Kendal, Sedbergh, Bowness, and
Tebay. AVELINE and HUGHES.

MEMOIRS OF THE GEOLOGICAL SURVEY.

ENGLAND AND WALES.

THE GEOLOGY OF

THE COUNTRY AROUND

KENDAL, SEDBERGH, BOWNESS, AND TEBAY.

(EXPLANATION OF QUARTER-SHEET 98 N.E., NEW SERIES, SHEET 39.)

BY

W. TALBOT AVELINE, F.G.S.,

AND

T. McK. HUGHES, M.A., F.G.S., F.S.A.

SECOND EDITION.

REVISED AND ENLARGED BY

A. STRAHAN, M.A., F.G.S.

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DEVONSHIRE†,—20†, 21†, 22†, 23†, 24†, 25†, 28†, & 27†. Hor. Sect. 19.
DORSETSHIRE,—15, 16, 17, 18, 21, 22. Hor. Sect. 19, 20, 21, 22, 58. Vert. Sect. 22.
ESSEX,—1*, 2*, 47*, 48. Hor. Sect. 84, 120.
FLINTSHIRE†,—74 NE, 79. Hor. Sect. 43.
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GLOUCESTERSHIRE,—19, 34*, 35, 43 NE, SW, SE, 44*. Hor. Sect. 12 to 15, 59; Vert. Sect. 7, 11, 15, 46 to 51.
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HEREFORDSHIRE,—42 NE, SE, 43, 55, 56 NE, SE. Hor. Sect. 5, 13, 27, 30, 34; and Vert. Sect. 15.
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LEICESTERSHIRE,—53 NE, 62 NE, 63*, 64*, 70*, 71 SE, SW. Hor. Sect. 46, 48, 49, 52, 122, 124, 125.
MERIONETHSHIRE†,—59 NE, SE, 60 NW, 74, 75 NE, SE. Hor. Sect. 26, 28, 29, 31, 32, 35, 37, 38, 39.
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NORTHAMPTONSHIRE,—64, 45 NW, NE, 46 NW, 52 NW, NE, SW, 53 NE, SW, & SE, 63 SE, 64.
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SUFFOLK,—47,* 48,* 49, 50, 51, 66 SE*, 67.
SURREY,—1 SW†, 6†, 7*, 8†, 12†. Hor. Sect. 74, 75, 76, and 79.
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NOTICE.

This Quarter-Sheet was originally surveyed by Mr. W. T. Aveline, Professor T. McK. Hughes, Messrs. J. G. Goodchild, F. Rutley, G. H. Wollaston, and G. H. Lightfoot, and was published in 1871. The boundary lines of the Silurian rocks were, however, almost entirely the work of the two first-named, the western part of the Sheet being by Mr. Aveline, and the Howgill Fells and the neighbourhood of Tebay and Sedbergh by Professor Hughes. The volcanic rocks of the Borrowdale Series, occupying the north-east corner of the Map, were subsequently examined by Messrs. J. R. Dakyns and E. J. Hebert, who traced out several sheets of Trap, and detected many lines of fault; the Map, thus revised, was issued in 1879.

In 1884–5 the whole Map was re-surveyed for the Drift; the north-east corner (the parts included in the 6-inch Maps, Westmorland, 22, 29, and a small portion of 21) by Mr. R. H. Tiddeman, the remainder by Mr. A. Strahan. In the course of this re-survey considerable alterations were made in the mapping of the Carboniferous rocks, but a few trifling corrections only in that of the older rocks. The new edition of the Map is now published; it is sold in two forms—for the Solid Geology only, and for Drift and Solid Geology combined.

The first edition of the Memoir was written by Mr. W. T. Aveline and Professor T. McK. Hughes, and was published in 1872. In the second edition, now published, there is a large amount of new matter, and the

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parts transferred from the first edition have been amplified. The changes and additions are as follows :—

Chapter I., with the exception of the account of the structure of the Silurian area by Mr. Aveline, has been written by Mr. Strahan.

Chapter II. contains an account of the Borrowdale Series by Mr. Dakyns, and a description of the Lower Silurian rocks by Mr. Strahan, which is in great part new, excepting some notes by Mr. Aveline. The account of the Stockdale Shales is by Mr. Strahan, but that of the Coniston Grits and Flags, the Bannisdale Slates, and Kirkby Moor Flags remains essentially as written for the first edition by Messrs. Aveline and Hughes.

Chapter III., dealing with the Carboniferous rocks, is entirely new. Mr. Tiddeman contributes the description of the part surveyed by himself; the remainder is by Mr. Strahan.

In Chapter IV., a description of the Shap granite, has been added by Mr. Strahan. The account of the dykes is slightly amplified from that by Mr. Aveline and Professor Hughes in the first edition.

Chapter V., dealing with the Superficial Deposits, &c., has been written by Mr. Strahan, excepting a note on weathering and landslips contributed by Mr. Dakyns.

The Appendix contains four tables of fossils, viz., two of the fossils of the Lower and Upper Silurian rocks of the neighbourhood, by Mr. Strahan; a table, kindly prepared for this Memoir by Professor Charles Lapworth, LL.D., F.G.S., containing a classified list of the Graptolites of Westmorland, with their synonyms and respective ranges in Westmorland, Wales, and Scotland; and a fourth table constructed from the Catalogue of the Carboniferous fossils in the Kendal Museum, which

were identified by Mr. R. B. Newton. The synonyms in Tables I., II., and IV. have been worked out by Messrs. G. Sharman and E. T. Newton, and are given in a form which, it is hoped, will remove this well-known source of trouble.

H. W. BRISTOW,
Senior Director.

Geological Survey Office,
28, Jermyn Street, London, S.W.
December 14th, 1887.

Hughes, Thomas McKenny.

TABLE OF CONTENTS.

CHAPTER V.—SUPERFICIAL GEOLOGY.

APPENDIX.

ILLUSTRATIONS.

THE GEOLOGY OF

THE COUNTRY AROUND

KENDAL, SEDBERGH, BOWNESS, AND TEBAY.

CHAPTER I.—INTRODUCTION.

Physical Geology and Table of Strata.

The district which this map illustrates comprises an area of about 216 square miles, lying chiefly in the county of Westmorland, but including a portion of Yorkshire in the south-east, and a small portion of Lancashire in the south-west. The most elevated part of the district is that occupied by the volcanic rocks, the highest point being Harter Fell, 2,539 feet above the sea. Many others also attain a considerable height, such as Stony Cove, 2,502 feet, Ill Bell, 2,476 feet, Froswick, 2,359 feet, Tarn Crag, 2,176 feet, &c. This high land includes a part of the principal watershed of the Lake District; the dividing line between the rivers running north and north-east to the Vale of Eden, and those flowing southwards to Morecambe Bay, passes by Kirkstone to Stony Cove, round the head of Troutbeck and over High Street, and thence by Nan Bield Axle and Harter Fell, round the head of Long Sleddale to the Shap Fells. But, viewed as a whole, the Lake District forms an elevated area, from which the rivers radiate in all directions, irrespectively of the strike of the rocks. This character is observable in the arrangement of the valleys of Troutbeck, the Kent, Long Sleddale, Bannisdale, Borrowdale, Wasdale, and Mosedale.

The Howgill Fells form an outlying tract of high ground, reaching an elevation of 2,220 feet. These fells form a separate centre of radiating dales, the waters of which, however, though starting to flow in every direction of the compass, are eventually all collected in the Lune.

The Lune Valley which separates these two centres of radiating drainage, offers for solution many interesting problems in physical geology. Like the rivers mentioned above, it flows for a large part of its course at right angles to the strike of the rocks, crossing the anticlinal axis, which brings to the surface the Coniston Grits of the Howgill Fells and Grayrigg Forest, and the synclinal, which brings in the Bannisdale Slates west and north-west of

Sedbergh. But it differs from the other rivers in this respect, that, rising in great part in the Carboniferous escarpment of Orton, it flows thence on to older and older rocks, that is to say, on to an area which has in the course of time undergone greater elevation than that in which the river rises. Many of its tributaries show the same peculiarity, as, for instance, the Rawthey, Clough, and Dee, which flow westwards from the downthrow to the upthrow side of the great Carboniferous boundary-fault, and thus, like the Lune, pass from newer on to older rocks.

In this respect the relations between the Lune Valley and the geological structure of the ground it traverses are different to those of such rivers as the Lowther, the Eamont, and the Derwent. All of these rise in the Lower Silurian Rocks (in the area of maximum upheaval), and flow towards and across the fringing escarpments of the Carboniferous strata. The origin of such valleys has become a classical problem in geology. It is supposed that at the time the rivers began to flow, the Carboniferous Rocks extended up the whole platform, of which the present hills and watersheds form remnants, and that the courses down the slopes of these rocks, once initiated, were kept and deepened by the rivers, while the Carboniferous Rocks were being denuded back into their existing scarped outcrop. This is the history of the greater number of English rivers, such as the Tyne, the Humber, the Fen rivers, the Thames, the Dee (Wales), and many others.

The course followed by the Lune also is capable of this explanation, if it be supposed that the upheaval of the Coniston Grits of the Howgill Fells and of the Howgill and Grayrigg anticlinal took place at a later period than that of the Lake District Lower Silurian Rocks, and after the southerly course taken by the Lune had been established. Similarly it may be supposed that those tributaries of the Lune which cross from the downthrow to the upthrow side of the great fault have retained and deepened valleys which were commenced before the fault existed, the erosion keeping pace with the upheaval on the upthrow side. The subject is too large and speculative, however, to be treated fully in this memoir.

It should be clearly stated that the relative height of different parts of the area at the present time is only indirectly due to the relative amount of upheaval in past times, but is, on the other hand, directly dependent upon the capability of the rocks to resist denudation. Thus the highest ground is formed by the volcanic rocks, as above stated. The Coniston Grits form a somewhat similar but less rocky tract, Whinfell Beacon (1,544 feet), Grayrigg Forest (1,619 feet), Dillicar Knot (1,144 feet), and the Howgill Fells (2,220 feet), being the principal heights. The Bannisdale Slates, which are repeated in many folds, or even crumpled or puckered, form less bold and undulating fells, or comparatively low though rocky ground, as between Kendal and Windermere. The Upper Ludlow Rocks, consisting of hard sandstones, stand out as a high ridge in the Bannisdale Slate area, and form the high and bleak country between Kendal and the Lune, of which

Benson Knot, 1,035 feet, and Lambrigg Fell, 1,109 feet, are conspicuous points. The Carboniferous Limestone forms the bold, picturesque escarpment called Cunswick and Scout Scars and the terraced limestone hills of Orton Scar, reaching elevations of 1,210, 1,250, and 1,270 feet above the sea in different parts.

A. STRAHAN.

The general structure of the district will be best understood by reference to the Sections at the end of the book. The Lower Silurian Volcanic Rocks have a general strike to the east-north-east; on the north-west the beds dip to the north-north-west, as shown in Section 1, but roll over where this section commences, and dip to the south-south-east, so as eventually after some minor undulations to pass under the Coniston Limestone series. These also, dipping in the same direction at angles varying from 20° to 40°, pass below the Stockdale Shales, which are followed in their turn by the Coniston Flags and Grits. These are succeeded by the Upper Ludlow Rocks of Docker Nook, an outlier forming the centre of a broken synclinal curve. The southern boundary of this outlier appears to be a fault, for it was found on examination that the Upper Ludlow beds, dipping from the Bannisdale Slates on the north side, were thicker than the beds which turned up again on the south. Still, on a large scale, it is a synclinal curve with an irregular anticlinal south of it; that further east brings in again not only the whole of the Bannisdale Slates, but also the Coniston Grits of Grayrigg Fell, and still further east, in the Lune Valley near Carlingill, a portion of the Coniston Flags. In the line of section, however, only the Bannisdale Slates are seen, in the anticlinal of Potter Fell. They are covered here and there by irregular patches of Carboniferous Basement Beds and Limestone, but near where the line of section crosses the London and North-Western Railway, north-east of Kendal, are seen plunging under the Upper Ludlow Rocks in the synclinal of Benson Knot. These Ludlow Beds roll over again and dip at low angles in a south-easterly direction to beyond the edge of the map.

W. T. AVELINE.

Plate III. will serve also to illustrate the pronounced unconformity between the Carboniferous System and the underlying Silurian Rocks. The general strike of the latter, together with their almost innumerable folds, and the associated phenomena of cleavage and partial metamorphism, were all the result of earth-movements, which took place before the commencement of the Carboniferous Period. To the same date also belongs the intrusion of the Shap Granite, and of the greater number of the dykes of igneous rock, which penetrate the Silurian strata. The Carboniferous Rocks are accordingly found to rest upon the upturned edges of every member of the Silurian system in turn, and to have been affected only by a more modern and a comparatively simple series of movements. They show a general tendency to fringe the Lake District, but a small portion only of the Carboniferous Limestone range is included in this Quarter-Sheet.

The Map is published in two editions, the one showing by colour the distribution of the Glacial Deposits, as well as the solid rocks (where not covered by the Glacial Beds), the other showing the solid geology only. The following are the formations, which are distinguished by colour on the two editions: —

- Alluvium, Peat, River Terraces — Recent and Post-glacial.
- Boulder Clay, Sand and Gravel — (Partly contemporaneous.) Glacial.
- Limestone, Sandstone, Limestone — Carboniferous Limestone Series
- Lower Limestone Shales
- Basement Conglomerate
  — Carboniferous.
- Kirkby Moor Flags, Bannisdale Slates — Upper and Lower Ludlow and Wenlock Shale.
- Coniston Grits, Coniston Flags — Denbighshire Grits and Flags
- Stockdale Shales. Tarannon or Pale Slates
  — Upper Silurian.
- Coniston Limestone with felsite. Bala Beds
- The Volcanic Series of Borrowdale, consisting of rough Ash and Breccia, Lava, Slate, altered Ash and Breccia
  — Lower Silurian.
- Granite. Intrusive.
- Granitic, Felsitic, Micaceous — Dykes.

A. STRAHAN.

CHAPTER II.—SILURIAN ROCKS.

(1.) Lower Silurian Rocks.

*The Volcanic Series of Borrowdale.**

These consist principally of alterations of rough ash and breccia with some bands of finer material. Much of the ash, especially of the rough variety, is well-bedded. The dip is generally to the south-south-east at angles varying from 20° to 60°, but there are many places where the dip is north-north-west, or even at right angles to the general strike of the rocks. On account of the entire absence of anything like a marine sediment, it is supposed that the rocks are accumulations of sub-aërial volcanic ejections. In this case it is highly probable that many of the higher dips and of those at variance with the general south-south-easterly inclination are due to original deposition at angles varying in amount and direction. But this general inclination, not only of the volcanic rocks, but of the overlying Silurian strata, towards the south-south-east shows that on the whole the dips are due to unequal elevation of the whole mass of rocks in post-Silurian times.

The best instances of well-bedded ash occur in the neighbourhood of Small Water, whence a thick band of massive, well-bedded, rough ash can be traced up to the south face of High Street, known as Bleathwaite Crag.

Much of the volcanic material is cleaved, but it is only the comparatively scanty supply of fine-grained ash that affords workable slates. Such are to be met with immediately south of Kentmere Reservoir, and range thence by Wren Gill into Mosedale, where they have been extensively quarried, as also at several spots along the line.† The Kentmere Slates are of the sort styled "Bird's Eye." They are marked all over with a number of little dimples, which bear a fanciful likeness to bird's eyes. These dimples look like small concretions, squeezed and flattened along the cleavage planes.

The strike of the cleavage varies from north-east to east-north-east, and the planes are generally inclined towards the north-west, but in many places are vertical or even inclined southwards. The rocks between Kentmere Reservoir and High Street, consisting nearly entirely of non-bedded rough ash, are particularly well cleaved. The very well-bedded rough ash, such as that forming Bleathwaite Crag, is never cleaved.

Amongst the ordinary rough ashes and breccias there are several bands of more highly altered rock. These get more numerous in the higher beds, that is to say, southwards, and especially is this

* The "Green Slates and Porphyries" of Professor Sedgwick.

† This series is known as the Tilberthwaite Slates, from a locality in Quarter-Sheet 98 N.W., where they have been extensively worked.

the case on the west side of the Kent, to such a degree that a large area, extending from the Kent to Troutbeck and a mile wide, is composed almost, if not quite, entirely of highly altered rocks. This is indicated on the map by the omission of the dots from the ground colour. As we follow the whole set of beds east-north-eastwards along the strike to the region of the Shap Granite, all trace of distinction between coarse and fine, bedded and not bedded, compact and open-grained, is lost, and the whole mass becomes in the neighbourhood of the granite of a uniform, compact, blue, flinty character, and it is only here and there on some weathered surface that any resemblance can be traced to the ordinary type of volcanic ash. This is doubtless due to alteration caused by the intrusion of the granite. The belt of altered rock surrounding the granite is indicated by the absence of dots. As the alteration mentioned above as occurring among the higher beds west of Kentmere is of a similar character, we are led to suppose that it is due to the presence of granite beneath the surface, perhaps at no great depth, in the region in question.

Amongst the ashes and breccias there are several beds of trap or trap-like rock. As the beds of highly altered ash, especially if originally fine-grained, are very like traps, it is often extremely difficult to decide whether a "trap-like" rock is really a trap or merely an altered rock. As examples of such doubtful beds we may mention the band of trap-like rock running from the north-east elbow of Kentmere Reservoir, and a similar mass at Lingmell End, half a mile north of the reservoir. But there are many beds of true trap, by which we mean either beds of contemporaneous lava, or sheets or masses of intrusive rock. The most noteworthy of these true traps is the thick band extending from near Rainsborrow Crag to Brant Tongue in Mosedale. This proved a useful bed for mapping purposes, as by tracing it we were enabled to discover faults which might otherwise have escaped notice; for among the Volcanic Rocks it is difficult, or even impossible, to detect faults in the absence of well-marked beds: but whether the trap is a lava or an intrusive sheet is somewhat doubtful. Mineralogically it is a diabase of the species termed by the late Mr. J. Clifton Ward a felsi-dolerite. Mr. Ward, who visited it with me, thought it was probably a lava. On the other hand, its want of strict parallelism with the Mosedale Slates would suggest the idea of its being an intrusive sheet: but as there must have been a great amount of contemporaneous denudation going on among the sub-aërial products, so that subsequent beds might easily lie across those previously laid down, we do not think the fact of the trap trending across the strike of the slates a proof of its being intrusive. This trap is finally lost sight of at Brant Tongue, but whether it thins out, or is cut out by a fault is uncertain.

J. R. Dakyns.

Coniston Limestone Series.

This series crosses the north-west corner of the map, with a strike of E. 20° N. The dip, which ranges in amount from 20° to 60°, is to the south-south-east, indicating that the Limestone Series overlies the Volcanic Rocks last described. It is believed to be equivalent to a portion of the Bala series of North Wales, about the horizon of the Bala Limestone.

The Coniston Limestone Series consists of the following members taken in descending order:—

Ashgill Shales.
Limestone.
Felsite.
Calcareous ash with fossils.*

The lowest two members occur in the eastern part only of the Quarter-Sheet. The felsite appears on the east side of Kentmere and thickens eastward, while the calcareous and fossiliferous ash thins in this direction, and ceases to be recognisable to the east of Stockdale. Near Shap Wells, however, two distinct outcrops of limestone (or of limestone and calcareous agglomerate) occur, with a felsite associated.

