

III. *Description of an Insulated Group of Rocks of Slate and Greenstone
in Cumberland and Westmoreland, on the east side of Appleby,
between Melmerby and Murton.*

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FEW rocks in this country present in a small compass a structure more complicated and difficult to be understood than those which occupy a small district in Cumberland and Westmoreland, on the east side of Appleby, between the villages of Melmerby and Murton, which I visited in September, 1814, accompanied by my friend G. B. Greenough, Esq.

The town of Appleby is situated about 12 miles from the upper extremity of the great plain through which the rivers Eden and Petteril have their course, and which continues across Solway Frith into Scotland, increasing considerably in breadth on the north of Carlisle.

The stratum composing the greater part of this Plain is a red sandstone affording gypsum in many places. Its breadth near Carlisle from east to west is about 15 miles, but it becomes gradually contracted as it approaches the south till it terminates near Brough and Kirkby Stephen, being encircled by hills more elevated and of higher antiquity.

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The west and south-west boundary of this plain are the slaty mountains of Cumberland winding from Ravenstone dale to near Hesket, Newmarket, Ireby and Cockermouth; a belt of entrochal or mountain limestone covered by a concentric belt of coal measures separates the red sandstone from the slaty rocks just mentioned.

The same plain is bounded on the east by an almost precipitous escarpment, extending north and south from near Brough by Dufton Fell and Cross Fell to Croglin, Castle Carrick, and the hills south-east of Brampton. The elevation of great part of this escarpment is considerable, varying from 1000 to 2000 feet; Cross Fell, its highest point, is 2901 feet. It displays the outcrop, and is chiefly composed of the lower members of the great series of strata described by Mr. Winch as occurring between Newcastle and the base of Cross Fell.

The regular structure of the plain of sandstone at the base of this escarpment is interrupted near Appleby by projecting masses of slate and greenstone, attended by some broken strata of lime and coal measures, which it will be the object of this paper to describe.

These rocks (as may be seen by reference to the annexed map)* form an insulated group extending nearly north and south along the base of the escarpment of the great limestone series of Cross Fell, and of which the lowest stratum is stated by Mr. Winch to be incumbent on the old red sandstone (Geol. Trans. vol. iv.) This old red sandstone, which it is of the highest importance to distinguish from that more recent red sandstone which forms the plain of Appleby and Carlisle, appears here in its common form of a coarse puddingstone, and may be traced along the scar in the place thus assigned to it from Melmerby to a spot called Highcup near Murton.

Coextensive with this conglomerate is a subjacent mass of slate which forms a kind of broken under-terrace at the base of the great

* Plate 5.

escarpment from Melmerby scar on the north to Murton Pike on the south. This narrow line of slate is bordered on its west side by an irregular but nearly parallel range of greenstone. The breadth of both these rocks together seldom exceeds a mile, and towards their north extremity is contracted to the compass of a few yards; here they appear also much disturbed and confusedly mixed together; the spot is marked in the map as Melmerby Lane End, about one mile south-east of the village of that name. They assume greater strength in their progress towards the south, and the position of the greenstone becomes more decided on the west of the narrow line of slate.* The variety of proportions in which its ingredients are found combined is quite endless; every hill, almost every block, gives a new character of it.

These rocks of slate and greenstone form two parallel narrow ranges, displaying on the surface an irregular outline, and attracting attention by the striking feature of three lofty conical pikes, distinguished by the names of Knock pike, Dufton pike, and Murton pike.† Of these the former, which is the most northerly, is chiefly composed of greenstone. Dufton pike, the central one, contains both greenstone and slate; and Murton pike, which is the most elevated, and at the south extremity, appears to be composed almost entirely of slate.

We found no greenstone indeed within a mile of Murton pike, it seemed to terminate at Keisley about one mile south-east of Dufton, a spot which I shall again notice as affording a singular mass of limestone.

Though the exact limits of these two ranges might possibly be ascertained by careful and patient investigation, their line of junction

* See Map and Section, plate 5.

† See Map, plate 5.

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is not distinctly marked; the eye cannot trace it in the outline of the hills, nor is it laid open in many places by sections of the water courses.

Their order of superposition (if there be any) is equally indeterminate; sometimes they abut abruptly against each other, sometimes the slate is uppermost, at others, indeed most frequently, the greenstone.

Imperfect roofing slate has been dug at each extremity of this range, on the south at Langdon moor near Murton pike, and on the north at Middle Rig near the head of Melmerby Beck.

