalbeattie, there were many boulders of a dark red granite, which I can also match by specimens from the Lancashire Drift; and I take these also to be local variations of the Criffel granite.

The Dalbeattie grey-granite quarries are also in the Criffel-granite mass, and I believe we have all these varieties of granite rocks in the Lancashire Drift.

The granite of Creetown is very similar to the Dalbeattie granite; and here can be seen the junction between the granite and the

* Quart. Journ. Geol. Soc. vol. xxxix. p. 119.

† This is only a very rough approximation. The Survey explanation of sheet 4 says—30 square miles of it are exposed in sheet 4 (p. 18).

Silurians, and specimens of granite veins penetrating the Greywacke can be taken with the altered Silurian adhering to both sides. This fine-grained vein granite can also be matched by granite fragments in the Drift about Liverpool.

In ascending the Moneypool Burn from Creetown I found among the boulders a granite with light pink felspar not unlike the Eskdale granite. This has, no doubt, been derived from Cairnsmore of Fleet, in which the burn rises.

In Palmure Burn, at Talnotry, a splendid junction of the granite and metamorphosed Silurians can be seen, and specimens taken showing the granite and gneiss adhering. I ascended Craignelder, a spur of Cairnsmore, 1971 feet high. The mountain is literally covered with splendid granite boulders which weather white. I cannot help remarking that here is a sublime study for a painter in the harmony existing between the mountain and its fragments,—no erratics—all one grand harmony of granite. I am led to believe from what I saw, that many of the coarser grey granites of the Lancashire Drift have come from Cairnsmore of Fleet.

But I was most interested in the Silurian Greywackes, for here were undoubtedly the parent rocks which have yielded many of the fragments found in the Low-level Boulder-clay about Liverpool. The identifications I consider unmistakable, and I exhibit specimens side by side from the Boulder-clay and from the Greywackes of Wigtonshire. These rocks seem never before to have been identified with Lancashire drift rocks; and before I traversed them from Kirkcudbright to the Isle of Whithorn and Luce Bay these numerous fragments, partly distinguished by the small veins of the carbonates of baryta and lime traversing them, were a puzzle to me. The colour of the Greywacke ranges through dark blue and grey to a deep purple red*. “It varies in texture from a fine-grained mudstone to a coarse gritty sandstone, and occurs in beds from 6 inches to 6 feet thick.” The Survey memoir explanatory of sheet 4 says (p. 13):—“The section which perhaps best shows the characteristic features of these thick grits and massive greywackes (the Queensbury Grit Group) runs along a line of cliffs called the Craigs of Garheugh at the side of the road from Glenluce to Port William.” I have compared a specimen I took from these “Craigs” with some obtained from the Low-level boulders of Great Crosby, Lancashire; they are identical. Also a specimen of the red greywacke of the Ardwell group obtained by me at Innerwick fishery, a few miles north of Garliestown, is matched by specimens from Great Crosby, as are some of the rocks in and near the Isle of Whithorn.

But it is the general appearance of the group of rocks, and long familiarity with drift specimens of the Low-level Boulder-clay that most convinces me. Unfortunately I did not ascend to the summit of Cairnsmore of Fleet; but the Survey memoir says of this granite †:—“The general colour of the granite is grey, shading

* These greywackes are well described in the explanations of sheets 1, 2, & 4, *Memoirs of the Geological Survey of Scotland*.

† Explanation of sheet 4, p. 18.

in places into a flesh-colour or pink tint. The latter is most commonly met with near the edge of the mass, and may be well seen along the south and west slopes of Cairnsmore Hill and up the valley of the Palnure Burn. The general texture of the Cairnsmore mass is extremely coarse; by far the coarsest-grained examples are exposed along the top of Cairnsmore Hill. Here masses of granite may be seen with crystals of quartz and felspar upwards of two inches in length, while the granite consists for the most part of quartz, orthoclase and plagioclase felspar, black and white mica, with occasional hornblende; its lithological character varies, owing to the disappearance of one or more of the ordinary constituents. The felspar is always the chief constituent, consisting for the most part of orthoclase, but numerous striated faces are also met with."

I have a specimen of coarse granite from the Low-level Boulder-clay, Great Crosby, containing a crystal of felspar $1\frac{3}{4}$ inch long. This coarse variety is generally found in a more crumbly condition than the finer-grained granites.

It is only necessary, in conclusion, for me to point out that these further identifications, which go far to complete the series of Low-level Boulder-clay rocks, are a further confirmation of the views expressed by me "that all the stones (of the north-west of England Drift) are confined to the basin of the Irish Sea and the river-basins flowing into it, excepting some stray stones that may have come from the Highlands of Scotland"*.

DISCUSSION.

Dr. HICKS remarked that similar evidence to that obtained on the north-west coast was furnished by the Vale of Clwyd. At St. Asaph the granites and other rocks in the Boulder-clay were to a great extent derived from a distant source, evidently somewhere to the north, only a few from the neighbourhood; but further south the boulders were mainly from the Welsh area.

"The Drift-beds of the North-West of England," *Quart. Journ. Geol. Soc.* vol. xxxix. p. 120.