It is of interest to note that rocks of igneous origin appear in the Coniston Limestone Series from Coniston south-westwards to the sea (Quarter-Sheet 98 N.W.), with a tendency to expand towards the south-west. On the east side of the Howgill Fells also (Quarter-Sheet 97 N.W.) a contemporaneous felspathic rock of volcanic origin occurs in the same series. A similar sequence, but of greatly increased thickness, is found at the foot of the Cross Fell range, north and east of Appleby (Quarter-Sheets, 102 S.W. and S.E.), while in the Craven area grits resembling ash-beds occur just above the Coniston Limestone.†

The shales, moreover, which constitute a large part of the series, and the impurities of the limestone bands themselves, appear to consist chiefly of a fine felspathic sediment or ash, either ejected contemporaneously or washed out of the already existing ash-beds of the Borrowdale series. From these facts it would appear, as stated by Professors Harkness and Nicholson,‡ "that the volcanic activity, of which the Lake District became the theatre subsequent to the deposition of the Skiddaw Slates, continued to prevail, at any rate, up to the later portion of the Bala period."

The junction of the Coniston Limestone and the Borrowdale series, wherever exposed in this Quarter-Sheet, appears to indicate perfect conformity. It should be stated, however, that near Coniston the relations of the Coniston Limestone to the underlying

* The "Style-End Grassing Beds" of Professors Harkness and Nicholson. *Quart. Journ. Geol. Soc.*, vol. xxxiii., p. 462, 1877.

† T. McK. Hughes, "On the Break between the Upper and Lower Silurian of the Lake District, &c." *Geol. Mag.*, vol. iv., p. 354, 1867. In this paper reference is made also to the passage of the Green Slates (the Borrowdale Volcanic Series) up into the Coniston Limestone Series (p. 349).

‡ On the Strata . . . between the Borrowdale Series . . . and the Coniston Flags. *Quart. Journ. Geol. Soc.*, vol. xxxiii., pp. 461–484, 1877.

Volcanic Rocks are such as to have led to the belief that the latter were subjected to movement and to a certain amount of denudation before the deposition of the limestone*; for the Limestone Series not only rests on very different horizons of the Volcanic Series in different parts of the southern side of the Lake District, but the strike of the two series is found to be locally discordant. This discordance is, however, accounted for by Professors Harkness and Nicholson,† on the supposition "that the Lake District was not entirely submerged at the time when the Coniston series began to be laid down, but that a portion of the volcanic region remained above the level of the sea, its vents occasionally giving exit to showers of volcanic ashes or even currents of lava . . . . In such a case beds of limestone would wrap round sheets of lava so as to be apparently transgressive thereon, or might be instratified with strata of tuff, of ash, or of volcanic rocks. Any seeming discordance . . . . would be due . . . . simply to the difference in the method by which the two groups were formed."

Mr. Goodchild‡ also points out that the eruption of the vast mass of rock, constituting the Borrowdale series, must probably have caused local subsidence in the neighbourhood of the *foci*, and that this local subsidence appears to have been accompanied at no great distance by movements of elevation. Thus the accumulation of volcanic *débris* in subsiding areas would proceed contemporaneously with denudation in the rising areas adjoining.

A. STRAHAN.

These explanations, however, which are derived from purely theoretical considerations, do not, in my opinion, apply to the Lake District. Observations in the field show that the Coniston Limestone Series, west of Coniston, is lying on far lower beds of the Borrowdale Series than at Shap. There is a far greater discordance than can be accounted for by any local disturbance. I regard the volcanic rocks which were ejected during the deposition of the Coniston Limestone Series as of much later date than those of the Borrowdale Series. That there should have been volcanic activity during the later period is very likely, for we have similar rocks in the equivalent beds in North Wales.

W. T. AVELINE.

The tracing of the Limestone Series in the eastern part of this Map is rendered difficult, partly by the prevalence of Drift, and partly by the influence of the intrusive mass of Shap Granite, which has altered the rocks in its immediate neighbourhood almost beyond recognition. It is believed also that for a distance of nearly three miles the whole series, with the overlying Stockdale Shales, is cut out by a strike fault.

On the west side, however, the outcrop of the Limestone may be followed almost uninterruptedly. One of the best exposures

* On the Continuity and Breaks between the various Divisions of the Silurian Strata in the Lake District, by W. T. Aveline. *Geol. Mag.*, vol. ix., p. 441, 1872.

† On the Strata . . . between the Borrowdale Series . . . and the Coniston Flags. *Quart. Journ. Geol. Soc.*, vol. xxxiii., pp. 461–484, 1877.

‡ Observations upon the Stratigraphical Relations of the Skiddaw Slates. *Proc. Geol. Assoc.*, vol. ix., No. 7, pp. 476–480.

occurs in Skelgill, a few yards beyond the western margin of the map. The calcareous shales (Ashgill Shales) are seen in the north-west bank of the stream, the Graptolitic Mudstones occupying the bed of the stream, as described on p. 12.

The base of the Limestone may be traced thence down the hill-side into Troutbeck, the last exposure being in a small gill opposite Long Green Head. But on crossing the river we find the outcrop shifted about three quarters of a mile to the south; clearly by a large fault along the bottom of the valley.*

The first good exposures of the Limestone occur at Moor Head, where the boundary between it and the Volcanic Rocks follows the road into Kentmere very closely for more than a mile, the two being frequently seen in close proximity. Some very good exposures of this junction are to be found in the gill running down from Ewe Crags by Kentmere Hall. The Limestone, though split up by shale bands, contains beds of considerable purity. It rests directly upon a slightly uneven surface of ash of varying coarseness, without any appearance of unconformity. The upper beds of the Limestone are not only split up by shales, but are nodular and impure. The series thins out considerably between Troutbeck and Kentmere.

The Limestone is next seen in the bed of the Kent, in a not very accessible ravine cut through the Drift and boulders that block the valley near this village, but it is concealed by Drift up the east slopes of the valley till we reach Stile End, near which farm it is split up by the felsite previously alluded to.

A. STRAHAN.

This contemporaneous felsitic lava is very irregular in thickness. It reaches a thickness of about 700 feet where it crosses Stockdale Beck and Long Sleddale, and though it cannot be traced across Crookland Beck, appears in some force on Great Yarlside, but again thins away at Wasdale Head. There the fault before alluded to may partly account for its thinness, but the ground is so much obscured by Drift as to make it difficult to come to any certain conclusion.

W. T. AVELINE.

The felsite has been microscopically examined and described by Mr. Rutley.† A specimen collected at Tills Hole, at the northern end of Long Sleddale, shows "a well-marked perlitic structure, and is completely divitrified . . . That this was once a perlitic obsidian, or perlite, as some might prefer to call it, there can be no doubt" (*op. cit.* pp. 12, 13, and Pl. II., Fig. 1). Another specimen from Red Crag, 1½ miles north-east of Stockdale, is an obsidian showing under the microscope perlitic structure, and spherulitic divitrification (*op. cit.* p. 12, Plate II., Fig. 2). A third specimen collected on the south side of the Beck, 300 yards north-west of Shap Spa Well, is without much doubt a felsitic

* The outcrop of the Coniston Limestone was very accurately traced, and the Troutbeck fault noted by Professor Sedgwick in 1831. *Trans. Geol. Soc.*, ser. 2, vol. iv., pp. 49–54, and pp. 67* and 68* (Appendix 1833).

† The Felsitic Lavas of England and Wales (Geological Survey Memoir), 1885.

lava (*op. cit.* p. 14). In the same memoir are described similar rocks from the Bala Beds of North Wales.

A. STRAHAN.

The shales underlying this felsite are brown in colour, sandy, and rather ashy in parts, which may arise from their having been derived from the underlying ash-beds previous to their consolidation, or from their having deposited during the later period of volcanic action, while ash was still falling from volcanic vents somewhere near. They have been much quarried, and contain numerous fossils, all common to the Bala Beds of North Wales. They are first clearly separated (by felsite) from the upper part of the Coniston Limestone series at Stile End near Kentmere.* They may be followed thence into Long Sleddale about 200 yards north of Tills Hole, some quarries near the watershed showing the ashy though calcareous and fossiliferous character of the rock. On the east side of Long Sleddale they are seen again as bluish and brown shales in some quarries east of Sadgill, but further east thin away, so as to be hardly recognisable in Stockdale Beck, and to eventually leave the felsite in contact with the volcanic ash series, as seen at Red Crag. This lower division of the Limestone is not seen again till we reach Shap Wells, as subsequently described.

The beds overlying the felsite and forming the top of the Coniston Limestone in this part of the district consist of hard, thin-bedded, and nodular limestones split up by shales, which have the appearance of being made up of felspathic sediment. They reach a thickness of about 200 feet on the west side of Long Sleddale, but are much less than that in Stockdale Beck. On the east side of this beck the upper boundary can be traced for only about half a mile, beyond which the ground is totally obscured by Drift. There is, however, very little doubt that there is a fault running E.N.E. and W.S.W. on the south side of Wasdale Head and Yarlside Crag, that cuts off not only the limestones, but some thickness of beds both above and below them.

W. T. AVELINE.

A highly metamorphosed limestone has been noticed by Professors Harkness and Nicholson on the line of this fault, near Wasdale Head. The rock is described as having a white colour and a crystalline structure. "It has a fine scaly structure, with a pearly lustre, and resembles fine-grained *Schiefer spar*. It contains within it *Idocrase*, and in the upper portion, where it has been subjected to the action of the water of the stream, the idocrase almost remains alone, the carbonate of lime having been removed."†

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* Whence they are referred to as the "Style End Grassing beds," by Professors Harkness and Nicholson. *Quart. Journ. Geol. Soc.*, vol. xxii., p. 480, 1866, and vol. xxxiii., p. 462, 1877.

† *Quart. Journ. Geol. Soc.*, vol. xxxiii., p. 466.

The section in the beck at Shap Wells is very peculiar. In the first place the ravine has been cut through the thick covering of Drift which overspreads Wasdale Foot and forms the hill on the north side of Shap Wells Hotel. The rock disclosed in the bed of the stream consists for the greater part of the distance of the Basement Conglomerate of the Carboniferous, but in two places the stream has cut through this conglomerate also, so as to disclose the underlying Silurian Rocks. These are first exposed at the Spa Well, where calcareous agglomerate is seen dipping to the south-east at 30°. The rock is composed, according to Professors Harkness and Nicholson,* of fragments of various rocks, consisting of angular fragments of quartz, with numerous fragments of limestone, felspathic ash, and perhaps traps, the cementing matter of the whole being a granular limestone, apparently devoid of fossils. This breccia is attributed by them to a volcanic outburst, not far from the neighbourhood of Shap Wells, towards the close of the period during which the Coniston Limestone was deposited. The second exposure occurs 300 yards above the Spa Well, and extends for 90 yards. The Coniston Limestone, in its normal form, is seen dipping S. 40° E. at a variable angle. It is overlaid by a mass of felstone, which has the appearance of being intrusive in the Limestone Series. The felstone, as noted by Mr. Goodchild, contains nodular masses of silica, and is similar to that which is exposed in the Railway cutting, south of Shap Summit cutting.

(2.) Upper Silurian Rocks.

The Stockdale Shales.

The Stockdale Shales, which form the base of the Upper Silurian in the Lake District, are separated (according to Mr. Aveline) by a palæontological break, accompanied by overlap, from the underlying Coniston Limestone series. They are capable of being sub-divided into a lower bed of dark anthracitic-looking shales, with Graptolites, and known for this reason as the Graptolitic Mudstones,† and an upper sub-division consisting of pale and sometimes purple shales, devoid of Graptolites, except where a thin band of darker shale may be interstratified. The pale and purple shales are precisely similar to the Tarannon Shale, or Pale Slates, which were first traced and named by Mr. Aveline in North Wales, and which, in the absence of the Pentamerus Beds, or May Hill Sandstone, form the base of the Upper Silurian series in that district. The Stockdale Shales were named by Mr. Aveline from the beck and hamlet of that name in Long Sleddale.

The Upper Silurian affinities of the Graptolitic Mudstones have been questioned by Dr. Hicks,‡ Professor Lapworth,§ and Pro-

* *Quart. Journ. Geol. Soc.*, vol. xxxiii., p. 466, 1877. The rock was first noticed by Professor Sedgwick. *Trans. Geol. Soc.*, Ser. 2, vol, iv., p. 68*, 1833.

† Harkness and Nicholson. *Quart. Journ. Geol. Soc.*, vol. xxiv., p. 296, 1868. Nicholson and Lapworth. *Rep. Brit. Assoc.* for 1875.

‡ *Geol. Mag.*, Dec. II., vol. iii., pp. 335 and 429 (1876).

§ *Geol. Mag.*, Dec. II., vol. iii., p. 477 (1876).

fessors Harkness and Nicholson,* on fossil evidence. As pointed out, however, by Mr. Aveline,† the mudstones graduate upwards into the pale and purple-coloured slates, which in their turn graduate upwards into the Coniston Flags, and so upwards into the Bannisdale Slates. The disappearance of the Graptolites of the mudstones is not sudden; they are found in the dark bands interstratified with the Pale Slates to the very top. Mr. Marr also alludes to the close relationship of the Graptolitic Mudstones with the Pale Shales, and points out that they contain very few fossils in common with the Coniston Limestone Series.‡ A list of the fossils will be found in Tables II. and III. In Table III., a list of the Graptolites by Prof. C. Lapworth, the Graptolitic Mudstones are referred to as the Skelgill Shales.

One of the best sections in the Stockdale Shales occurs in Skelgill, a few yards beyond the western margin of this Quarter-Sheet. The following measurements are given by Mr. Marr in the paper quoted above :—

Section at Lower Foot-bridge, Skelgill.

		ft.	in.
Light blue flags	seen to	11	0
Mudstones	,,	2	0
Blue flags	,,	2	6
Mudstones	,,	0	8
Blue flags	,,	4	0
Mudstones (*Graptolites convolutus*, var. *spiralis*, and *Diplograpsus tamariscus* at base)	,,	6	6
Blue flags with bands of calcareous concretions	,,	8	0
Mudstones	,,	0	8
Blue flags with bands of calcareous concretions	,,	4	0
Mudstones	about	6	0
Blue flaggy mudstones	,,	3	0
Mudstones, flaggy at base		6	0
Basement bed of Silurian (Sedgwick)		1	0
Coniston Limestone Series		—	
		55	4

These beds are frequently exposed also by Moor Head down into Kentmere. The Graptolitic Mudstones are seen a few yards east of the watershed between Kentmere and Long Sleddale, and again in the lower part of Stockdale Beck. Brow Gill,§ a tributary of this beck, follows the line of outcrop of the Coniston Limestone and Graptolitic Mudstones for some yards. East of this the beds are generally obscured by Drift, but have been observed about 200 yards south of Shap Spa Well.‖

A. STRAHAN.

* *Quart. Journ. Geol. Soc.*, vol. xxxiii., p. 474 (1877).
† *Geol. Mag.*, Dec. II., vol. iii., p. 527 (1876).
‡ *Quart. Journ. Geol. Soc.*, vol. xxxiv., p. 880 (1878).
§ Apparently the stream referred to by Professor Harkness as Arncoside Beck. *Quart. Journ. Geol. Soc.*, vol. xxiv., p. 296.
‖ Harkness and Nicholson. *Quart. Journ. Geol. Soc.*, vol. xxxiii., p. 466, 1877.

The Coniston Flags and Grits.

The Coniston Flags lie next above the Stockdale Shales. They are referred, with the included and overlying grits, to the Wenlock series, and are precisely similar to the Denbighshire Grits and Flags, which overlie the Tarannon Shale in North Wales. They contain also the same large Orthoceratites and Graptolites.

In the district west of the River Lune it will be seen that there are three beds of grit occurring at three different horizons in this series on the west side of the map, only the highest and thickest being continuous across the country. The lowest bed increases considerably in thickness when traced westwards beyond the district included in this map, but on the east it thins out and disappears in about three miles from the edge of the map. The middle grits also diminish in thickness to the east, and are lost after crossing Crookdale Beck. The highest beds also are considerably thicker on the west than on the east. The whole series thus appears to thin out to the east.

The Coniston Flags consist of dark blue sandy mudstone, showing fine lines of lamination and splitting into good flags when the cleavage and bedding coincide or nearly so, and into rough slabs when the cleavage is across the bedding. The Coniston Grits consist of thick beds of tough sandstone or grit with interstratified slates or flags.

Fossils are not abundant, except in the lower part of the Flags, where Graptolites and Orthoceratites are tolerably plentiful, as may be seen on the east side of Kentmere. In some sandy flags above the lowest grit *Phacops obtusicaudatus* occurs abundantly, associated with encrinites and a few traces of other fossils. These beds, which will be referred to as the Coldwell Beds,* from a quarry of that name near Ambleside, can be traced for many miles across the country.

Cardiola interrupta, *Orthoceras primœvum*, and *O. subundulatum* are not uncommon in the flags between the upper grit and the middle grit, quarried near Latterigg Cottage, north of Windermere.

It will be noticed on referring to the map that the Coniston Flags and Grits occupy two distinct areas, the one where they follow the older formations in regular order, and range across the north-western part of the map from west-south-west to east-north-east, and the other where they occupy the high lands around Whinfell Beacon and Grayrigg Common on the west side of the Lune, and the Howgill and Langdale Fells on the east side of the Lune.

In the first area the Coniston Flags and Grits have a steady dip to the south-south-east at angles varying from 60° to 80°. The total thickness of this series is about 6,800 feet, being 2,800 feet for the flags with subordinate grits, and 4,000 feet for the

* On the use of this name, *see also* Marr, *Quart. Journ. Geol. Soc.*, vol. xxxiv., pp. 880–3, 1878.

upper grits; but the flags, as well as the grits, become thinner towards the east side of the area. In their course they are much broken by faults chiefly running south-south-east and across the strike of the beds. Some of these faults are of considerable magnitude. Other important faults run along the strike, as, for instance, the fault mentioned on p. 3, forming the southern boundary of the Ludlow Rocks, and the fault which brings the lower beds of the Coniston Flags against the Shap Granite and the Coniston Limestone series.

In the second area the Coniston Grits are brought up in a broad anticlinal roll, which, on the west side of the Lune, is about $3\frac{1}{2}$ miles wide from north to south.

W. T. AVELINE.

The structure of the district east of the River Lune will be best understood by reference to Plates Nos. 2 and 3. Section 2 is drawn on the scale of 2 inches to 1 mile, about N. 30° W., from the Coniston Limestone of Helm Gill, Dent (Quarter-Sheet 98 S.E.), across the Sedbergh Valley about a mile further east than Section 3, as far as Arant Haw, 1,950 feet above sea level. At the south end of the section the Coniston Flags and Grits dipping south are faulted against the Coniston Shale and Limestone. They roll over in the Riggs anticlinal (at the southern margin of Quarter-Sheet 98 N.E.) and dip away to the north, but turn up again near and under the Carboniferous Conglomerate east of Sedbergh. The whole series, with the Conglomerate, is cut off by the Sedbergh faults, beyond which it resumes its northerly dip, and the Coniston Flags are at the surface again, plunging under the Coniston Grits of the Howgill Fells.