Slate pencils also may be obtained from many parts of the slate rock. Places named to us were **Knock Fell* on the east of Knock pike; *Flasker*; *Asblake Pike*, half a mile north of Ardale water; *Gale intack*, Melmerby Lane End, also a field half a mile south of Murton in the valley towards Brough, and Rickargill Beck 4 miles north of Melmerby under the continuation of the escarpment northwards. I mention this last place because (if the information was correct which we received on this point from two competent witnesses) the existence of these pencils shews the presence of the slate rock four miles north of the spot where it seemed to end near Melmerby. We did not examine this line ourselves, but could hear no tidings of slate or greenstone at any place north of Melmerby, excepting Rickargill, and we know from observation that they do not exist a little further to the north at Croglin, or between Croglin and Castle Carrock.

At Swinedale Beck, between the south base of Knock pike and Dufton Fell, the slate contains one or two thin beds of blackish transition limestone, which are laid open in the water course at Cater-

* The places printed in Italics are not mentioned in the map.

pallet, a hillock one quarter of a mile east of Gale Hall, and between one and two miles south-east of Melmerby. The slate is cut by a broad dyke, of which the direction is nearly east and west, and its breadth about 25 feet. The substance of this dyke is composed of reddish compact felspar mixed with talc, and the latter becomes more bright and distinctly visible where the rock has undergone decomposition.

Under the south base of Knock pike close to the Swinedale Beck is a small portion of rock composed chiefly of dark mica, occasionally interspersed with small crystals of felspar, disseminated uniformly through the mica. On this lies a mass of highly compact whitish felspar and coarse greenstone.

On the summit of this Pike, which is nearly conical, and steep on all sides, is an outlying hummock of coarse grained sandstone, agreeing in substance with one of the lowest strata in the neighbouring escarpment, and more recent than the old conglomerate. Whether this latter rock, or any traces of slate, are interposed between the summit of the pike and greenstone of its base, we had no opportunity to ascertain. I have specimens of the grit taken from the summit.

At the west root of Dufton pike, in a field called Banky Close, and surrounded on all sides by greenstone, is a species of granite that is extracted to build field walls. It consists of bright salmon coloured felspar, in which are disseminated at very irregular intervals plates of bright silver coloured mica, varying in diameter from an inch to a line, and interspersed with a few small specks of quartz. This granite was so covered as to be visible only at a small ridge where the quarry was wrought. It might either be the projecting crest of a subjacent fundamental mass, or it may be a dyke cutting through the greenstone. In the quarry it is 15 yards broad, and

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seems to run east and west. It is found also two fields below in a westerly direction.*

About a mile south of Dufton pike, in the direction of Keisley, in a streamlet that joins the Keisley Beck, and runs down to the village of Dufton, in a field or farm called Hindrigs are other traces of granite exactly like that of the hills on the south-west of Shap, containing large flesh coloured crystals of felspar; it appears to be in its natural position, and (like the neighbouring granite of Banky Close under Dufton pike) either a dyke or the projecting back of a substratum of this substance.

The part I saw uncovered was about 10 feet square, and had no appearance of being a rolled block. The watercourse, 10 yards off, passed over a small portion of the same granite in a little cascade; but here also it was so covered with grass that absolute demonstration could not be obtained. I am inclined however to think, that this granite is the point of a subjacent rock, and a new locality of that variety which is so different from all other English granites, and so strongly characterised at Shap Fell.

In the field adjoining the Hindrigs granite immediately above and on both sides of the water course were large blocks composed entirely of dark mica, which lay half buried in the soil, and appeared

* This granite much resembles that of a dyke which at a place called Demming or Red Crag at the highest point of the road about half way between Shap and Kendal, and near the mass of the granite of Shap and Birbeck Fells, is clean extracted from a long narrow quarry by the road side, so as to prove decidedly that it is a dyke about 30 feet in breadth, and lying between two side walls of course slate.

We were told that this dyke runs off nearly north and south, a mile or two south-south-east, and nearly a mile north-north-west of the spot where we saw it by the road side.

Its south-south-east portion keeps nearly along the crest of the hills of grauwacke and grauwacke slate that run south-east from Birbeck Fells to Tebay on the Lune near Orton, in their course towards Sedburgh and Ingleton.

to have been derived from a subjacent rock of mica connected with the granite.

Having described as far as I know the extent of the slate and greenstone, with the subordinate rocks and dykes that accompany them, I will now consider the strata by which they are encircled, and which on the east side are widely different from those on the west.