Section 3 is drawn on the scale of 1 inch to a mile, running due north, a little west of Sedbergh. The south end of the section is across similar ground to that traversed by Section 2, but about a mile further west. In a large view the beds of Arant Haw may be considered as the northern slopes of the Riggs anticlinal, broken by the Sedbergh faults, which bring the Coniston Flags again to the surface, dipping to the north under the Coniston Grits of the Howgill Fells. These all plunge under the Bannisdale Slates in the Castley Knot synclinal, and turning up again go over the Coniston Flags in the broken double anticlinal of Carlingill. Dipping away to the north with many subordinate faults and folds they are succeeded by the Bannisdale Slates and Upper Ludlow Rocks, which are also faulted and crumpled along axes parallel to the general lines of disturbance of the higher Silurian ground to the south. These disturbances are pre-Carboniferous, and the Carboniferous Rocks with the Conglomerate at their base creep over the Bannisdale Slates and Ludlow Rocks. A subsequent upheaval has tilted the Carboniferous Rocks up a little on the south.

It will be noticed that the strike of the Silurian Rocks west of the Lune is east-north-east, but east of the Lune they strike nearly east, and still further to the south-east, north of Ingleton and Settle, the strike of these rocks is east-south-east, and parallel

to the Craven faults.* So corresponding to the prevailing north-north-westerly faults on the east of the Lune we have on the west of that ancient river-valley a prevailing set of faults running north and north-east.

(*a.*) *Coniston Flags.*

The base of the Coniston Flags is nowhere seen east of the Lune in the district included in this map. On the north side of Helm Knot the Flags with Graptolites and Orthoceratites are exposed in a small quarry, and again north of Thorny Hills there is a small section in dark blue flags. Both these localities are in Quarter-Sheet 98 S.E.

The Coniston Flags are exposed also in the rivers Clough and Rawthey, in both of which they are much interrupted by faults, mica-trap dykes, and pockets, or faulted-in wedges, of Carboniferous Conglomerate.

In Hebblethwaite Gill the Coniston Flags are seen faulted on the west against this Conglomerate and on the east against the Pale Slates. (Quarter-Sheet 97 N.W.)

On the lower slopes of Crook, Winder, and Knot, as seen especially in the gills dividing these hills, there is a belt of grit occurring between the Flags in the River Rawthey and those on the fell side. There is strong evidence that these grits are faulted in, but whether they should be referred to the Coniston Grits, or are a gritty series in the Coniston Flags, there is not sufficient evidence to show.

In the centre of the Carlingill anticlinal the Coniston Flags are again brought to the surface. The beds are much contorted and broken by faults, but in a general way it can be made out that they plunge under the Coniston Grits of the Tebay Fells. I found only a few obscure Orthoceratites and Graptolites in the Coniston Flags of this district, but just outside the Map on the south fossils are numerous and well preserved.†

(*b.*) *Coniston Grits.*

The Coniston Grits constitute the greater part of the high land extending from the Rawthey Valley to within a mile and a half of the Lune, where it runs along the north side of the Tebay and Langdale Fells. They present their usual character of tough greywacke, with subordinate beds of roughly cleaved shaly sandstone and slate. The lower part, with subordinate flaggy beds, graduates insensibly down into the Coniston Flags, and in the upper part the shaly sandstones pass up still more gradually into the striped sandstones and flags of the Bannisdale Slate Series.

* For references to previous writers on the districts, *see* Explanatory Memoir on 98 S.E.

† Explanatory Memoir on 98 S.E., p. 9.

The Coniston Grits form nearly the whole of the Riggs south of Sedbergh, where they are exposed in many sections and have yielded numerous fossils. Fossils are also not uncommon, especially towards the lower part of the series, in the Howgill Fells. At Cautley Crag especially *Cardiola interrupta* is abundant, *Pterinea tenuistriata* and *Orthoceras subundulatum* not uncommon, and near Cautley Spout I found one specimen of *Lituites giganteus*.

Within about 1,200 feet of the base of the Coniston Grits there is a remarkable fossiliferous band. It consists of a very coarse grit, like some of the coarser parts of the Denbighshire Grits, and contains numerous fossils. Specimens of the following were collected from this grit on Winder and Crook, about three-quarters of a mile north of Sedbergh :—

A small Bryozoon.
Favosites aspera, D'Orb.
Halysites catenularius, Linn.
Monticulipora, sp.
Petraia, sp.
Cyathocrinus, sp.
Cornulites serpularius, Schloth.
Tentaculites tenuis, Sow.
Beyrichia Klædeni, McCoy.
Phacops, sp.
Chonetes lata, V. Buch.
Orthis elegantula, Dalm. (var. *O. lunata* or *orbicularis*).
Rhynchonella navicula, Sow.
R. nucula, Sow.
Spirifera crispa, Hising.
S. elevata, Dalm.
Cardiola interrupta, Sow.
Holopella gregaria, Sow.
Bellerophon, sp.
Orthoceras (?), sp.

This band, which, to avoid repetition, will be referred to as the Winder Grit Band (*see* Plate II.), is not more than 20 feet thick. It can be traced along the south slopes of the hills from Winder to near Hobdale Beck. It is seen on the Riggs also, at about the same distance above the Coniston Flags.*

The most remarkable circumstance in connexion with this fossiliferous bed is that the *group* of fossils is entirely different from that which usually occurs in the other fossiliferous portions of the Coniston Grits, both above and below, and has an exclusively Ludlow facies. The prevalence of *Rhynchonellæ*, especially *R. navicula*, of *Chonetes lata*, of that round rather than elongated variety of *Orthis elegantula*, known as *O. lunata* or *orbicularis*, and other fossils, would, in Wales, lead one to suspect that we were somewhere about the passage beds from Upper to Lower Ludlow.

Another point worthy of note is the enormous interval between the horizon where this fossil band occurs, and the formation or part of the series where the fossils which characterise it become

* *See* Memoir on Quarter-Sheet 98 S.E., p. 11.

the prevalent forms. If we except the doubtful beds at Cocklake, near Newbiggin, in the adjoining district, no such group of fossils occurs through about 7,000 feet of strata, while in the intermediate portions fossiliferous beds with a totally different group are frequently seen. This, therefore, seems to be one of M. Barrande's colonies. A group of fossils is lost in this area for a long period, and reappears in newer rocks. In the cases he has adduced, however, the forms of life common in older rocks appear to recur over a limited area and for a short time in a later period. In this case the earliest appearance of the group is in a band of small thickness and limited extent, while it is in newer rocks that that they become the prevalent forms.

T. McK. Hughes.

The Bannisdale Slates.

The name of Bannisdale Slates was given to these rocks by Professor Sedgwick, from the dale of that name in this district, in the upper part of which trials for slates were made many years ago. They are considered as in part the equivalents of the Wenlock Shale when they are indicated by the letter and number $b^{6''}$, and in part of the Lower Ludlow when they are marked by the index ${}^{6}b^{7}$. When the exact equivalent is doubtful the index ${}^{6''}b^{7}$ is used. In the absence of the Wenlock Limestone or of any marked difference of lithological character between the upper and lower part of the group, it was found impracticable to make any twofold division of these beds in the western part of the district, or to correlate them exactly with the Welsh series.

The boundary line between the Bannisdale Slates and Coniston Grit also is very arbitrary, as beds of grit recur in the Bannisdale Slates and slates in the upper part of the Coniston Grit. Moreover, we know that beds of grit and slate frequently thicken and thin out along the same horizon.

The Bannisdale Slates may be described as sandy mudstones divided by thin bands of hard sandstone and occasional beds of grit. The sandy mudstones are much jointed and roughly cleaved, never making good slates, but often large rough slabs, quarried for paving or building stones. The only tolerable slates were formerly worked in the higher part of the valley called Bannisdale, in the very lowest beds of the series.

True flags rarely occur in the Bannisdale Slates, especially in the western part of the district. In the eastern area, near Grayrigg and Lowgill, some very thin-bedded flags are found.

The total thickness of the formation is about 5,200 feet.

W. T. Aveline.

Fossils are rare. In the flag quarry at Crook of Lune I observed obscure traces of Orthoceratites and Graptolites, probably *O. primœvum*, and *Monograptus priodon*, also some well preserved specimens of a variety of *Calymene Blumenbachii*, rather like *C. tuberculosa* in form, but it is not distinctly tuberculated, and is remarkable for its broad produced and turned-up lip.

In a flag-quarry east of Castley Knot *Monograptus* (*Graptolithus*) *colonus, M. priodon, Orthoceras primœvum,* and *O. subundulatum* are not uncommon, but it is rather doubtful whether those beds should be included in the Bannisdale Slates or left in the Coniston Grit.

From the passage beds * included with the Bannisdale Slates on the north side of the Tebay Fells I found the following fossils in the localities mentioned after each :—

Petraia, sp., like *subduplicata,* Red Gill, Wyegarth Gill.
Actinocrinus pulcher, Red Gill.
Palœaster hirudo, Tebay Gill.
Acidaspis, "n. sp.," Salter, Red Gill, Wyegarth Gill.
Phacops, "sp., like *Davisii,*" Salter, Bowderdale.
Athyris ? Red Gill.
Orthis, sp., Red Gill, Tebay Gill, Langdale Beck, Bowderdale.
Pterinea tenuistriata, Red Gill, Bowderdale, Wyegarth Gill.
Orthoceras, sp., Red Gill, Langdale Beck.

In two small railway cuttings north-west of Sedbergh Station there is a dark blue shale or flag which has been referred to the Bannisdale Slates. The Bannisdale Slates are again troughed in by the broken synclinal, near How Gill, between the Carlingill and Sedbergh anticlinals, and occur all along the north slopes of the Tebay Fells on the north side of the Carlingill anticlinal.

Higher beds included in the Bannisdale Slate group are seen all down the Lune from near How Gill to the southern margin of the district included in this map. These beds differ considerably from the lower part just mentioned, and in this part of the district might with advantage be separated from it. They consist of a blue or grey thin-bedded sandstone or tough greywacke with subordinate beds of laminated shale, and form the passage beds into the massive sandstone of the Kirkby Moor and Benson Knot Beds above. They are the beds referred to in the Explanatory Memoir on Quarter-Sheet 98 S.E., p. 13, under the head (4).

T. McK. Hughes.

The few lead-veins, which have been noticed in this area, occur in the Bannisdale Slates. A vein of pink sulphate of baryta with a little galena has been opened by the road-side a quarter of a mile south-west of Knipe Tarn. About two miles to the north-east, in a hollow south of Borwick Fold, a shaft has been sunk in search of lead-ore, and an engine erected. Lastly, a vein running E. 30° S. has been worked on Staveley Head Fell, and by a level opening into the Kent valley, south of Millrig. In all these cases the works have been abandoned as unprofitable.

A. Strahan.

Kirkby Moor Flags.

These rocks, marked on the map by the index $b^{7''}$, are the equivalents of the Upper Ludlow formation of Wales. They

* These are the beds included under (6) of the list given in the Memoir on Quarter Sheet 98 S.E., p. 13.

consist chiefly of thick beds of hard sandstone, which often take a massive concretionary structure, with thinner and more regular beds of fine-grained micaceous flaggy sandstone. Fossils are very plentiful in this formation, generally occurring in bands, which, when decomposed, form conspicuous lines of soft, brown, earthy rock in the hard grey sandstone. The most common and characteristic fossils are *Holopella gregaria*, *H. conica*, and *Chonetes lata*. (*See also* Appendix, Table II.)

The Upper Ludlow Rocks may be seen below the Carboniferous Limestone near Scarfoot and Barrowfield west of Kendal. They extend also from the Carboniferous Rocks near Kendal by Docker Fell and Benson Knot to the Firbank fault west of the Lune Valley. The boundary between this formation and the Bannisdale Slates is broken by many smaller faults parallel to the Firbank faults, with a down-throw to the west. An outlier of Upper Ludlow Rocks (*see* p. 3) runs in a narrow band from about three quarters of a mile north-west of Staveley by Docker Nook to Borrow Beck, lying in the trough of a sharp synclinal which crosses the centre of the district from Windermere to near Tebay. This outlier consists of beds in composition like those forming the main mass, and containing similar fossil bands. The evidence for its southern boundary being a fault has been given previously.

W. T. Aveline.

Another outlier of Upper Ludlow Rocks occurs about a mile north-west of Tebay. The beds seen on the north-east side of the railway near Loups Fell Side are very similar to the Firbank beds, and contain *Rhynchonella navicula* abundantly. But the beds which may be seen projecting in iceworn bosses through the Alluvium on either side of the railway embankment near Low Scales, from the frequency of *Chonetes lata*, *Orthis orbicularis*, &c., and the large exfoliating concretionary masses in the micaceous sandstone, more resemble the beds referred to the Upper Ludlow. They are cut off abruptly on the west by the Low Scales fault. For further description of the Upper Ludlow Rocks, *see* Explanation of 98 S.E., the adjoining Quarter-Sheet on the south.

T. McK. Hughes.

CHAPTER III.

THE CARBONIFEROUS ROCKS.

Introduction.

The Carboniferous Rocks which come within this Quarter-Sheet are sub-divided as follows:—

Carboniferous Limestone Series	Melmerby Scar Limestone. Ash Fell Beds; sandstones and limestones. Ravenstonedale Limestone.
Lower Limestone Shales.	
Carboniferous Basement Beds	Red conglomerates and sandstones.

The principal areas occupied by the Carboniferous Rocks in this map are in the neighbourhood of Orton in the north-east, and of Kendal in the south. Some small outliers occur in the depressed area of Skelsmergh and Grayrigg, which separates the Hay, Lambrigg, and Firbank Fells from those which flank the Lake District. The Basement Beds are found also in the Sedbergh valley, into which they extend from an area where they are very fully developed (Hebblethwaite Gill, Quarter-Sheet 97 N.W.).

It should be noted here that the divisions given in the table above are not clearly recognisable in the Kendal area, or in the outliers. The Lower Limestone Shales appear to be absent, and the Ash Fell Beds to be represented only by a band of sandy limestone with quartz pebbles, if at all. The Carboniferous Rocks at Kendal are therefore separated merely into Limestone and Basement Beds.

In the neighbourhood of Orton the rocks have a gentle northerly and north-easterly dip, and are remarkably free from faults. They form part of a prolonged escarpment of these rocks which fringes the Lake District on its north and east sides. In the Kendal area they dip to the east, and present an unusually precipitous and continuous face to the west; on the east they are cut off by a fault, the course of which will be described subsequently. This limestone forms the most northerly projection from a much faulted range of Carboniferous Rocks, which fringes the Lake District on its south side. The Skelsmergh and Grayrigg outliers are much obscured by Drift, but it is believed that the limestone rests naturally, as shown, upon the platform of Upper Silurian Rocks, and is not introduced by any important fault.

It will be readily seen that these outliers (and others in Quarter-Sheet 98 S.E.) indicate that the Carboniferous Rocks must have once extended far beyond their present limits. When standing on any of the watersheds near the head of Bretherdale or Langdale it becomes apparent to the observer that the ridges separating the dales form the remains of a gently inclined platform, having a slope about equal to, and in the same direction as, the inclination of the Carboniferous Rocks, while the dales themselves

are water channels cut in this old slope after the retreat of the Carboniferous escarpment. The relations of the Carboniferous and Silurian Rocks are illustrated in the Figure (p. 25) by Mr. Tiddeman, and in Plates I. and III. In every case the Carboniferous Rocks rest with a most pronounced unconformity on the underlying Upper and Lower Silurian Rocks.

The Carboniferous Basement Beds.

This subdivision varies considerably in thickness, being sometimes absent altogether, as on the west side of Kendal Fell. It varies also in character from a coarse conglomerate to a sandstone with a few scattered pebbles. The conglomerate beds are made up of fragments of rocks derived from the older rocks of the north-west of England, sometimes well-rolled, sometimes angular, sometimes of great size, sometimes graduating down into sand or clay, and all stained red by peroxide of iron, except in patches of greenish or white, in which calcareous matter is always found to occur.

The top beds of the conglomerate consist of alternations of clay, sandstone, grit, and conglomerate, containing, unlike the lower beds, pebbles of white quartz. These beds, which have a prevailing green colour, form a passage up into fossiliferous shales and impure shaly limestones which form the base of the Carboniferous Limestone. The green conglomerates with quartz pebbles and the shales with impure limestones are grouped together under the title Lower Limestone Shales. Fossils first appear in the upper part of this sub-division. No fossils, except derivative specimens in the included fragments, have ever been found in the Basement Beds.*

In the Kendal neighbourhood the Carboniferous Limestone rests in its southern part directly on the Upper Ludlow Rocks, but where the road to Furness descends the scar there are indications of the red beds intervening, and 300 yards south-west of Cunswick Hall, and again west of Ash Spring, there is an exposure of red conglomerate. Towards the north these beds and the lower beds of the limestone are shifted by a fault running a little south of west, and visible in the side of the Kendal and Bowness road, 260 yards north-west of Halhead Hall. The larger fault, which passes along the north side of the Halhead quarries, is not actually seen, but its position is easily fixed towards the west, though it is obscure towards the east.

The lower beds of the conglomerate are seen near Tolson Hall, round the north and east sides of the hill on which the monument stands. They are made up of large well-rounded pebbles. The upper beds, consisting of red but coarse conglomerate and yellow sandstone, are seen near Madgegill. The base is seen again in the railway cutting 250 yards north of Sparrowmire Bridge, but the section is nearly grassed over.

* *See also* Memoir on Quarter-Sheet 97 N.W. (in preparation) for a further account of the Carboniferous Basement Beds.

The Basement Beds reappear in the bend of River Sprint south-east of Burneside Hall, where they consist of red sandstone, red marl, cornstone, and conglomerate; the boundaries of this outlier are obscured by deep Drift.

The Skelsmergh outlier is also concealed by Drift, except in the deep ravines cut by the rivers. The Sprint has exposed the north-western part of the outlier, and shows alternations of sandstone and conglomerate, with some marl, dipping to the east. In the Mint conglomerate is exposed dipping north. Towards the north the Basement Beds thin out rapidly, and at Littlemire seem to be represented by a little red shale only, while at Edgebank the limestone and the Bannisdale Slates are seen in close proximity.

In the Grayrigg outlier the same irregularity is observable, and the beds seem to be of very partial occurrence, so far as the Drift admits of observation being made. They are exposed for some distance in Thrushgill, but at Agnesgill and Cockin on the north side of the outlier, the limestone appears close up to the Silurian Rocks, but whether brought in by a fault or not it is difficult to say. The beck flowing past Cockin has exposed at 500 yards distance from the house some red shales and flags, which may be either a continuation of the beds seen at Whinhowe, as shown on the map, or a small detached outlier. In the section at Whinhowe are seen red shales and flags resting unconformably on Coniston Grit, and passing under the lower impure limestones. The dip ranges from 10° to nearly 60° to the south, but it was not possible to detect any fault. In the next gills to the south the limestone is seen to run close up to the Coniston Grits.

The Basement Beds of the Sedbergh neighbourhood are shown on the map as being faulted down on the north by a fault running rather north of east along the foot of the Howgill Fells. This fault is not anywhere visible, but was inferred by Professor Hughes on the following evidence:—The dip of the conglomerate, as seen in the gills descending these fells, is usually gentle, so that the planes of bedding, if prolonged, would not pass clear over the Coniston Grit hills. This in a conglomeratic deposit, that is known to have been laid down on a deeply eroded surface of the older rocks, would not by itself be conclusive, but might have been taken as indicating that the Sedbergh Valley had come into existence in pre-Carboniferous times. In the district east of the Lune and its tributaries we do not find evidence of pre-Carboniferous valleys, except that the small depressions filled with conglomerate, &c. at the base of the Carboniferous rocks of Ingleborough may be remains of valleys in the otherwise even surface of the plain of marine denudation on which the Carboniferous rocks there rest. But in, and west of, and north of the basin of the Lune he has found much evidence of valleys running down to the sea and filled with enormous masses of conglomerate derived from a pre-Carboniferous mountain district. In the Sedbergh valley, however, on tracing the northern boundary of the conglo-

merate it is found that it does not tend to run up the hollows between the Coniston Grit hills, but follows a nearly straight line, parallel to the system of faults which has been observed in the Upper Silurian Rocks. Lastly, this line is a continuation of a line of fault, observed in the west bank of the Rawthey near Fawcett Bank.

The Basement Beds of this neighbourhood consist everywhere of coarse red conglomerates. They are exposed in the lanes near Castlehaw, in the gill above this hill, and in the gill at Thorns Hall, where the base also is visible, a red sandy shale lying next above the Coniston Grit. There are good sections also in the Ashbeck Gill and Thrush Gill. The best exposures, however, are to be found in the Rawthey. From Straight Bridge upwards the river bed is in a very coarse conglomerate. Two hundred yards above Low Ridding the base of the conglomerate is reached and the Coniston Flags exposed. But 150 yards further on the river is crossed by a fault running north-east and south-west, and throwing in the conglomerate again on the north-west. The fault is filled with calcite, and appears to have been tried for hæmatite. The base of the conglomerate is finally reached 80 yards above this fault, and its unconformity with the Silurian Rocks can be fully seen in the bed of the river. The Basement Beds enter the map again for a few chains in the south-east corner. The base is exposed here also; but the description of the section, with an account of the fine exposures of the conglomerate in Hebblethwaite Gill, will be given in the explanatory memoir of Quarter-Sheet 97N.W., now in preparation.

The Basement Beds of the north-east part of this map are more persistent, though the evidence of unevenness in the platform of Silurian Rocks on which they rest is unusually strong. Reference has already been made to the neighbourhood of Shap Wells. There the junction of the Basement Beds with the older rocks is exposed in three localities, namely, in the Spa Well Beck, in Wasdale Beck, and in the cutting at Shap Summit. The conglomerate is seen to be spread over and round such rock-masses as may be seen on a modern sea-shore. From Shap Wells southwards the Birk Beck runs nearly along the strike of the beds, and shows frequent sections in flaggy or current-bedded sandstones, which seem to form the middle part of the subdivision. The lower beds consist of coarse red conglomerate as seen in the beck at Gill, where the junction with the Silurian Rocks is once more visible. The same beds are seen again south of Gill, where, however, it is doubtful whether the boundary is a fault, or is formed by a steep bank of Bannisdale Slate, against which the conglomerate has been piled. The small outlier here shows a greenish tint in the lower beds. The base is next seen in the Birk Beck above Bridge End. There are seen from 10 to 15 feet of a greenish conglomerate and breccia of strictly local fragments (that is, fragments of the underlying Silurian Rock) resting upon three or four feet of red conglomerate, which lies upon the upturned edges of the Bannisdale Slates.

A. Strahan.

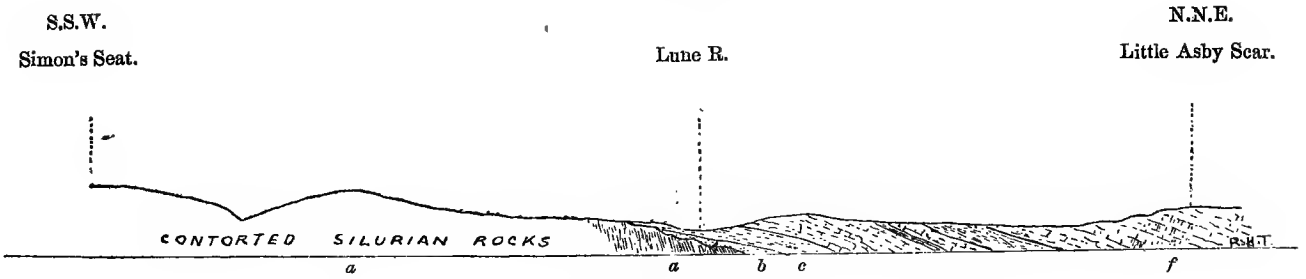
The base of the Carboniferous Rocks follows thence the valley of the Lune, crossing this river near the village of Tebay, and running a short distance up the slopes of the Silurian hills to the south of Ravenstonedale. The Basement Beds are seen in a little gill running down from Cooper House to Cockdale, where they consist of a coarse conglomerate with large pebbles of quartz and beds of red sandstone. Redgill shows sections in hard and soft red sandstone. The next two gills near Gaisgill show soft, current-bedded, red sandstone, with occasional fragments of Silurian Rock. In none of these last three is the actual base visible. Ellergill, which is a larger brook, gives a good section, above the bridge, of beds consisting of red conglomerate and current-bedded sandstone. Langdale, which is next in order, only gives a short section. West of the farm-house are red sandstones and conglomerates, resting on the edges of highly inclined Silurian slate and shale. East of this point the Basement Beds thin out, and the next member of the series immediately above forms the base of the Carboniferous system.

The accompanying horizontal section (Fig. 1), drawn from Simon's Seat to the north-north-east, on a true scale, and as accurately as the nature of the beds and the sections permit, appears to show that the Carboniferous Rocks must have been deposited, not *against* the higher Silurian fells on the south, but *over* the rocks of which they are composed, before they were upheaved and denuded into hill and dale. It will be observed that the dip of the Carboniferous Rocks is sufficiently high to carry them right over the Silurian fells. This is evident to any-one standing on higher ground to the east, from whence a view of the Carboniferous escarpment and the Silurian fells may be seen. In saying this, I refer to the Lower Limestone Shales and the beds which overlie them. The so-called "Basement Beds" are undoubtedly very local and have every appearance of having been deposited in valleys. The beds lying at the base of the Carboniferous Limestone in other places, as in Craven, which are undoubtedly marine, and contain corals and shells interspersed with the beach-gravels formed from the underlying rocks, have a very different aspect. They are seldom, if ever, remarkable for that red colour which is so conspicuous in the conglomerates of the "Basement Beds" about Kirkby Lonsdale, Kendal, Tebay, and Sedbergh.

R. H. TIDDEMAN

Section across the Carboniferous Rocks near Ravenstonedale.

By R. H. Tiddeman.



Scale, one inch to the mile.

a Silurian. *b*. Basement Beds. *c*. Lower Limestone Shale. *d*. Ravenstonedale Limestone. *d'*. Brownber Beds. *e*. Ash Fell Beds, *f*. Melmerby Scar (?) Limestone.

The Lower Limestone Shales.

These beds, though resembling the Basement Beds in being to a considerable extent made up of conglomerates, differ from them in containing a larger proportion of pebbles of quartz, and generally speaking of rocks that must be far-derived; in having a prevailing greenish tinge; and in being interstratified with shales and impure limestones, which increase in importance upwards so as to form a passage up into the Carboniferous Limestone series.

The beds are clearly exposed in the gill south of Sproatgill, where the following section occurs:—

		Feet.
Lower Limestone Shales	Hard greenish conglomerate with quartz pebbles	—
	Blue shale	5
	Red shale	1
Basement Beds	Red conglomerate	4
	Red sandstone	15+
		25

The greenish conglomerate is seen also, associated with red, blue, and mottled shales, in the rain-channels which cross the railway between Sproatgill and Haybank. Beneath it run the thick red sandstones and conglomerates, which are seen in Birk Beck; upwards it passes into shales, containing an occasional conglomeratic band, and shading almost insensibly up into the Ravenstonedale Limestone. These shales are seen in the railway cutting south of Haybank, and in the cutting by which a subway is approached, near this house. It may be noticed that in the lower part the shales, both above and below the green conglomerate, are mottled, or contain red bands. But as a general rule a greenish tinge replaces the red, where the calcareous element begins to predominate.

A. Strahan.

The same beds are seen again on Orton Common and Low Moor, and in the Chapel Beck above Coalflatt Hall, where the following section was noted many years ago, before the survey of this district was commenced:—

Hard, massive, yellow breccia, 4 feet.
Bluish sandy clay, full of plants, 2 feet.
Several beds of yellow breccia, one black and fine.
Magnesian-looking limestone.

* * * *

Dark impure limestones.
Yellow breccia.
Red sandstone.
Soft conglomerate of red pebbles and fragments of ruddle.
Yellow sandstone with included small green fragments and quartz pebbles.
Conglomerate with large Silurian and other pebbles.

* * * *

Soft white and purplish red sandstone with "pockets" of green marl.
Fine breccia with "pockets" of red marl, quartz pebbles, and hornstone (below the footbridge, Coalflatt Hall).

* * * *

Limestone, containing quartz pebbles and other fragments.
Yellow limestone.
Fine and coarse conglomerate.
Red sandstone, not unlike Triassic Pebble Beds.

Writing after this lapse of time, I am unable to say where the line between the Lower Limestone Shales and the Basement Beds should be drawn in this section.

About Gaisgill the Lower Limestone Shales are almost entirely concealed beneath Alluvium and Drift. South of Far Garth a spring issues at what is probably the top of the series, and in the river-bank west of Raisgill Hall Bridge the following section was obtained:—

	Feet.
Limestone, with included gravel - - - -	3
Red and green shale - - - - -	2
Limestone with included gravel - - - -	2
Stiff, sandy, chocolate marls - - - -	5

These are dipping N.N.E.

There seems to be a fault running north and south up the valley of Rais Beck. I came to this conclusion by tracing the base of the Ravenstonedale Limestones from the east, and found that the line ran up this valley. The high easterly dips about Fawcett Mill, raising the beds up, also point to this conclusion. This fault takes the shales a little way up the east side of the valley, though the stream itself shows nothing but limestone. Eastwards the upper boundary is shown by springs, the shales being covered. A limestone is visible east of Rayne Wood, not far above the Alluvium; this may, perhaps, belong to the series.

A level has been driven up through these beds to the farmhouse called Rayne. It did not go direct from the river by the shortest route, but was driven north, from the up-stream end of a a little spinney bordering the Alluvium, until it crossed the road, and then west to the house, to avoid the field immediately opposite the house, which was on another lordship. The cause of all this perseverance was a large *boulder* of galena, which was found in Drift, in sinking the foundation of a cow-shed. Nothing of value nor any vein was found. The level is now built up, and the water in it dammed back, and the shaft to it used as a well. There is some trace of a disturbance in the limestone off to the north-east, and possibly this might have been a more profitable field of research, but there is positively no evidence to go on, save a probable line of fault there. The top of the series is shown further east by springs and wet places, and the Drift consequently has slipped a good deal between here and Kelleth. East of that

village, where two occupation-roads diverge, are seen shaly limestones, dipping at about 10° to the N.N.W. The next spot where some of these beds are seen is at a point south-south-east of Potlands, just north of the river and the railway. They are red and grey shales, but in spite of the red colour there is nothing indicating any approach to the Basement Beds. Here the dip is north-north-westerly, but at the next exposure higher up the river, in its bed, the rocks have turned to dip north-east, and are limestones and thin shales.

The exposures on the south side of the river in this Map are few but interesting. They occur in three gills in the neighbourhood of Flakebridge and Long Gill and at Scar Sikes. At Flakebridge we saw bastard limestone, with a speck of galena in a crack, and below it calcareous sandstone, resting on the worn edges of green Silurian Shales, much impregnated with lime at the surface. The basement and line of junction are exceedingly well shown here in the stream and in a road cutting.

Impure limestones are seen in the next gill, dipping N.N.E. at 10°, and lower down in the river bank are seen black shale and brown cherty limestone.

The next gill to the east shows, at a short distance up it, grey calliard, and below dark olive shales and calcareous beds resting on the upturned edges of the Silurian strata. There are little outlying cakes of the bottom rock containing Silurian pebbles, resting on the smoothed surfaces of the parent rock.

This brings us to the edge of the Map; and for a further description of these beds the reader must be referred to the Explanation on Quarter-Sheet 97 N.W.

R. H. Tiddeman.

The Carboniferous Limestone Series.

(*a*) *Kendal, Skelsmergh, and Grayrigg.*

The hill on the west of Kendal consists for the greater part of the greyish-blue limestones, in which the sub-divisions given on p. 20 are scarcely recognisable. Towards the west these massive beds terminate in a nearly continuous vertical wall, known in different parts as Cunswick Scar and Scout Scar. In the slopes below this scar crop out the less massive, lower, impure limestones, which either rest directly upon the Upper Ludlow Rocks, or pass down into the Basement Conglomerates. Towards the east the massive limestones form long gentle dip-slopes, covered, in the higher part of the hill, with limestone *débris*, or by outlying drumlins of Boulder Clay (*see* p. 39), and finally ended by the fault, which runs south-south-east through the outskirts of Kendal.

The position of this fault can be fixed near the north end of the Serpentine Walks, where there is an exposure of Upper Ludlow Rocks within a few yards of the limestone. Further

south, where the limestone of Chapel Close and Obelisk Hill is abruptly terminated by a small cliff, the beds dipping at 30° to the west, the form of the ground and the abnormal dip clearly indicate the line of fault, though the Silurian Rocks are not seen. Similar evidence of its position is found in the railway cutting south of Oxenholme, where the Burton road crosses the line (Quarter-Sheet 98 S.E.). The northern extension of the fault is less clear. One branch of it passes under Hallgarth, cutting out the Basement Beds, and throwing out the spring which supplies the public drinking trough south of this house. Another branch cuts off the beds worked in the Kettlewell Quarries on the strike, and runs along the foot of the north-east face of Helsfell Nab, throwing some impure shaly limestone (the lower beds of the sub-division) against the grey limestone of the crag. A small subsidiary fault, with a downthrow of about 4 feet to the north-east, runs through the Kettlewell Quarries and along the south-west side of Helsfell Nab. All these faults seem to die out to the north. The fault bounding the limestone on the north-east side has been already referred to (p. 21). There were formerly exposures of the limestone in quarries on the east side of the Bowness road, near Madgegill, and 230 yards north-west of Plumgarths Toll Bar. Both are now grassed over.

The massive greyish-blue limestones can be well studied in the scars named above, on the nearly bare dip-slopes, and in the Kendal Quarries. In the Kettlewell Quarries there are two beds of shale, and the limestone, though massive, is rather earthy, and resembles the lower beds of the sub-division. It is rich in corals and other fossils, as will be seen from the list on p. 85.

The lower and less pure limestones are seen in the side of the high road to Church Town, two miles west of Kendal. Next below the rock of Cunswick Scar there crops out earthy limestone with shale, and thin bands of very sandy limestone with small quartz-pebbles.* Lower down the hill there is a massive brown limestone with earthy bands, in which a small quarry has been opened to obtain grindstones for the Gunpowder Mills. But the presence of grit and small threads of chert in the stone rendered it useless for this purpose. The beds below are earthy and shaly thin-bedded limestones. Northwards, below Cunswick Scar and near Halhead, it is possible to draw a line separating these sandy and impure limestones from the purer beds of the Scar above, but southwards the division between them becomes very indefinite. It may be mentioned that the sandy limestone with quartz pebbles occurs at about the same horizon as the interstratified sandstones and limestones near Orton (p. 32), which are known as the Ash Fell Beds.

The base of the limestone runs along the bottom of Barrowfield Wood, and thence by Park Spring to Cunswick Hall. In both places there issue large springs, the water of the latter probably finding its way down from Cunswick Tarn. The lowest

* First pointed out to me by the Rev. G. Crewdson.

beds are seen in a small opening on the south side of the Bowness road, 350 yards north-west of Halhead Hall. A little distance above the base there run some massive beds containing numerous carbonised stems of plants. They are seen in some quarries 300 yards north-west of Ash Spring Wood, and again in the quarries at Halhead Hall, where they contain some current-bedded and very sandy bands, but no plant remains, so far as is known. Corals are abundant in many of these impure lower limestones.

The limestone of the Skelsmergh outlier is nearly all covered by Drift; it is seen in the farm-yard at Edgebank, and 200 yards south-west of Garnett Folds there is an old quarry in earthy limestone, probably in the lowest beds of the sub-division.

The boundaries of the Grayrigg outlier are in great part equally obscure. The limestone is seen in Thrushgill Beck, north-west of St. John's Church and in the gill running down from Deepslack, apparently succeeding the conglomerates without any fault. There it shows such characters as are found in the lower limestones, but north of Deepslack and near Agnesgill and Cockin it is grey and more massive. At Whinhowe it is seen to succeed naturally to the Basement Beds described on p. 22, but with a dip ranging from 10° to nearly 60° to the south, while in a quarry 300 yards to the south-east it is nearly horizontal. It is seen again in a quarry 500 yards north of Grayrigg Hall and in a gill close by dipping 6°–12° to the south-west. The gill passing the Hall shows thin-bedded impure limestones in gentle undulations.

(*b*) *Orton.*

The Carboniferous Limestone of the neighbourhood of Orton is divided, as before-mentioned, in descending order into—

Melmerby Scar Limestone.
Ash Fell Beds.
Ravenstonedale Limestone.

The greater part of this area was surveyed by Mr. Tiddeman, by whom the following notes have been written, except where otherwise stated:—

The Ravenstonedale Limestone.

This sub-division is composed almost wholly of limestones, and forms a broad belt of an average width of a mile and a quarter. The best section of the beds is to be seen in Scandal Beck at Ravenstonedale Village and north of it, in Quarter-Sheet 97 N.W.

There a carefully observed section gives, at an average dip of 15°, a thickness of between 1,500 and 1,700 feet. Over the greater part of this belt the limestones are covered with Drift-mounds or wide undulating spreads of the same material, but, where the Drift is absent, they give rocky ground with short sweet pasture between the limestone ridges. The Drift-covered

portion, where not well drained and cropped, is usually covered with ling and bent-grass.

North of Gaisgill this belt of limestone covers a wider country than at Ravenstonedale, but the beds are more undulating, and have a lesser general dip, so that probably these limestones are decreasing in thickness westwards. They may perhaps be two or three hundred feet thinner.

R. H. Tiddeman.

The best sections in the Ravenstonedale Limestone at the west end of this range are to be found in the quarries by the Orton and Shap road, one mile and a half west of the former place, and in the ravine about one mile south of Orton. The limestone has everywhere a very earthy and sometimes cherty character, presenting on the whole a close resemblance to the lowest beds of the limestone in Flintshire. Like these also they contain *Athyris Royssii* abundantly, while along certain bands, as seen in the quarries mentioned above, corals are very abundant. Plant remains have been noticed at a point 500 yards south of these quarries and are fairly abundant near the Granite Works at Shap Summit. Towards the base these earthy limestones pass into shale with nodular limestone, shale, and finally conglomerate.

A. Strahan.

Just above the Lower Limestone Shales the base is frequently a compact white porcelainous limestone with conchoidal fracture. This is frequently recurring at sections all the way along the line, as far as the Vale of Eden. From Raisgill to Kelleth along the escarpment, or rather rounded bank, dun limestone is very frequent. In other places the limestone is usually grey and sometimes brown, and occasionally you find sections with grey and brown alternating in successive beds.

There is an interesting horizon about three or four hundred feet below the Ash Fell beds which deserves mention. I propose to call the beds alluded to the *Brownber Beds*, because that is the nearest locality to them in this range, and they are well seen under the railway to the east of that house,* near Newbiggin. I have found continually appearing at about this horizon a bed or beds, sometimes merely sandstone, sometimes limestone with abundant quartz pebbles, and sometimes a sandy limestone without pebbles. It is usually thin and cannot be visibly traced far, but there can be little doubt that the same bed has a long range. The most easterly point where I have recognised it is in the little beck alongside the Kirkby Stephen and Sedbergh road at Crooks Beck,* in the valley a little north of Cross Bank. It is there a limestone with sandy beds and others containing quartz pebbles. It cannot be traced all the way owing to Drift, but

* In Quarter-Sheet 97 N.W.

appears again as a sandy limestone, in, or close to the road going to Ravenstonedale beyond Bowber.* In a quarry in a field north-east of Claylands* may be seen a limestone with quartz pebbles along the same strike.