On the east side beneath the outcrop of the great limestone series of Cross Fell, (of which Mr. Winch gives the thickness at 450 fathoms,) the old red sandstone, in the form of a conglomerate, is regularly interposed between the lowest stratum of the above series and the slate, with no appearance of any great derangement. But on the west side of the line of greenstone there are evidences of disturbance, on a scale of considerable magnitude.

There is not a trace of those beds that are so regular on the east side, and appear there in such enormous thickness, and except in a few spots which will immediately be described, the red sandstone of the plain of Carlisle abuts abruptly against the greenstone and slate,* as it does also against the truncated extremities of the lower strata of the great limestone series† along the base of their escarpment on the north of Melmerby towards Brampton, and on the south of Murton towards Brough, beyond the north and south terminations of the slate and greenstone that have been described.

The village of Melmerby stands upon this red sandstone; a small stream that runs down to it (called Melmerby Beck), from the base of the great escarpment of the scar, has its course for three quarters of a mile above the village in the red sandstone, which here also

* See Section No. 1, Plate 5, letters A. B. C.

† Ibid. letters C. D. E.

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contains gypsum as in numerous other places on the banks of the Eden and the Petteril, and in the great valley of Carlisle.

At the distance above mentioned the sandstone abruptly ceases, the water course (a ravine about 30 feet in depth) which till now had traversed the red sandstone in a direction east and west, suddenly turns at a right angle to the south, and continues its bearing exactly along the line of junction, having its east and west banks composed of materials very different.

At the point where the water course turns suddenly to the south the sandstone abuts abruptly against a dark compact greenstone, red externally, and very ferruginous.

This last rock with its varieties forms the east, and the sandstone the west cheek of the ravine for a quarter of a mile up the stream southwards, the excavation being so exactly along the line of junction that no contact or order of superposition can be distinguished.

Here, at about a mile above the village along the Beck (the name of the spot is Melmerby Lane End,) the greenstone on the east bank becomes mixed confusedly with considerable masses of slate, and the channel ceases to have the red sandstone on its west flank, which becomes occupied by shattered fragments of limestone and coal measures.

These last beds extend from hence in a line nearly parallel to the slate and greenstone ranges, being interposed between them and the red sandstone of the plain for nearly three miles south from Melmerby Lane End towards Kirkland,* but are so dislocated and confused that the coal seams (which are very thin, often less than a foot,) are in many places quite vertical, and extracted by sinking perpendicularly downwards as in a well; but they occur no where

* See Section, Plate 5, No. 2, letter A.

in great quantity, as from the shattered condition of the strata, the coal is soon lost without a clue to lead to its recovery. It has no regular roof or floor, but is rather inclosed by broken side-walls, and sometimes is found lodged in confused nests and heaps: it is now seldom wrought.*

The edges of these highly inclined and broken strata may be traced by a very low scar,† or kind of escarpment slightly rising towards the east and running parallel to, and along the base of the greenstone hills from Melmerby towards Kirkland.

The limestone accompanying these coal measures is but in thin beds, and equally dislocated and shattered, so that no order of superposition can distinctly be made out. I saw it at one place nearly vertical, its dip being to the west; it was on the north side of the Ardale water, as marked in the map; it lay between two beds of sandstone that had the appearance of coal grits, and within a few yards of the slate and greenstone which are here confusedly mixed together. The lowest grit bed touched the slate.

Vertical coal measures are seen touching the greenstone at a section in Ousby Beck at the corner of the highest inclosures in ascending the stream from the village of Ousby.

The following are localities where coal has been dug within the limits above mentioned.

Melmerby Lane Head, Hag Gate, Gale Hall, and Ousby Town Head, &c.

Limestone is dug near Hag Gate, Gale Hall, and Ardale water, &c.

* Similar cases of beds of coal becoming vertical by dislocation will be recognized in the perpendicular bed of coal described by Mr. Bakewell at Bradford near Manchester, (Geol. Trans. vol. ii. p. 283,) and in the Mendip collieries near Mells, where a bed of coal is said to be bent backwards to the shape of the letter Z. I have this fact on good authority but have not seen it.

† See Section, Plate 5, No. 2, letter A.