It is concealed mostly by Drift between here and Scandal Beck.* On the east side I have not found it, but it is visible west of the Scandal Beck fault, in an abrupt limestone bank above an old quarry, half a mile north of Park House.* Its horizon may be surmised hence by Friar Bottom, by the strike of the beds above and below, to the locality mentioned near Brownber,* but it is not seen until you get there. Here the quartz pebbles are very abundant close to the railway, but the section is very soon covered up again by mounds of Drift.

The beds appear again on Ravenstonedale Moor,† where they have perhaps their maximum development. They consist here of sandstones above, and limestone containing rolled quartz pebbles below. The pebbles vary in size up to about an inch in length. The beds may be well traced across the Moor south of Sunbiggin Tarn, for about half a mile. We next see them on the other side of Tarn Sike, but they are a good deal thinner. They follow the strike south of Grimes Moor House, but are not seen crossing the valley of Rais Beck. We meet with them, however, on the north side of the road from Gaisgill to Raisbeck, where in a little quarry is seen limestone with quartz pebbles on calcareous sandstones.

There is a lower bed here, some distance below, consisting of a calcareous sandstone, intercalated in the limestone.

It is difficult to say whether these are the same as the gritty sandstones which run through Howes Plantation, where they have been quarried, and cross Middleholes Beck. Here they are affected by a twist of the rocks, which probably runs as far north as Asby, and are dipping north-easterly. This sandstone occurs again north of Street, but I have not recognised these beds further west. If they continue, they are covered up with Drift. It is more likely that they are dying out in this direction.

The Ash Fell Beds.

There are two fairly marked escarpments running through the Carboniferous Rocks in the north-eastern corner of this map. One consists of the hard feature produced by the Ravenstonedale Limestone, overlying the Lower Limestone Shales, and, though somewhat obscured by Drifts in the river-valley, forms a good bold bluff running by Kelleth to Raisgill. The other is formed by the mass of limestone (Melmerby Scar Limestone) overlying the alternations of sandstone and limestone, which compose the Ash Fell Beds. Where it enters the map on the east this escarpment is not so well marked, but as it goes west from near Sunbiggin Tarn it forms a bolder escarpment, which makes a

* In Quarter-Sheet 97 N.W.
† In Quarter-Sheet 98 N.E.

conspicuous feature throughout the rest of its course in this map.

The Ash Fell Beds are best seen at Ash Fell and in Smardale, in Quarter-Sheet 97 N.W., but are tolerably exposed about Sunbiggin Tarn. There are at least three limestones, separated by shales and sandstones. A fault occurs just west of the Tarn, with a north-easterly course, and a downthrow to the north-west, and this seems to have thrown the beds into gentle contortions, so that, in some places, they are not easy to follow. Some beds in the limestone are crammed with Brachiopoda, and so is a bed in the thick limestone immediately overlying this series. These beds throughout are very similar to the alternations of the Upper Limestone Shales (above the Melmerby Scar Limestone), and by their position only are shown to belong to an earlier horizon of the Carboniferous Rocks.

R. H. Tiddeman.

This series can be traced across the Birkbeck Fells Common by the change of soil and slight feature, produced by the beds of sandstone, the interstratified limestones being marked by lines of swallow-holes. Calcareous sandstone is seen in a pit indicated on the map by a dip of 15°, while the base of the Melmerby Scar Limestone is seen at the angle made by the township boundary just above. About 80 yards south of this pit and below it, is a band of limestone which is seen at intervals northwards, and makes a line of swallow-holes. Below this again is a second line of holes, indicating the presence of another limestone band. The series, however, is very variable, and presents almost every shade between limestone, calcareous sandstone, and sandstone.

A. Strahan.

The Melmerby Scar Limestone.

This rock, as seen in this portion of the map, calls for little comment. It is of the usual character and here for the most part bare, though little spreads of Drift between the scars occasionally occur. The beds dip gently to the north-north-east, and are occasionally affected by rather sharp rolls. A few insignificant beds of shale occur at different horizons, and chert-nodules are also scattered through some parts of the mass of the rock. The surface is much pitted by swallow-holes, but they never attain the grand development of those which honeycomb the Ingleborough country.

R. H. Tiddeman.

CHAPTER IV.

INTRUSIVE IGNEOUS ROCKS.

The Shap Granite.

This rock occurs as a low dome-shaped boss extruded among the Lower Silurian Volcanic Rocks. The alteration effected in these rocks by the contact with the granite has been already alluded to. It extends for a distance of about a mile from the edge of the granite, as observed at the surface, but it must be remembered that the granite is probably at a much less vertical distance than this from the rocks so affected; for as shown by the section in Sherry Gill (at the north-west angle of the granite area of this map) the junction between the altered volcanic rocks and the granite is not vertical, but slopes downwards at a gentle angle. The extrusion of the granite took place in pre-Carboniferous times, for the Carboniferous Basement Beds are found to rest on rocks that have been intensely metamorphosed by the granite, without themselves showing any such change. These Basement Beds, moreover, according to a statement by Mr. Goodchild, contain pebbles of Shap Granite. On the other hand, the occurrence of dykes of granite, similar to that of Shap Fell, in late Silurian rocks (p. 35) points to the extrusion having been post-Silurian. Presumably it took place after the close of the Silurian period, and during the long continental epoch which separated the Carboniferous and Silurian periods.*

The Shap Granite boss has this character in common with many others in the British Isles and elsewhere, namely, that it does not seem to have thrust aside the rocks in which it occurs, so much as to have eaten through them. Great as is the bulk of the granitic mass, the sedimentary rocks show no sign of having been bent aside to make room for it. The Coniston Flags and Grits keep their normal strike, and even the Coniston Limestone, so far as can be observed, is not diverted from its course, though it is highly altered. We are forced in this, as in many other cases, on seeing that the sedimentary rocks were not thrust aside by the granite, to suppose that they were absorbed by it, to the addition of its bulk.

The granite was formerly largely quarried in Wasdale, and carried down by a light railway to Shap Summit, where it was polished for ornamental purposes; but the quarries are not now being worked. The rock is of two varieties, a dark red and a pale red. The colour is due to the presence throughout of large and small crystals of pink orthoclase felspar. The colouring matter is probably iron peroxide, and the effect of the percolation of water along joints has been to decompose the felspar, and convert the

* *See* Clifton Ward. On the Granitic, Granitoid, and Metamorphic Rocks of the Lake District. *Quart. Journ. Geol. Soc.*, vol. xxxi., p. 568. 1875.

red peroxide into a greenish-yellow salt of iron. The marked character of the rock has made it possible to identify its boulders in the Drift at great distances from Shap. The distribution of these boulders is discussed subsequently (p. 47).

The junction of the Granite and the Volcanic Rocks is visible by the side of the Kendal and Shap Road near the northern margin of the map; in a boss of rock by the side of the mineral railway at the margin of the map; in Longfell Gill, about 300 yards further west; in Howe Gill, 1,000 yards further to the west-north-west; in Sherry Gill; at the Sleddale Pike Trigonometrical Station, marked 1,659 feet; and 600 yards north-west of Wasdale Head. In most of these exposures the dividing line between the Granite and altered rock is very sharp, as in Longfell Gill and Sherry Gill, but in others, as in Howe Gill, the Volcanic Rocks are so split up by veins of granite that it is difficult to draw a hard and fast boundary. These veins or dykes of granite appear at intervals in the Upper Silurian Rocks as much as four miles from the central boss, as will presently be described.

A specimen of the sedimentary rock (sandstone) in contact with the granite at the exposure by the Kendal and Shap road, is described by Dr. F. H. Hatch as an arkose, as follows:—

A compact aggregate of subangular grains of colourless quartz and fragments of slightly turbid felspar (orthoclase and plagioclase) in approximately equal proportions. The rock shows no evident signs of alteration due to contact with the Granite unless, perhaps, it owes its induration thereto.

A. STRAHAN.

Dykes.

A great number of dykes * have been observed in various parts of this district, and it is probable that many more have escaped observation, through being concealed by Drift or even by surface soil. The dykes are entirely confined to the Silurian rocks in this district,† and occur in the greatest abundance in the eastern part of Westmorland and the north-western part of Yorkshire.

There are three chief varieties: 1, granitic; 2, micaceous (mica-trap); 3, felsitic:—

1. Granitic dykes. All the granitic dykes are found within a distance of four miles south-east of the Shap Granite, from which they are probably spurs. They resemble the Shap Granite in

* Specimens of the dykes of this district, collected by the late Mr. John Ruthven, may be seen in the Kendal Museum.

† From which it may be inferred that the intrusion of the dykes, like that of the Shap Granite, was pre-Carboniferous. That this was also the age of mica-trap dykes in Teesdale has been proved by Messrs. Gunn and Clough (*Quart. Journ. Geol. Soc.*, vol. xxxiv., p. 27, 1878). Mica-trap and kersantite dykes are found, however, in the Carboniferous strata (Culm Measures) of Devonshire and the Devonian of Cornwall. (*See* On a newly-discovered Dyke of Mica-trap at Roseash, near Southmolton, by the Rev. E. Downes, *Trans. Devon. Assoc. Adv. Sci.*, &c., vol. xvi., p. 498, 1884; and the Geological Age of Central and West Cornwall, by J. H. and H. F. Collins. *Journ. Roy. Inst. Cornwall*, Part II., vol. viii. 1884.)

lithological character, and contain the same large crystals of pink felspar. The largest is to be seen one mile south of Shap Wells, where it is exposed for about 80 yards.

Another occurs at Gill, near Crag, on the Birkbeck Fells. It has been examined by Dr. F. H. Hatch, who identifies it as a Quartz-Porphyrite or Felsite, and describes it as follows:—

This rock consists of a compact, reddish-grey, groundmass, in which are embedded isolated blebs of quartz; orthoclase in large (up to $\frac{1}{2}$-inch in length) porphyritic crystals, curiously rounded and suggestive of refusion in the yet molten magma; silvery flakes of mica; and a few granules of magnetite.

Under the microscope the groundmass, which is of a dirty brown colour, is seen to be made up of a crypto-crystalline aggregate of quartz and felspar, together with minute granules of magnetite and scales of chlorite, probably resulting from the alteration of the mica. The rock bears considerable evidence of alteration; the orthoclase has partially been converted into calcite; the mica, which is a strongly pleochroic uniaxial variety (biotite), has given rise to, and is surrounded by, innumerable scales of chlorite.

There are many smaller dykes of finer or coarser grained granite on these fells and on Berthdale Common. All these dykes are in Upper Silurian rocks, except a boss of rock of a granitic character with small crystals of mica, which occurs near Wansfell Pike, north of Troutbeck.

2. Felsitic dykes. A red felsitic dyke occurs one mile north of High Borrowdale Bridge, and another a mile to the west of the same bridge. A similar dyke may be seen at intervals for about a mile and a quarter running north-east on Potter Fell, east of Staveley. In one place this dyke is exposed for 250 yards. Light-coloured varieties of the felsitic dykes are seen on the slope of the hill south of High Borrowdale, and to the south-east of Whinfell Beacon. Both felsitic and micaceous dykes occur also near Summer Head and Highgill, west of Lowgill Station. These all occur in Upper Silurian Rocks. In the Borrowdale series, north of Sadgill, between Kentmere and Long Sleddale, there are two small dykes of a very hard, dark-coloured variety of felsite.

3. Micaceous dykes. Many of these dykes have been microscopically and chemically examined by the Rev. T. G. Bonney and Mr. F. T. S. Houghton.* They are distinguished into minette (mica-syenite), and kersantite (mica-diorite), two principal subordinate members of the mica-trap group (the former having chiefly an orthoclastic constituent, and the latter a plagioclastic constituent; and into minette-felsite, or a minette with a micro- or crypto-crystalline base, and kersantite porphyrite, or a kersantite with a similar base.

Two dykes are seen in the railway three-quarters of a mile east of Windermere Station in Bannisdale Slates, with a width of about 1 foot each. They are determined as minette-felsite.

W. T. Aveline.

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* On some Mica-traps from the Kendal and Sedbergh Districts. *Quart. Journ. Geol. Soc.*, vol. xxxv., pp. 165–180. 1879.

A dyke at Barley Bridge, Staveley, is about 2 feet wide in Bannisdale Slates, and has been described as porphyrite. Mr. Aveline remarks that a dyke which comes to the surface in four places on Head Hill, south of Staveley, and another seen in the brook north of Gillbank, to the north-east of Staveley, are probably continuations of the Barley Bridge Dyke. The last named is identified by Prof. Bonney as a micaceous diorite.

A dyke on the Kendal Road, 250 yards south of the third milestone, is termed a minette-felsite. Similar dykes occur in the London and North-Western Railway cutting, near Docker Garth, and south of Haygarth. Mr. Aveline remarks that a mica-trap dyke is seen in the Lune, about 1¼ mile south of Lowgill, and probably the same dyke, a quarter of a mile lower down; and that another dyke of the same character is exposed north of Killington Bridge. The last named is described as kersantite by Prof. Bonney. The dykes mentioned above are all in Upper Silurian rocks, but one has been observed by Mr. Aveline in the Coniston Limestone, between Kentmere and Long Sleddale, and has been described by Prof. Bonney as a micaceous diorite.

A. Strahan.

The dykes which occur east of the Lune may be referred to the same groups as those on the west, except that there are no granitic dykes in this part of the district.

In the Bannisdale Slates of Birkbeck, near Low Scales, Tebay, there is a porphyritic felstone, running N. 20° W.

In the Coniston Grit of Stock Gill, a tributary of Langdale, there is a felstone dyke, running W.N.W.

In the Coniston Flags of Holbeck Gill, in the extreme south-east corner of the map there is a similar dyke, identified as kersantite by Prof. Bonney.

In the Coniston Flags and Grits of Ashbeck Gill, near Sedbergh, there are some mica-trap dykes seen here and there running about N. 12° W.

In the Coniston Grits, or rather perhaps along a small fault which brings the Coniston Grits against the Coniston Flags, in the stream which runs from Uldale Head into Carlingill, about 5 miles north of Sedbergh, there is a decomposing mica-trap dyke running N. 15° E. This is described by Prof. Bonney as a kersantite-porphyrite.

In the Coniston Grits, on the west slope of Blease Fell, there are at least two mica-trap dykes, running N. 20° E.

South of Bram Rigg fragments of a mica-trap dyke occur at the surface along a line running N. 12° W. At the south end of Cautley Crag there is a decomposing mica-trap dyke in a small fault which runs N. 20° W.

In a tributary of Langdale west of Hazelgill Knot, there are two dykes, one running N. 20° W., the other S. 50° E.

In the tributary of Langdale, which runs in where Grains joins Middle Grains, there are one or two mica-trap dykes running

W. of N., but their direction is not clear. In Grains there is a similar dyke running N. 25° W.

On Middle Tongue, near the head of Crossdale Beck, north of Sedbergh, there are fragments of a mica-trap dyke, apparently running E.N.E.

At the foot of the hill north of Lock Bank, Sedbergh, there is a decomposed mica-trap dyke, apparently coinciding with a line of fault.

In the Bannisdale Slates there is a mica-trap dyke in Tebay Gill, east-north-east of Tebay Station. The direction of this dyke is not clear.

The dykes of the Lake District occur in all the divisions of the Silurian rocks, but there does not seem to be any difference in mineral character according to the division in which they occur; nor can we refer the dykes to any systems according to their direction, though sometimes they occur in lines of fault, and, so far, fall under the grouping which may be applied more clearly to the lines of fault of the district. Sometimes the dyke appears to have been injected, or otherwise produced, along a line of fault; sometimes a small fault seems to have been caused along the dyke during movements subsequent to its formation, through the rigid mica-trap not having yielded to the same extent as the softer slate and shale, and portions of it having been thrust through the surrounding strata.

T. McK. Hughes.

CHAPTER V.

SUPERFICIAL GEOLOGY.

Glacial Deposits.

On the edition of this Map for Superficial Geology the following subdivisions of the Glacial Deposits are indicated by colour, the solid geology being shown only where there is no Drift:—

Boulder Clay or Till.
Sand and Gravel.

The Boulder Clay occupies by far the larger area, but in some of the broader valleys, as in that of the Kent, near Kendal, and that of the Lune, near Sedbergh, passes into a gravelly deposit, to which the name Boulder Clay is inapplicable, though, on the other hand, its stratification is generally far more rudimentary than that of the sands of the low lands. The division between the two forms of Drift is therefore very ill-defined, nor is it possible to state definitely which is the older. The evidence points rather to their being in part contemporaneous. The Drift of the whole region has a tendency to form hills, which are clearly the original heaps into which the material was piled at the time of its distribution, and not, like the hills of solid rock, remnants of an elevated mass which have been spared by denudation. The hills composed of Boulder Clay will be referred to as drumlins, those of sand and gravel as eskers. The former are extremely abundant throughout this area, and are the cause of the existence of most of the small tarns, and of the alluvial flats occupying the site of old tarns. The eskers are no less marked in the smaller areas occupied by the sand and gravel. The drumlins usually have their longer axes parallel to the direction of the valley in which they occur, but sometimes cross valleys obliquely, with a tendency to trend southwards. Where they are found on a high table-land, as between Sedbergh and Kendal, their axes run nearly north and south, that is, in the direction in which the general ice-flow was moving.

The largest spreads of Drift in this map are found in the Kent Valley, in the depression between this valley and that of the Lune by Grayrigg, in the Lune valley, above Tebay and where entered by the Clough, and on the Lambrigg and Firbank Fells. In addition to these larger spreads are found long tongues of clay-drift running up every dale, in most cases quite up to the dale-head, the limit depending not so much on the height above the sea, as on the form of the ground. As a contrast with the broad Drift-covered tracts mentioned above, the ground between Kendal and Windermere Lake is nearly all bare, the Boulder Clay occurring only as isolated drumlins, which make a small show on the map, though their peculiar rounded outline is sufficiently striking on the ground. It will be convenient in describing the Drift to take the river systems in succession, commencing on the west with the valley in which Windermere Lake lies.

Kirkstone, Troutbeck, and Windermere.

In the Kirkstone Pass there are many mounds of *débris* covered with large blocks, such as the Kirkstone, from the neighbouring hills. This mounds *débris* is characteristic of the upper parts of the Lake District dales. While not distinctly in the form of either lateral or terminal moraine, it still seems to be in part of a morainic origin. It is possible that in some instances the materials were brought down from the hill-sides by sliding snow, though no slides of sufficient magnitude to move the blocks have been recorded within the historic period. In the present instance, the mounds are on the watershed, and not where a Kirkstone glacier would drop its moraine. In Wounsdale drumlins occur at about 1,600 feet, and under John Bell's Banner at over 2,000 ft. In all this neighbourhood striated rock-surfaces and *roches moutonnées* are abundant, the scratches all ranging from a little east to a little west of south.

In Troutbeck the Drift runs up to 1,250 feet. A thick mass of Drift passes over from Kirkstone into this dale, where the ridge is crossed by the road. Striæ are found by the side of this road, north of Raven Crag, running nearly south. At and below the village of Troutbeck the Drift spreads out, and great drumlins are developed, the whole being of the clayey type, except a small pebble-gravel patch at Limefitt. The bed of the river south of Town End occupies a deep ravine, cut down to the rock surface through a mass of Drift of 100 feet thickness in places. There are well-developed drumlins west of The Wood (Stybarrow), on the east side of the road at Highfield, and a quarter of a mile north-west of this house. A conspicuous drumlin (Flagstaff Hill) stands by the side of the lake, west of The Abbey. Another has been cut into by the railway terminus at Windermere. Bannerigg is also a good example of a large drumlin. Others occur on the north and south sides of Bowness, a conspicuous cluster lying east of Thornburrow House. Large drumlins occur also near Storr's Hall.

Many glacial striæ have been noticed in this neighbourhood. In Windermere churchyard they run S. 20° E.; 500 yards east of Thornburrow House S. 10° E.; on Brant Fell S. 12° E.; on the road one mile south of Bowness S. 3° E.; 500 yards east of Orrest, N. 20° W.; 800 yards east-north-east of Orrest, S. 34° E.; north of Bellmanground S. 8° E. and S. 5° W.; the islands in Windermere are many of them glaciated in a due south direction.

The Kent and its Tributaries.

The Kent.

The Drift first appears (in a moraine-like form) at a height of about 1,800 feet, under Bleathwaite Crag, a bold rock front, scored almost all over by striæ running down the steep face southwards.

Many ridges resembling moraines occur near here. One lies in Over Cove between Froswick and Ill Bell, another in Rainsborrow Cove, south of Ill Bell, in each case seeming to have been piled up at the side of a tiny glacier, formed in the hollow of the hill. At the head of the reservoir there is a good strong till, and lower down at the old slate quarries there are many mounds. Striæ and *roches moutonnées* are abundant, always indicating a flow of ice down the valley. There are small but well-developed drumlins at Hartrigg, half a mile north of Scales, with striæ running S.E., and at Scales S. 10° E.

In Kentmere, high up on the fell on the east side of the dale, at heights of 1,750 and close upon 2,000 feet above sea-level, two groups of scratches both running south, and others lower down on the path from Hollowbank to the fell at 1,250 to 1,500 feet pointing S. 11° W. and S.W., have been observed by Mr. Dakyns. On the west side of the dale also, at a height of a little below 2,000 feet, he observed scratches running south.

The upper part of the Kent Valley is divided at the village into two basins by a barrier formed principally of loose blocks and Drift. It is noticeable that a large proportion of the erratic blocks from the Borrowdale Volcanic series found their last resting place on this barrier. The flat alluvial tract above this barrier seems to be the site of an old lake, emptied by the natural deepening of the cut through the barrier. The lower basin, formerly occupied by the mere after which the village is named, has been artificiallydrained by a cutting through the rock below Millrig.*

In the Park Beck there is a great development of Drift, and of drumlins, but southwards the Kent Valley narrows, leaving but little room for Drift. The striæ hereabouts run straight down the valley, a little east of south.

At Browfoot the Drift mounts the hill and crosses the watershed into the adjoining valley, its exact limits, however, on Hugill Fell and to the north of Borrans being very obscure. At 300 yards above Fellfoot Mill are striæ in an opening by the roadside, running S. 35° E.

A great development of drumlins is found about Ings between Staveley and Windermere. There all the lower part of the valley is occupied by rounded hills of tough till, Brundriggs being one of the largest. The drumlins run also up the slope of the hill to the south, and one, extending from Middle Fairbank to Low Fairbank has enclosed between itself and the hillside a hollow, which appears to have been a lake, till the outflow cut a narrow ravine through the Drift-dam. At High Fairbank there is a similar drift-dammed hollow. The drumlins in this neighbourhood have their longer axes pointing obliquely across the valley, *i.e.*, in a direction about south-south-east. The valley runs nearly east, curving round to the south-east below Staveley. Near Kent

* Patches of "diatomaceous earth" occur beneath the peat in parts of this old basin. Nearly 70 species of Diatomaceæ have been determined from this deposit by Dr. Stolterfoth, of Chester, to whom I submitted specimens.

Bank, south of Staveley, there are some small banks of gravelly Drift, resembling eskers. Striæ, in the railway 700 yards south of Staveley Station, run S. 25° E., and 300 yards west of Ashes, S. 35° E. All the small patches of Drift, shown on the map to the south of this locality, are in the form of isolated drumlins with the same general trend. Another instance of a tarn enclosed between a drumlin and a hill of solid rock is found in Cunswick Tarn.

At Bowston and Burneside the drumlins are again well developed. Here, also, their axes point about south-south-east, while at Ellergreen there are striæ running S. 20° E. and S. 18° E. In the broad Drift-covered area where the Sprint joins the Kent, the drumlins run nearly due south. A good example of one is mounted and followed by the Kendal and Burneside road near Sparrowmire. Others start from the hillside near Helsfell, and run a little east of south. The Castle Hill at Kendal, and the similar hill half a mile south east of it, known as Aikrigg, are excellent examples of these Drift hills.

The greater part of the Drift about Kendal is of a gravelly character. A pebbly gravel rises through the Alluvium as small islands, and the same deposit is seen south of Kendal, in a great number of small hummocks, or rudimentary eskers. The gravel on the west side of the river is very rudely stratified, but on the east side, half a mile south of Loundes is a pit in an esker, showing well-stratified pebbly gravel and grit. It may be noticed that the bedding has been disturbed in this pit, as is so often the case in gravels of Glacial age, in such a way as to produce the appearance of a small fault with a throw of about one foot. Such disturbance may have been due to the stranding of floating ice, or to the melting out of a buried mass of ice.

Around Underbarrow are many great drumlins trending a little east of south. One near Church Town is known as Bendhue Hill; another near the church, as Church Bank; while on another has been placed the Wellington Monument. The nearest striæ are at Capplerigg to the north of Underbarrow, where they run S. 14° E. Others, by the side of the Kendal and Barrow road, 300 yards east of Low Yews, run S. 25° E.

Between the Firbank and Lambrigg Fells there is a great development of drumlins at a height ranging from 800 to 900 feet above the sea. The longer axes of the drumlins trend a little west of south, but the only striæ that have been observed, 700 yards north-west of the site of the old church, point S. 20° E. The drumlins are well seen about the west side of Lily Mere and round the reservoir. It may be noticed that the watershed between the Lune and the Kent, after running along the Firbank Fells and thence across Tarn Moss at the south end of Lily Mere, passes on to the region occupied by these drumlins.

About Rawgreen, also, on the west side of New Hutton Common, there are great drumlins, running a little west of south. Several basins, naturally emptied of water, and filled with peat or Alluvium, are enclosed by them. One such hollow, west of Rawe Head,

is drained by a natural cut through Drift 15 feet in depth. Hill Top and Hawkrigg are among the most conspicuous drumlins.

Long Sleddale

In the head of this dale there is a great mass of Drift. In Wren Gill it runs up to a height of 2,400 feet, while eastwards it spreads over the "col" into Mosedale at a height of 1,700 feet. Near the slate quarries it forms mounds and ridges resembling moraines. Striæ have been noticed near here by Mr. Dakyns running W.S.W. A little lower down the rocky sides of the valley close in upon the river, but open out again after about half a mile, leaving room for a strip of Drift on one side or the other of the river. In Stockdale there is a great mass of Drift, extending far up among the hills. Just above the hamlet Mr. Dakyns observed striæ running a little south of west. Small drumlins appear in Long Sleddale near the church, and at Sleddalefoot Mill one has been cut through by the river, showing the usual tough, stony clay. In some quarries on Skelsmergh Common, south-west of High Thorn, there are striæ running S. 10° W., and S. 17° W., and a short distance to the north, about Gateside and the Plough Inn are large drumlins trending nearly south.

Bannisdale.

The top of Bannisdale also is occupied by a great spread of Drift, forming wet, featureless slopes. The deposit is seen in a large hollow, left by the slipping down of a mass of clay; it contains many large boulders of grit. Below Bannisdale Head the valley has been dammed in three places by drumlins, long since cut through by the river. The drumlins about Forest Hall run nearly south, that is, obliquely across the dale, and under Bannisdale New Bridge there are striæ pointing S. 20° E. In Grisdale the drumlins trend nearly due south.

Grayrigg.

We now enter the great Drift-covered tract around the village of Grayrigg. This is in part drained into the Lune, the watershed between the Kent and this river after running along Grayrigg Forest, passing between Grayrigg Tarn and Sand Bed, by Grayrigg Station to the Firbank Fells. The lowest point in the watershed is near Grayrigg Station, at a height of about 612 feet above the sea.

In this area a vast number of drumlins occur, enclosing among them many lakes and alluvial flats marking the sites of former lakes. Among the former may be mentioned Flat Tarn, Whinfell Tarn, Grayrigg Tarn, Peggy Tarn, and Skelsmergh Tarn, while the alluvial flat of Sand Bed is a good example of the latter, drained by a naturally formed cut of a depth of nearly 90 feet

through a drumlin. The drumlins trend a little west of south throughout the area, as may be well seen near Shaw End. Striæ have been noticed one mile south-west of Moresdale Hall, running S. 22° W., and 200 yards north-west of Browfoot (one mile north-west of Shaw End) running due south. At Meal Bank there is a remarkable Drift section, where an elbow of the river has deeply undercut a large drumlin, consisting of tough Boulder Clay with many scratched boulders of Silurian Rocks.

The Lune and its Tributaries.

Borrowdale.

In the head of this dale also there is a great mass of Drift, forming swampy, featureless ground, and covered in great part by peat, with a thickness of 3 to 8 feet, and containing trunks of birch of 6 inches diameter. The Drift runs continuously the whole length of the dale. It can be well seen about half a mile above Low Borrow Bridge, where the river has cut into it to a depth of about 100 feet near the centre of the pre-Glacial valley.

Crookdale.

The Drift of this dale can be best observed above Hause Foot, where it overhangs the river in great banks, similar to those of Borrowdale. The thickness of Boulder Clay near the centre of the valley, before the river cut out its present channel, probably amounted to about 80 feet. In the lower part of this dale there are many boulders of red porphyry, and a flow of Shap Granite boulders can be proved to have entered by the low pass leading into Wasdale on the south side of Yarlside (*see* p. 47).

Roundthwaite and Bretherdale.

These dales are deeply spread with Boulder Clay. In the head of the latter, as in Borrowdale, there is a great expanse of peat, known as Dennings Moss. About Scale Howe the Drift has been cut through, the rock being laid bare in the ravines at a depth of about 20 feet. On Bretherdale Common the Drift mounts the watershed between Roundthwaite and Bretherdale. Shap Granite boulders are common and red porphyry has been noticed in the Drift near this common.

The striæ in this dale are interesting. They are finely preserved on the hillside south-east of Scale Howe, and near Winster Bank, and run in all cases nearly due south, that is, obliquely across this deep dale, which trends south-east.

Wasdale and Blea Beck.

The Drift of the head of Wasdale runs continuously into Crookdale over a low pass (between 1,350 and 1,400 feet) under Yarl-

side, known as Wasdale Mouth, and the same route, as will be shown subsequently, was followed by a portion of the southerly flow of Shap Granite boulders. The hillside on the north of Wasdale Mouth is well glaciated, the striæ running S. 8° E., that is along and not down the slope of the hill.

At Wasdale Head is a great slip in the Boulder Clay, the thickness of the deposit reaching at least 50 feet. Striæ are seen on the granite in the mineral railway north-west of Wasdale Old Bridge, and run due south. Others observed by Mr. Dakyns run S.S.W.

Blea Beck joins Wasdale Beck at Shap Wells. At Blea Beck Old Bridge is an esker, very small, but composed of well-stratified sand and pebble-gravel with much granite. The beck lower down cuts into the great mound of Drift on which the Queen's monument stands. This mound, like those about Castlehowe, is composed of so gravelly a form of Boulder Clay that it might almost be classed as an esker.

Birkbeck.

This name is given to the river formed by the union of the streams last referred to. The Drift in it is principally of a distinctly clayey type, and small drumlins may be seen starting from the hillside below the railway near Haybank, and trending due south. But at Rampshowe there is a small but conspicuous hill composed of pebble-gravel, a well-marked esker.

In this part of Birkbeck, the Drift spreads out east and west over a large area. That on the west is a tough yellow clay with many boulders, as seen in the numerous gills and rain channels; that on the east is a gravelly Drift derived principally from the sandstones and conglomerates of the Carboniferous Basement Beds, on which it rests. This Drift appears to have travelled eastwards, for in the ground to the south of it, about Tebay, a Drift derived from the Upper Silurian rocks sets in again. Striæ are seen in the railway 400 yards south-east of Loupsfell Cottage, running S. 35° W.

In Tebay Gill the Drift runs up a height of 1,400 feet, in Churn Gill to 1,650 feet, and in the upper part of Langdale to 2,000 feet. From Bowderdale it runs continuously across the watershed into the Cautley Valley. In the steeper part at the heads of all these gills the Drift has been scored and cut through by so many rain channels, as to make its actual boundary extremely indefinite.

In the head of Uldale a remarkable instance of the intersection and tapping of the water of one dale through the eating back of the head of another has been observed. It will be seen by the distribution of the Drift that the Uldale Valley starts under Wind Scarth and crosses the County Boundary. The hills forming the west side of the valley, however, are breached at the County Boundary by a deep and rocky but narrow ravine, by which the water collected under Wind Scarth finds its way

direct to the Lune at Carlingill, instead of following the Uldale Valley to Gaisgill. There can be little doubt that originally Uldale formed a continuous line of drainage up to the foot of Wind Scarth, and that the diversion of its head waters has been due to the cutting back action of the head-waters of the Carling Gill. A small dam would even now be sufficient to turn the waters back to their old course. The date at which the change took place is uncertain. The rocky ravine referred to is altogether devoid of Drift, but this may merely be the result of the rapid erosion that is taking place, and not necessarily a proof that the ravine is of post-Glacial origin. It seems hardly likely that so deep a cut can have been made in solid rock within the post-Glacial period.

The Lune.

Below Tebay the Lune Valley narrows, so as to leave but a narrow terrace of Drift alongside of the river. The depth attained by the deposit, however, in the hollows of the hills is very great, as may be seen above Brockholes, and in Cleuch Gill, where a deep ravine has been cut through a roughly stratified, very stony Boulder Clay with scratched stones, resting on a buff-coloured stiff clay with fewer stones. Lower down between High and Low Carlingill, there is a well-marked Drift terrace on the east side of the river, and in a deep ravine about 350 yards south of the former house the following section was noted by Professor Hughes:—

	Feet.
Light brown unstratified clay with scratched stones, almost all Silurian - - - - -	25
Stratified gravel, with granite, porphyry, &c. - -	12
Do. cemented into a rock - - -	½—2
Do. with granite, porphyry, Carboniferous sandstone, &c. - - - -	50+

Near Lowgill the Boulder Clay runs from the Lune eastwards and crosses the low watershed into the drainage of the Kent.

On the south and west sides also of the How Gill Fells, the dales are occupied by long tongues of Drift, though not to the same extent as on the north side. There is a good section in Bland's Gill, under Bram Rigg, showing roughly stratified Boulder Clay, with many Upper Silurian boulders and a few of Carboniferous origin. The bedding planes slope at an angle of 25° down the valley. The gill between Crook and Winder, and that on the east of Crook, have been partially filled with great masses of Boulder Clay, in which the streams have now cut deep ravines.

In the broad valley at Sedbergh we find the Drift assuming a distinctly gravelly aspect. It is a loose pebbly deposit, with a habit of forming mounds and ridges, enclosing many peaty and alluvial hollows, as near Ingmires. A pit in Ingmires Park

shows about 15 feet of very rough but distinctly stratified gravel, with boulders of Silurian Rock ranging up to two feet in diameter, but with few or no scratched stones. In the side of the railway, 250 yards north of Firbank Church, are striæ running S. 25° W., and 350 yards south of the church, due south.

The Eden.

Mosedale.

In the small part of the Eden drainage, which is included in this map, there is a great spread of Drift. The Boulder Clay of Long Sleddale crosses the watershed (1,750 feet) into Mosedale, though it is not actually continuous with that which extends northwards down this dale. There are sections in the gills north-east of Mosedale Cottage showing 15 to 20 feet of tough Boulder Clay. Mr. Dakyns remarks that the ground at the head of Mosedale is *moutonnée*, and that there are several instances of glacial striæ in the dale. Their directions are S. 15° E. near Mosedale Cottage, S.S.E. on the road to the quarry, and S. 34° W. on the path over into Wet Sleddale. Just outside the map on a dyke of grey granite near Sleddale Beck, he observed two sets of scratches on the same rock, the directions being S.W. and S.S.W., and those to the S.W. being the oldest.

Shap Granite Boulders.

The marked character of the Shap Granite, and the fact of the rock being confined to a single small outcrop, has rendered it possible to trace the directions of boulder-flow in its neighbourhood with great exactness.* The larger number of boulders travelled eastwards, and a little north of east, over Stainmore Forest into Yorkshire, but a very well-defined southerly flow passed over the hills into the valley of the Kent, extending thence far southwards.† The following observations on this southerly flow have been made during the re-examination of this district.

Boulders of Shap Granite ranging up to 10 feet in length are found in abundance in Wasdale. Thence they may be traced into Crookdale by way of the "col" or depression on the south side of Yarlside Crag. In Crookdale they are found below but not above the point where this col overlooks the dale. In Borrowdale they make their first (most westerly) appearance at a point immediately south of that where they are first found in Crookdale,

* The distribution of Shap Granite boulders has been described by Professor Harkness, *Quart. Journ. Geol. Soc.*, vol. xxvi., p. 517 (1870); by Mr. Goodchild, *ibid.*, vol. xxxi., p. 70 (1875); and a map showing both the easterly and southerly flow is given by Mr. Mackintosh, *ibid.*, vol. xxxv., pl. xxii. *See also* Mr. Dakyns *Brit. Assoc. Rep.* for 1878, and *Proc. Yorkshire Geol. Soc.*, N.S., vol. vii., p. 60, 1879.

† They have been observed by Mr. Tiddeman at Hestbank and Bolton-le-Sand, near Lancaster, and near Preston (*Quart. Journ. Geol. Soc.*, vol. xxviii., pp. 471, 491, 1872), and subsequently near Longridge Fell and Whalley.

and at the spot where they are found, 1,000 yards west-south-west of Borrowdale Head, are striæ pointing S. 5 E. About Scale Howe, and Breast High in Bretherdale, these boulders are abundant and large, one at a short distance east of Bretherdale Hall, measuring 10 × 9 × 6 feet, while another above Whitebrow (1½ miles north) measures 14 × 10 × 5 feet. The striations in the neighbourhood point nearly due south (*see* p. 44). In Bannisdale Head, again, there are no boulders of Shap Granite, nor do they occur in Long Sleddale; but, on the other hand, they are very abundant about Forest Hall where Bannisdale joins Grisdale near the Old Plough, and are found also at Gilthwaiterigg and Summerhowe. Thence they run down the east side of the Kent valley southwards.

Towards the south-east and east of Shap Fells the boulders are found in abundance on Birkbeck Fells Common (east of the L. & N. W. Railway) and in rapidly diminishing numbers to the east of Tebay. A great boulder, measuring 12 × 10 × 7 feet, lies on the side of Sproatgill. An outlying fragment lies in Blind Beck, three quarters of a mile south of Selmire, and another occurs about half a mile north-north-west of Tebay village, while a few have found their way up Tebay Gill. One boulder, measuring 4 × 4 × 3 feet, lies a third of a mile south of Lune's Bridge, where the Kendal Road crosses the Lune. They are not known south of this point in the Lune Valley, though they travelled so far down that of the Kent; but a great number spread eastwards over Orton Fell and up Ravenstonedale to the neighbourhood of Kirkby Stephen.