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These limestone and coal measures occupy no great breadth, and run north and south in a line nearly parallel to the ranges of greenstone and slate, being generally in contact with the former of these substances. Their extent longitudinally is from Melmerby Lane End to the Ardale water. From the latter stream southwards to the village of Murton, the red sandstone abuts for the most part against the greenstone. One exception occurs at Keisley about one mile south-east of Dufton, in the direction of Murton pike, where there is an insulated mass of stratified entrochal limestone several fathoms in thickness, and occupying superficially a little more than an acre of ground. It is inclined to the west at an angle of about 80° , and covers like a shield the abrupt end of a hill of greenstone, known by the name of Keisley pike, but insignificant in comparison with the three great pikes before described.

This limestone seems to bear the same relation to the greenstone as did the shattered coal measures and limestone before mentioned near Melmerby. It dips so rapidly that it disappears immediately at the base of the hill towards Appleby, and is at once lost under the red sandstone.*

We did not examine the base of the continuation of the great escarpment from Murton pike southwards towards Brough, but the concurrent testimony of many experienced miners leaves no doubt that the slate terminates a little south of Murton pike, and the red sandstone of the plain closes up against the escarpment from thence to the town of Brough.

It was stated at the beginning of this paper, that it is of the highest importance to distinguish this more recent sandstone of the plain of Carlisle from the old red sandstone or conglomerate that divides the great limestone series of Cross Fell from the slate.

* See Section, Plate 5, No. 3.

It is important because it has been stated by Mr. Forster (in his section from Newcastle to Cross Fell) that this red sandstone of the plain is the lowest stratum of the above series, and because its position at the base of the escarpment, both on the north of Melmerby towards Brampton, and on the south of Murton towards Brough, would without careful investigation lead to such a conclusion.

But the section that has been described from Melmerby to Dufton proves that the old conglomerate is the only rock that exists there between the limestone series and the slate, and our examination of the base of the escarpment north of Melmerby from Croglin to Castle Carrick pointed out the source of this error, which is so common that we could not find an individual who did not believe in it, though not one had ever seen a section that proved the fact.

The source of this natural and almost necessary error, is the low position of the red sandstone at the base of the immense escarpment,* where it abuts so bluff against the abrupt and truncated extremities of the lower strata of the great limestone series, is in such absolute contact with them, and so accommodated to their irregularities, which it fills up, and seems as it were to notch into them, that it would be almost impossible to avoid the error which is so popular, without looking to the general history of this stratum, and to the sections which display junctions at the edges of the plain of Carlisle, in which this new red sandstone forms the upper and most extensive deposition.

One of these sections has been given near Melmerby: another may be seen in the cliffs between Whitehaven and St. Bees Head.† These are lofty, and present a distinct perpendicular section, in which it is seen at the point of the junction nearly two miles south-

* See Section, Plate 5, No. 1, C. D. E.

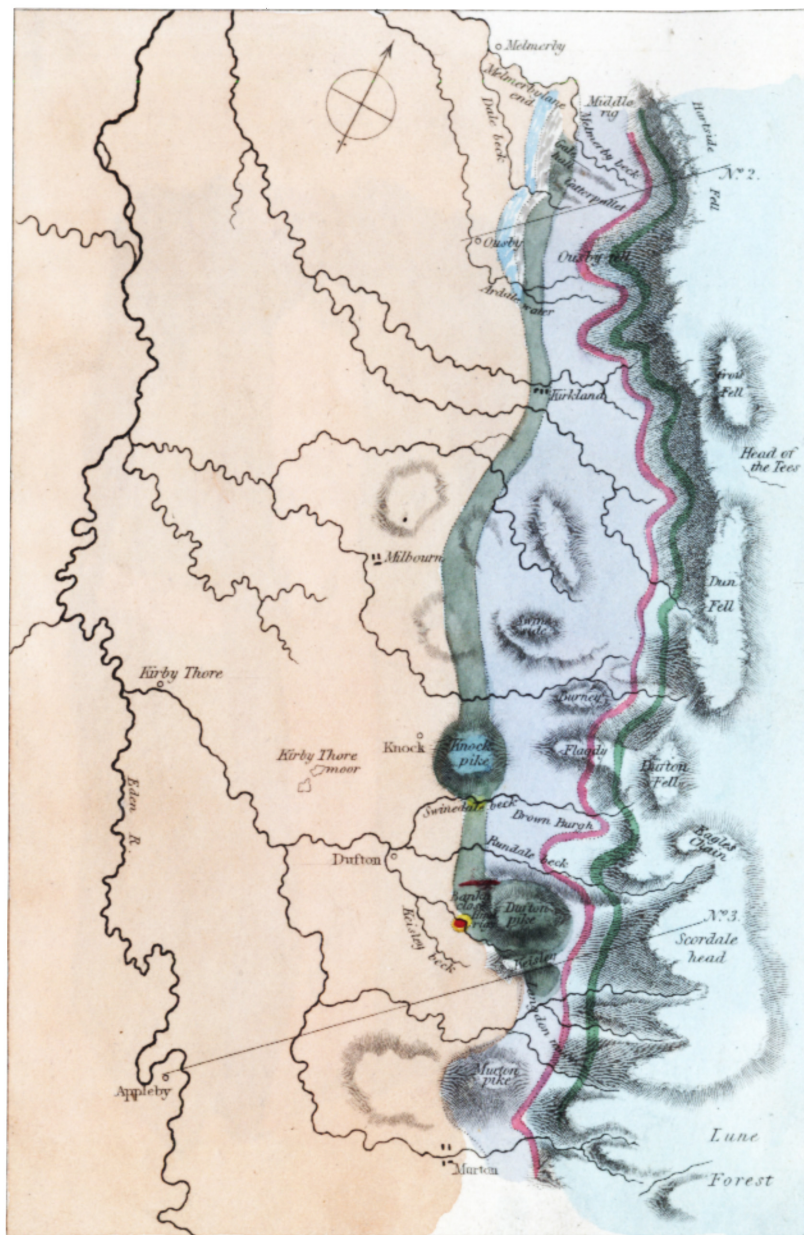
† Plate 5, No. 4.