All over the ground intervening between the Lune (as far as Tebay) and the direct southerly boulder-flow by Yarlside and Borrowdale Head, namely, over the Birkbeck Fells, Bretherdale, Roundthwaite, and Borrowdale as far east as High Borrowdale, the ground is more or less plentifully strewed with these boulders. One of the largest, near Bretherdale Foot, measures 10 × 9 × 6 feet; another near Knot House measures 8 × 6 × 3 feet.

Below High Borrowdale, however, the Shap Granite boulders become scarce, nor have they been observed on the higher parts of Grayrigg Forest. They are, however, so abundant in Grisdale, about Whelpside, and Forest Hall, as previously noted, as to show that the high ground of Grayrigg Forest, ranging from 1,100 to 1,500 feet in height, caused the boulder-flow to diverge both along its west and east sides, but principally on its west side.

On the south side of Grayrigg Forest runs the depression between the Kent and Lune valleys, which has been followed by the London and North-Western Railway, and which reaches a height of only 612 feet at the watershed. It is noticeable that the Grisdale boulder-flow spread after passing Whinfell Beacon, so as to extend eastwards up this depression as far as Whinhowe and Blackett Bottom, the most easterly boulder lying in the brook 300 yards north-west of Whinhowe. On the south side of the railway they have not been noticed east of Docker Garth, but they extend southwards from this point up a depressed area for about a mile.

The high ground of Benson Knot and Docker Fell is devoid of these boulders, and the continuation of the southerly flow is found in the valley of the Kent, this river forming approximately its western boundary, while a line drawn from Spital to the Kendal Reservoir, and thence to the road which runs along the hillside above Singleton Park and High Park forms their eastern limit.

In reference to the southerly boulder-flow, which enters the Kent Valley by way of Grisdale, Mr. Dakyns writes:—*

"It seems, then, that these boulders came nearly due south from the parent-rock across the high ground . . . . . over which the old coach-road goes from Shap to Kendal. The highest point where the granite occurs in place, viz., Sleddale Pike, 1,659 feet above the sea, is higher than the greater part of this ground; but the greater part of the granitic area is lower than the ground across which the boulders travelled in their southerly course. Nor is there immediately to the north of the granite any ground as high as the granitic fell itself. It is clear, then, that the dispersal of the granite boulders did not take place by means of ordinary glaciers. The boulders must either have come over the fells on floating ice, or by means of an ice-sheet moving southward regardless of the slope of the ground . . . . . The lowest part of the Silurian range, over which the boulders must have come, is the Hause† . . . . . Further, an examination of the distribution of the boulders south of Kendal shows that they still continued to travel in a lineal direction nearly due south; they occupy a narrow band of country, whose long axis points directly for the granitic area. The most westerly I have seen are at Hincaster. A line drawn from Sleddale Pike, the most westerly outcrop of the granite in place, to these boulders at Hincaster, bears south by west." . . . . .

"Most of the granite boulders near Kendal are lying on the surface; but there is one in a bank of Drift cut through by the canal at Larkrigg. This shows that the boulders are not merely surface erratics, but that they belong to the Drift formation. Sections in this are so few and far between that we seldom have a chance of seeing erratics anywhere except on the surface."

Mr. Dakyns notices also (*op. cit.*) that erratics of volcanic rock from the Lake District are found *east* of this line of granite boulders. By this is indicated a flow from the north-west across the granite-flow; and it was probably of earlier date, for otherwise the lineal north and south dispersion of granite boulders would have been swept into confusion. A boulder of volcanic ash, measuring 8 × 5 × 4 feet, lies south of the Sedbergh and Kendal Road on the west side of New Hutton Common.

It may be noticed that about Tebay, in Bretherdale, and in Borrowdale (between High Borrow Bridge and High Borrowdale) there are many boulders of red and pink porphyry, the source of which is uncertain.

On Harrop Pike a block of a peculiar nodular rock has been noticed by Mr. Dakyns. He remarks that no such rock is known to exist anywhere near the spot, but that a precisely similar rock occurs on Kidsty Pike, and in several places on the hills west of Hawes water.

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* "On the Southward Flow of Shap Granite Boulders." *Proc. Yorkshire Geol Soc.*, N.S., vol. vii., p. 60, 1879.

† The height of this point is probably above 1,400 feet.

The limestone fell immediately west of Kendal "is plentifully strewn with large boulders of Upper Silurian Rock, and small ones of volcanic rocks, though there are a few large boulders of volcanic ash as well; for instance, one well-glaciated boulder of volcanic ash about a mile and a half S.W. of Kendal, and a large one above Cunswick Scar, near the footpath to Kendal."* Others may be seen near Helsfell.

Peat, Alluvium, and River Terraces.

The River Terraces are found bordering the Alluvium of the larger rivers. They are usually formed of coarse gravel, but the terrace at Burneside consists of fine gravel and sand, which has been used for building purposes. In some cases there may be seen several terraces, marking successive stages in the deepening of its bed by the river. They cannot, however, be traced far, but shade one into the other, or even into the lowest alluvial deposit, which is often in these rapid rivers also a coarse gravel. The Alluvium north of Kendal consists of fine sand, loam, and gravel, resting on coarser gravel. In many cases the alluvial flats alongside of the rivers mark the site of former lakes, the dam having been formed by a drumlin extending across the valley. Instances of this have been previously noted in Kentmere, Long Sleddale, and Bannisdale (pp. 41–43). The River Mint, in particular, for the lower five or six miles of its course, has cut its channel through or round a very great number of such obstructions. There are many tarns also dotted about the country, most of which have been drained naturally or artificially, and some of which are occupied by silt, and some by peat. A few only are rock-basins, the greater number being enclosed by drumlins. The greatest growth of peat in this map is found in the arm of the marsh, which extends northwards into this map about a mile and a half east of Church Town. There it is extensively dug to a depth of eight feet without reaching the bottom.

A. STRAHAN.

Weathering and Landslips.

The Volcanic Rocks are very much disintegrated by the action of the atmosphere in many places, the weathered part extending as much as 20 or 30 feet down from the surface. This may be well seen in the Mosedale Slate Quarry, where the upper weathered portion is bent over down hill. Evidently the bending over is due to what is termed the "weight of the hill," *i.e.*, the disintegrated rock heels over under its own weight, and the pressure from behind of similar material on the higher slopes. In other instances that have been observed the bending over was always down hill. On the Mardale side also of the fell on which the

* *Brit. Assoc. Rep.* for 1878. Report of the Committee on Erratic Blocks (Note on Boulders near Kendal, by Mr. J. R. Dakyns), p. 3.

Mosedale Quarry is situated, the cleavage planes are bent over downhill, *i.e.*, towards the north-west, while in the quarry they are bent to the south-east. A similar bend-over was noticed on Lingmell End.

In many places great masses of the steep hill-sides have slipped down bodily. Huge slices, probably along lines of master-joints, have subsided one after the other, with the result of forming a series of parallel trenches along the face of the hill. The best instance, perhaps, is on the west side of Long Sleddale, near the head of the dale, above the crags known as Steel Pike and Raven Crag. It is noteworthy that this tract of slipped ground is known by the natives as the "shaken earth." Instances of such wholesale slipping may be seen in many places throughout the Lake District.

J. R. DAKYNS.

A great mass of *débris* was washed down from the sides of Blease Fell, on the east of the Lune, about two miles south of Tebay Junction, in the course of three or four hours during a thunderstorm about the year 1858. The rain excavated deep channels in the weathered rock of the hill-side, and spread the rubbish over some pasture-land below. The *débris* still forms a striking object as seen from the train.

Shap Spa Medicinal Springs.

The following analysis of the Shap Spa Water was made in 1881 by J. W. Montgomery, F.C.S., Public Analyst for the County of Cumberland:—*

"One Imperial pint of the Shap Spa water contains:—

	Grains.
Chloride of Calcium - - - -	27·22
,, Sodium - - - -	24·23
,, Magnesium - - -	·36
Sulphate of Soda - - - - -	1·72
,, Lime - - - - -	·48
Silica - - - - - -	·12
Oxide of Iron and Alumina - - -	·08

"The water also contains an appreciable quantity of Sulphuretted Hydrogen in solution. It is a valuable natural water, and will be found of value as a diuretic, and in many skin affections."

This medicinal spring, according to Professor Sedgwick,† rises from the calcareous breccia, which, as previously described, represents the Coniston Limestone in this section. The breccia is stated by him to be impregnated with pyrites. The actual source of the spring has been for many years covered in. A second and similar spring rises in the railway cutting, 400 yards north of the bridge by the Old Wells, and is much used by the servants of the Railway Company.

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* Handy guide to the English Lakes and Shap Spa. 8vo. London.

† *Trans. Geol. Soc.* Ser. 2, vol. iv., p. 68*.

APPENDIX.

TABLE I.—1. Coniston Limestone Fossils from localities in, or on the borders of, Quarter-Sheet 98 N.E. 2. Fossils of the Ashgill Shales in the same neighbourhood.

TABLE II.—Table showing the Distribution of Fossils in the Upper Silurian Rocks in the neighbourhood of Kendal, Kirkby Lonsdale, and Sedbergh.

TABLE III.—Classified List of the Graptolites of Westmorland, by Professor Charles Lapworth, LL.D., F.G.S.

TABLE IV.—List of Carboniferous Limestone Fossils in the Kendal Museum, from the neighbourhood of Kendal.

The synonyms in Tables I., II., and IV. (printed in italics) have been revised by Messrs. G. Sharman and E. T. Newton., F.G.S.

TABLE I.

1. Coniston Limestone Fossils from localities in, or on the borders of, Quarter-Sheet 98 N.E.

2. Fossils of the Ashgill Shales in the same neighbourhood.

The synonyms (printed in *italics*) have been revised by Messrs. G. Sharman and E. T. Newton, F.G.S.

Authorities.

W. = the Description of British Palæozoic Fossils in the Woodwardian Museum by Fred. McCoy, 1855, and the Catalogue of Cambrian and Silurian Fossils by J. W. Salter, 1873.
Sd. = Sedgwick. *Quart. Journ. Geol. Soc.*, vol. i., p. 444, 1845.
S. = Survey Collections.
Hs. = Hughes. *Geol. Mag.*, vol. iv., p. 346, 1867.
Hk. = Harkness and Nicholson. *Quart. Journ. Geol. Soc.*, vol. xxii., p. 482, 1866; vol. xxiv., p. 296, 1868; and vol. xxxiii., p. 461, 1877.
M. = Marr. *Quart. Journ. Geol. Soc.*, vol. xxxiv., p. 872, 1878.
K. = Kendal Museum, identified by R. B. Newton in 1885.

Localities.

1. High Haume
2. Barkin
3. Helm Gill
4. Near Dent

} In the neighbourhood of Dent.

5. Rother Bridge
6. Sarly Beck
7. Spengill
8. Fairy Gill

} In the neighbourhood of Sedbergh.

9. Ravenstonedale.
10. Long Sleddale
11. Style End Grassing
12. Kentmere
13. Applethwaite
14. Troutbeck
15. Nanny Lane
16. Scot Beck
17. Wansfell
18. Skelgill

} From Shap to Windermere.

1. Coniston Limestone Fossils.

Hydrozoa.

Monograptus (Graptolites) ludensis, *Murch.* Hk., 10.
Stromatopora concentrica, *Goldf.* Sd.

Actinozoa.

Aulacophyllum nitratum, *His.* W, 13. S, 3. M. Hk, 10, 11.
Catenopora. See Halysites.
Ceramopora (Discopora) squamata, *Lonsd.* K, 13, 14. (? Polyzoon.)
Chætetes, sp. Hk.
Cyathophyllum, sp. Sd, 1.
———————— flexuosum, *Linn.* S.

Favosites alveolaris?, *Lonsd.* *See* F. aspera.
——— *cristata*, *Blum.* *See* Pachypora.
——— *fibrosa*, *Goldf.* *See* Monticulipora.
——— Forbesii, *E. & H.* K, 17.
——— girvanensis, *N. & E.* K.
——— *polymorpha*, *Goldf.* *See* Pachypora cristata, *Blum.*
Fistulipora. K, 14.
Halysites catenularia, *Linn.* W. K, 10, 14. M, 13.
——— ——— var. labyrinthica, *Linn.* M, 1.
——— escharoides (?), *Lamk.* Sd, 1 (?). K, 10.
Heliolites interstinctus, *Wahl.* W, 10, 13. S, 3. K, 10, 17. M, 10, 13.
——— inordinatus, *Lonsd.* Sd.
——— megastoma, *McCoy.* Sd, 1. W. S. M, 1. K, 12.
——— subtubulatus, *McCoy.* W. M.
——— tubulatus, *Lonsd.* W. M.
——— sp. S. M, 2.
Lindströmia subduplicata, *McCoy.* K, 10, 14. Hk, 11.
Lyopora (Palæopora) favosa, *McCoy.* K, 12.
Monticulipora (Favosites) explanata. *McCoy.* W, 13. M.
——— favulosa, *Phil.* M, 13.
——— fibrosa, *Goldf.* Sd, 1. S, 3. M, 14. Hk, 11. K, 13, 14, 18.
——— lens, *McCoy.* K, 13, 14. M.
Nebulipora. *See* Monticulipora.
Omphyma subturbinata, *D'Orb.* S.
——— turbinata, *Linn.* M.
Pachypora cristata, *Blum.* Sd. K, 14.
Palæopora interstincta, *Wahl.* *See* Heliolites.
——— var. *subtubulata*, *McCoy.* *See* Heliolites.
——— *megastoma*, *McCoy.* *See* Heliolites.
——— *petaliformis*, *Lonsd.* *See* Plasmopora.
——— *tubulata*, *Lonsd.* *See* Heliolites.
Petraia æquisulcata, *McCoy.* *See* Aulacophyllum nitratum, *His.*
——— bina, *Lonsd.* Sd, 1.
——— elongata, *Phil.* S.
——— *subduplicata*, *McCoy.* *See* Lindströmia.
——— sp. S. M, 14.
Plasmopora petaliformis, *Lonsd.* W. S.
Porites inordinata, *Lonsd.* *See* Heliolites.
——— *pyriformis*, *Lonsd.* *See* Heliolites megastoma.
Prasopora Grayæ, *N. & E.* K, 14.
Sarcinula organum, *Linn.* *See* Syringophyllum.
Stenopora fibrosa, *Goldf.* *See* Monticulipora.
Streptelasma æquisulcata, *McCoy.* K, 13, 14.
Syringophyllum organum, *Linn.* W, 10, 13. K, 10, 14. M, 1, 10.
Turbinolopsis bina, *Lonsd.* *See* Petraia.

Echinodermata.

Caryocistites Davisii, *McCoy.* *See* Echinosphærites.
Echinosphærites balthicus, *Eich.* M, 14.
——— Davisii, *McCoy.* W. K, 14. M, 14.
——— mammosus? *Salt. MS.* M, 14.
Glyptocrinus basalis, *McCoy.* K. 14.
——— sp. S, 3.
Marsupiocrinus cælatus?, *Phil.* S.

Annelida.

Conchicolites gregarius, *Nich.* Hk.
Cornulites serpularius, *Schloth.* K, 14.
Worm markings. S.

Crustacea.

Acidaspis Brightii, *Murch.* Sd.
Agnostus trinodus, *Salt.* K, 14.
Amphion, n. sp. M, 14.
Ampyx nudus ?, *Murch.* Hk.
Asaphus Powisii, *Murch.* Sd. W, 9.
——— tyrannus, *Murch.* Sd.
Beyrichia complicata, *Salt.* M.
——— impendens, *Jones.* Hk.
——— *strangulata, Salt.* *See* Primitia.
——— wilckensiana, *Jones.* Hk.
Bronteus, n. sp. Sd.
Calymene Blumenbachii, *Brong.* Sd. W. S. K, 14. Hk. 11.
——— *brevicapitata, Portl.* *See* C. senaria.
——— senaria, *Conr.* W, 13. K, 10, 14. M, 1, 13.
——— *subdiademata, McCoy.* *See* C. Blumenbachii.
——— n. sp. Sd.
Ceraurus clavifrons, McCoy. *See* Sphærexochus boops.
Chasmops Odini ? Eich. *See* Phacops conopthalmus.
Cheirurus bimucronatus, *Murch.* M, 4.
——— sp. S, 3.
Cybele rugosa, *Portl.* M.
——— verrucosa. *Dalm.* W, 9. S, 3. M, 9, 14. Hk.
Cytherina lævigata, *Salt.* Sd.
Encrinurus multiplicatus, *Salt.* M, 2.
——— multisegmentatus, *Portl.* M, 3.
——— sexcostatus, *Salt.* S.
——— sp. Hk.
Harpes Doranni, *Portl.* M.
Homalonotus bisulcatus, *Salt.* W, 9.
Illænus Bowmanni, *Salt.* S. M. Hk.
——— Davisii, *Salt.* K, 14.
——— Rosenbergi, *Eich.* W. M. K, 10, 14. Hk.
——— sp. S, 3.
Isoteles Powisii, Murch. *See* Asaphus.
Lichas laciniatus, *Dalm.* W. M.
——— laxatus, *McCoy.* Hk.
——— *propinqua, Barr.* *See* L. laciniatus.
——— sp. S, 3.
Odontochile obtusicaudata, Salt. *See* Phacops.
Paradoxides quadrimucronatus, Murch. *See* Acidaspis Brightii.
Phacops apiculatus ?, *Salt.* Hk.
——— Brongniarti, *Portl.* K, 14.
——— conopthalmus, *Bæck.* W, 13. M, 4.
——— macroura, *Sjögren.* M, 10, 11, 13. K, 14. Hk.
——— obtusicaudatus, *Salt.* W.
——— sp. S, 3.
Primitia McCoyii, *Salt. MS.* M.
——— ——— var. M.
——— protenta, *Jones.* Hk.
——— semicircularis, *Jones & Holl.* Hk.
——— strangulata, *Salt.* W. M.
Remopleurides. M, 4.
Sphærexochus boops, *Salt.* W, 13. M, 13.
Trinucleus concentricus, *Eaton.* K, 14. Hk.
——— seticornis, *His.* M, 13.
——— sp. S, 3.
Turrilepas. K, 14.
Zethus atractopyge, McCoy. *See* Cybele verrucosa.

Polyzoa.

Berenicea (Diastopora) heterogyra, *McCoy*. W. M, 13. K, 14.
Diastopora heterogyra, McCoy. *See* Berenicea.
Fenestella Milleri, *Lonsd*. K, 14.
——— sp. S.
Phyllopora Hisingeri, *McCoy*. W. M.
——— ? Sd, 1.
Ptilodictya acuta ?, *Hall*. M, 14.
——— costellata, *McCoy*. K, 14.
——— dichotoma, *Portl*. M.
——— explanata, *McCoy*. W. K, 14.
——— lanceolata, *Goldf*. S, 3. K, 14.
Retepora. *See* Phyllopora.

Brachiopoda.