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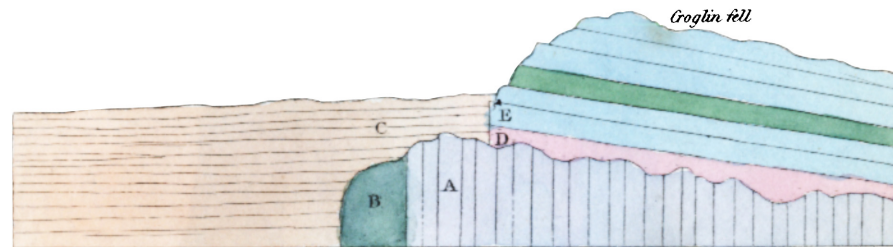
west of Whitehaven that the upper beds of the coal measures lie under a stratum of magnesian limestone. On the limestone is immediately superimposed the immense deposit of red sandstone that forms the entire thickness of the cliff from this point to St. Bees Head.

The dip of the coal measures and magnesian limestone is nearly south-west towards St. Bees, which brings them under the red sandstone at the point of junction above described, where there is also a large gypsum quarry in the lowest part of the red sandstone.

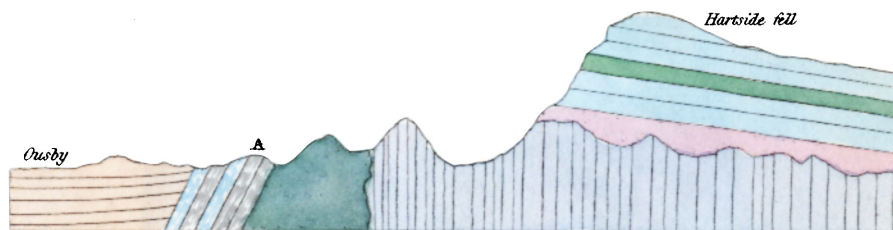
It would not be within the object of the present paper, (which is to describe the district between Melmerby and Murton pike,) to enter into the detail of these sections or the general history of this stratum. These however lead to a conclusion almost inevitable, that the Carlisle red sandstone is the same with that of the vales of Cheshire, of Salop, Lancashire and York; the matrix of our great quarries of gypsum and rock salt; and a deposition more recent than that magnesian lime which is incumbent on the upper strata of the principal English Coal-fields.



Drawn by Professor Buckland



Section N° 1.














Section N° 2. (marked in the map.)



Section N° 3. (marked in the map.)



Section N° 4.

- | | | | |
|---|---|---|-------------------|
|  | New red sandstone |  | Whin sill |
|  | Magnesian limestone |  | Old red sandstone |
|  | Coal measures |  | Grauwacke slate |
|  | Shattered & Vertical coal & grit & lime |  | Trap & greenstone |
|  | Limestone alternating with grit & Shale |  | Mica slate |
| | |  | Granite |

Engraved by G. Cooke.

Map and Sections of the Country between Melmerby and Merton.

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