Atrypa affinis, Sby. *See* A. reticularis.
——— imbricata, *Sby*. S, 3.
——— marginalis, *Dalm*. Hs.
——— reticularis, *Linn*. Sd.
Discina Corona, Salt. *See* Trematis.
——— sp. S.
Leptæna antiquata, Sby. *See* Strophomena.
——— *deltoidea, Conr*. *See* Strophomena.
——— ——— *var. undata, McCoy*. *See* Strophomena.
——— *depressa, Sby*. *See* Strophomena rhomboidalis.
——— *grandis, Sby*. *See* Strophomena.
——— *pecten, Linn*. *See* Strophomena.
——— quinquecostata, *McCoy*. M, 4.
——— sericea, *Sby*. Sd. S, 3. Hk.
——— *spiriferoides, McCoy*. *See* Orthis.
——— tenuissimestriata, *McCoy*. W.
——— transversalis, *Dalm*. W. Sd. S. M. Hk.
——— n. sp. Sd.
——— sp. S.
Leptocœlia (Atrypa) hemisphærica, *Sby*. K.
Lingula ovata, *McCoy*. W. K, 14 ? M, 13. Hk.
——— tenuigranulata, *McCoy*. Hk.
——— sp. S, 3.
Lingulella Davisii, *McCoy*. W.
Meristella ? crassa, *Sby*. W.
Orthis Actoniæ, *Sby*. Sd, 1. W. S, 3. M, 13. K, 14.
——— alternata, *Sby*. S. Hs.
——— bidens, *Salt. MS*. M, 3.
——— biforata, *Schloth*. W, 9. S, 3. M, 14. K, 14. Hk.
——— calligramma, *Dalm*. W. S, 3. K, 14.
——— ——— ——— var. virgata, *Salt*. Sd. M, 13.
——— ——— ——— var. Walsalliensis ?, *Salt*. S.
——— *canalis, Sby*. *See* O. elegantula.
——— crispa, *McCoy*. M, 3 (as var. of O. calligramma).
——— elegantula, *Dalm*. Sd, 1. S, 3. K, 14.
——— flabellulum, *Sby*. W, 13. S. M, 13. K, 14. Hk, 11, 18.
——— *inflata, Salt*. *See* O. porcata.
——— insularis, *Eich*. W. M. K, 14.
——— plicata, *Sby*. M (as var. of O. calligramma).
——— porcata, *McCoy*. Sd, 1. W. S, 3. M. K, 14.
——— protensa, *Sby*. W.
——— radians, *Sby*. Sd. (? = O. calligramma).
——— spiriferoides, *McCoy*. W. K, 14.
——— testudinaria, *Dalm*. Sd. K, 14. Hk.
——— unguis, *Sby*. K, 14 ?

Orthis vespertilio, *Sby.* W. Sd.? M. K, 14. Hk. 11.
——— *virgata, Salt.* *See* var. of calligramma.
——— sp. S.
Pentamerus? K, 14.
———— *lens, Sby.* *See* Stricklandinia.
Rhynchonella, sp. M, 9.
Siphonotreta anglica, *Morris.* W.
Spirifer dentata, Pand. *See* Orthis biforata.
———— *fissicostata, McCoy.* *See* Orthis biforata.
——— *insularis, Eich.* *See* Orthis insularis.
——— *percrassa, McCoy.* *See* Meristella? crassa.
——— n. sp. Sd.
Stricklandinia lens. *Sby.* W.
Strophomena alternata, Sby. *See* Orthis.
———— antiquata, *Sby.* W. M.
———— compressa, *Sby.* K, 14.
———— *corrugata, Portl.* *See* S. corrugatella.
———— corrugatella, Dav. M.
———— deltoidea, *Conr.* W. M.
———— ———— var. undata, *McCoy.* W. K, 14.
———— *depressa, Dalm.* *See* S. rhomboidalis.
———— expansa, *Sby.* S. K, 10. Hk.
———— grandis, *Sby.* W. S. K, 14.
———— pecten, *Linn.* W, 9, 13. K, 14. M, 9, 14.
———— rhomboidalis, *Wilck.* W. Sd. S, 3. K, 4, 14. M, everywhere. Hk, 11.
———— *tenuistriata, Sby.* *See* S. rhomboidalis.
Trematis (Discina) corona, *Salt.* M. Hk.

Lamellibranchiata.

Modiolopsis? K, 14.
Orthonota? M, 13.

Gasteropoda.

Bellerophon bilobatus, *Sby.* Hk.
Cyclonema crebristria, *McCoy.* K, 12.
Euomphalus? Sd.?
———— perturbatus? *Sby.* K, 14.
Holopea, M, 14. K, 14.
Holopella, M, 14. K, 14.
Murchisonia, K, 14.
Pleurotomaria, K, 17.
Turbo? Sd.

Pteropoda.

Tentaculites anglicus, *Salt.* W. Sd. K, 14.
———— *annulatus, McCoy.* *See* T. anglicus.
———— n. sp. Sd.

Cephalopoda.

Cyrtoceras sonax, *Salt.* M, 3.
Lituites cornuarietis, Sby. *See* Trochoceras.
Oncoceras (Poterioceras). Hk.
Orthoceras annulatum, *Sby.* W.
———— *bilineatum, Hall.* *See* O. gracile.

Orthoceras filosum, *Sby.* W.
——— gracile, *Portl.* K, 14.
——— vagans, *Salt.* W. M, 14. K, 14.
——— sp. Sd. S, 3. Hk.
——— sp., like Troostii. M, 14.
Trochoceras cornuarietis, *Sby.* K, 14.

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2. Fossils of the Ashgill Shales.

Hydrozoa.

Diplograptus, K. 18.

Actinozoa.

Halysites catenularia, *Linn.* K, 17.
Lindströmia subduplicata, *McCoy;* var. crenulata, *Salt.* M, 4.
Petraia. *See* Lindströmia.

Echinodermata.

Echinosphærites. M.
Glyptocrinus. M, 14.
Sphæronites Litchii, *Forbes.* K, 14.

Annelida.

Cornulites. M, 14, 15.
Serpulites. K, 18.

Crustacea.

Agnostus. K, 18.
Asaphus (Megalaspis) zonatus, *Barr.* 18.
Calymene Blumenbachii, *Brong.* K, 18.
——— sp. M.
Cheirurus clavifrons, *Dalm.* K, 18.
Encrinurus sexcostatus, *Salt.* K, 18.
Leperditia. K, 18.
Ogygia. M. K, 18.
Phacops apiculatus, *Salt.* K, 18. M, 5, 15, 18.
——— Brongniarti, *Portl.* K, 18.
——— eucentra, *Angelin.* K, 18.
——— mucronatus, *Brong.* var. M, 15, 18.
——— sp. (not obtusicaudatus). M, 6.
——— sp. (with long head spines). M.
Phyllopods. M, 18.
Staurocephalus clavifrons. M.
Trinucleus concentricus, *Eaton.* M, 3, &c.
Turrilepas. K, 14.

Polyzoa.

Ptilodictya acuta ?, *Hall.* K.
——— dichotoma, *Portl.* K, 18.

Brachiopoda.

Leptæna sericea, *Sby.* K, 18.
Lingula. M, 18. K, 13.
Meristella. K, 13.
Orthis Actoniæ, *Sby.* K, 18.
——— alternata, *Sby.* M, 4.
——— biforata, *Schloth.* M, 4, 18. K, 18.
——— calligramma, *Dalm.* M, 4. K, 18.
——— ——————— var. crispa, *McCoy.* K, 18.
——— elegantula, *Dalm.* K, 18.
——— flabellulum ?, *Sby.* K, 18.
——— protensa, *Sby.* M, 18.
——— testudinaria, *Dalm.* K, 18.
——— vespertilio, *Sby.* M, 4, 18. K, 18.
Strophomena *alternata, Sby.* *See* Orthis alternata.
——————— *depressa, Dalm.* *See* S. rhomboidalis.
——————— Jukesii, *Dav.* K, 18.
——————— rhomboidalis, *Wilck.* M, 4.
——————— siluriana, *Dav.* M, 8, 13, 15, 18. K, 8, 18.

Gasteropoda.

Bellerophon trilobatus ?, *Sby.* M.
Holopella obsoleta, *Sby.* K, 17.
Raphistoma æqualis, *Salt.* K, 18.

Pteropoda.

Conularia elongata ?, *Portl.* K, 13.
——————— Sowerbyi, *Defr.* K, 18 ?
Theca triangularis, *Portl.* K, 18.

Cephalopoda.

Orthoceras vagans, *Salt.* K, 13.

TABLE II.

SHOWING the DISTRIBUTION of FOSSILS in the UPPER SILURIAN ROCKS in the Neighbourhood of Kendal, Kirkby Lonsdale, and Sedbergh.

The synonyms have been revised by Messrs. G. Sharman and E. T. Newton.

S indicates Survey Collection.
K indicates Kendal Museum, identified by Mr. R. B. Newton in 1885.
M indicates the collection of Mr. J. E. Marr, now in the Woodwardian Museum, and the lists given by Mr. Marr in *Quart. Journ. Geol. Soc.*, vol. xxxiv., pp. 876–883.
W refers to the Catalogue of the Collection of Cambrian and Silurian Fossils in the Woodwardian Museum, by J. W. Salter, 1873, and to the description of British Palæozoic Fossils in the Woodwardian Museum, by Fred. McCoy, 1855.

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Plantæ.																	
Spongarium equistriatum, *McCoy* -	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
——— interlineatum, *McCoy* -	..	W	..	KW	SW	..	..	..	..	..	..	..	..	..	..	..	Lupton (S.); Scalthwaiterigg (W.).
——— interruptum, *McCoy* -	..	..	..	K	W	..	..	..	..	..	..	..	..	..	..	..	Spital.
Spongidæ.																	
Cliona prisca, *McCoy* - -	..	..	..	..	..	..	..	..	..	..	..	S	S	..	..	..	Casterton Fell.
Pasceolus Goughii, *Salt.* - -	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
Dictyophyton (Tetragonis) Danbyi, *McCoy.*	..	..	K	W	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

———	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underharrow.	Benson Knot.	Various.	Crossdale Beck Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Actinozoa.																	
Cyathaxonia siluriensis, *McCoy* -	..	..	..	..	..	..	..	W	..	..	..	..	..	..	..	..	Underbarrow.
Favosites aspera, *D'Orb.* -	..	..	..	..	..	..	..	..	..	..	S	..	M	..	..	M?	Stockdale.
——— Forbesii, *E. & H.* - -	..	..	..	..	..	..	..	..	..	..	..	..	K	..	..	..	Locality?
——— multipora, *Lonsd.* - -	..	..	..	..	..	..	..	..	..	..	..	K	..	..	..	..	
Halysites catenularia, *Linn.* - -	..	..	..	..	..	..	..	..	..	..	S	..	..	..	..	..	
Lindströmia *sp.* - - -	..	..	..	..	..	..	..	K	K	..	..	..	K	..	..	K	Orrest, Underbarrow, and Troutbeck (Coniston Grits).
——— siluriensis, *McCoy* -	..	..	K	..	K	..	..	..	..	..	..	..	..	..	..	..	Hay Fell.
Monotrypa macropora, *Foord.* -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	K	
Monticulipora (or Alveolites), *sp.* -	..	..	..	..	..	..	..	..	..	..	S	..	..	..	..	..	
——— (Favosites) fibrosa, *Lonsd.*	..	..	K	..	K	..	..	W	..	..	..	W	MW	..	M	..	Reston (Kirkby Moor Flags); Coldwell and Troutbeck (Con. Flags); Horton (Pale Slates); Howgill Fells (Con. Flags); Rather Heath (Bann. Slates).
——— (———) papillata, *McCoy*	W	KW	..	..	W	..	..	..	..	..	..	..	W	..	..	..	Firbank, Coniston (Coniston Flags).

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Deut.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Petraia, *sp.*	..	..	..	..	..	..	..	S	..	..	S	..	SM	..	M	M	Casterton Fell, Lincoln's Inn Bridge (Bann. Slates), Troutbeck (Con. Flags), Spengill (Pale Slates).
———, like subduplicata	..	..	..	..	..	..	..	S	..	..	..	S	S	..	..	..	Wyegarth Gill, Red Gill (Bann. Slates), Cautley (Con. Grits).
Stenopora fibrosa, Goldf. See Monticulipora.	..	..	..	..	..	..	W	..	..	..	..	..	..	..	..	..	
Syringopora																	
Echinodermata.																	
Actinocrinus?	..	..	..	K	..	S	..	S	..	..	..	..	..	..	..	..	Lincoln's Inn Bridge.
———— pulcher, *Salt.*	..	..	..	..	W?	..	..	SW	..	..	..	K	MS	..	..	..	Shepherd's Quarry (Low. Ludlow); Red Gill (Bann. Slates); Casterton Fell and Cautley (Con. Grits); Coldwell and Troutbeck (Con. Flags).

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Crinoidal stems	..	..	..	..	..	..	..	K	..	..	..	..	..	..	..	..	Underbarrow.
Cyathocrinus, *sp.*	..	..	..	..	W	..	..	..	..	..	S	..	..	..	..	..	Shepherd's Quarry.
——— goniodactylus, *Phillips*	..	..	..	..	..	..	..	..	..	..	..	K	..	..	..	..	
Icthyocrinus mcCoyanus, *Salt.*	..	..	..	..	..	..	..	W	..	..	..	..	..	..	..	..	Underbarrow.
——— pyriformis, *Phill.*	..	..	..	..	..	..	W	..	..	..	..	..	..	..	..	..	
Palæaster hirudo, *Forbes*	..	..	..	..	..	..	K	KW	..	..	..	..	..	..	..	..	Potter Fell, Tebay Gill.
——— Ruthveni, *Forbes*	..	..	..	..	..	..	KW	..	..	..	..	..	..	..	..	..	
Palæasterina primæva, *Forbes*	..	..	..	..	..	..	KW	..	..	..	..	..	..	..	..	..	
Platycrinus, *sp.*	..	..	..	W	W	..	W	..	..	..	..	..	..	..	..	..	Shepherd's Quarry.
Protaster Sedgwickii, *Forbes*	..	..	..	W	..	..	..	SW	..	..	..	..	..	..	..	..	Lincoln's Inn Bridge (S.), Docker Fell (W.)?
Pseudocrinites	..	..	..	..	..	..	..	..	..	K	..	..	..	..	..	..	
Taxocrinus Orbigni, *McCoy*	..	..	..	..	..	..	W	K	..	..	..	..	..	..	..	..	Docker Nook, Long Sleddale, Shepherd's Quarry.
Annelida.																	
Serpulites dispar, *Salt.*	..	..	..	KW	W	..	..	W?	..	..	..	..	..	..	..	..	Scalthwaiterigg, Tenter Fell.
Spirorbis Lewisii, *Sby.*	..	..	..	K	..	..	..	K	..	..	..	SW	W	..	..	..	Underbarrow (Ludlow), Casterton Fells (Con. Flags, W.).

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Trachyderma squamosa? *Phill.*	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
Crustacea.																	
Acidaspis, *sp.*	..	..	..	..	..	..	..	S	..	..	..	S	S	..	..	M	Wyegarth Gill and Red Gill (Bann. Slates), Casterton Fell, and Cautley (Con. Grits).
——— Hughesii, *Salt.*	..	..	..	..	..	..	..	..	..	..	..	..	W	..	..	..	Casterton Low Fell.
Ampyx aloniensis, *n. sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Aptychopsis	..	..	..	..	..	..	..	..	..	K	..	..	..	..	..	K	
Beyrichia Klœdeni, *McCoy*	S	..	..	..	SW	S	K	W	..	..	S	..	..	..	..	..	Three Mile House (Ludlow), Cowan Head and Underharrow (Bann. Slates).
Calymene Blumenbachii, *Brong.*	..	..	..	..	S	S	K	..	..	..	..	..	..	..	..	M	Crook of Lune.
——— tuberculosa, *Salt.*	..	..	..	..	..	..	KW	..	..	..	..	..	..	..	..	..	
Ceratiocaris?	..	..	..	..	W	S	..	..	..	K	..	..	..	..	..	..	Beck Mills.
——— elliptica, *McCoy*	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— inornata, *McCoy*	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Crossdale Beck Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Ceratiocaris Murchisoni, *Ag.*	..	..	..	..	..	..	..	..	..	..	..	S	MS	..	..	..	Casterton Fell, Troutbeck, Coldwell.
——— robusta, *Salt.*	..	..	..	..	..	..	..	..	..	..	..	S	S	..	..	..	Casterton Fell, High Hollins, Cautley.
——— solenoides, *McCoy*	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
Cheirurus bimucronatus, *Murch., var. nov.* longispinus.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	M	Spengill.
——— moroides, *n. sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Discinocaris browniana, *Woodw.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— gigas (?), *H. Woodw.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— *n. sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Encrinurus punctatus, *Brünn*	..	..	..	..	..	..	..	..	..	..	..	..	W	..	..	..	Middleton Park.
——— *var.* arenaceus, *Salt.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— variolis, *Brong.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Entomostraca	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	M	Spengill, Torver Beck.
Eurypterida (Hemiaspis?)	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	..	
Eurypterus cephalaspis, *Salt.*	..	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Crossdale Beck Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Forbesia latifrons, McCoy. *See* Proetus.																	
Harpes, ? *n. sp.* - - -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Hemiaspis aculeatus, *Salt.* - -	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	..	
Homalonotus Knightii, *König* -	..	..	..	K	SW	..	..	..	..	..	..	..	W	..	..	..	Endmoor (?) Hutton Bridge End, Tenter Fell, Middleton Park (W.).
Odontochile caudata, Brong. *See* Phacops Downingiæ, *Murch.*																	
Peltocaris anatina, *Salt.* - -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	..	Coldwell.
——— aptychoides, *Salt.* - -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	M	Long Sleddale.
Phacops, *sp.* - - - -	..	..	..	..	..	..	..	..	..	..	S	..	..	..	..	..	Spengill, Torver Beck.
——— caudatus, *Brünn* - -	..	..	..	K	S	..	..	..	..	..	..	..	..	..	..	..	Endmoor (?), Lily Mere, Cowby Gill (?).
——— Davisii, *Edgell MS.* -	..	..	..	..	..	..	..	S	..	..	..	..	S	..	..	..	Bowderdale (Bann. Slates), Casterton Fell, and High Hollins (Con. Grits).
——— Downingiæ, *Murch.* -	S	..	..	KW	S	S	K	W	..	..	..	..	..	..	..	..	Hutton Bridge End, Tenter Fell, Middleton Park (W.), and Underbarrow (W.).

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Phacops Dowuingiæ, *Murch., var.* inflatus, *Salt.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
——— elegans, *Bröeck & Sars.*	..	..	..	..	..	..	..	..	K ?	..	..	..	..	..	..	M	
——— glaber, *n. sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— obtusicaudatus, *Salt.*	..	..	..	..	..	..	..	..	K	K	..	MK	MK	..	..	K ?	Coldwell, Troutbeck. Everywhere (Con. Flags, M.).
Phyllopod, large	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Proetus brachypygus, *n. sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— latifrons, *McCoy*	..	..	..	..	..	..	K	W	..	..	..	..	..	..	..	..	
——— Stokesii? *Murch.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Pterygotus, *sp.*	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— problematicus, *Ag.*	..	..	..	K	..	..	..	W ?	..	..	..	..	..	..	..	..	
Turrilepas	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
Polyzoa.																	
Fenestella patula (?), *McCoy*	..	..	..	..	..	..	..	..	..	K	..	..	..	..	..	..	
Ptilodictya	..	..	..	..	..	..	..	K	..	..	..	..	..	..	..	..	Cowan Head.

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Brachiopoda.																	
Athyris obovata. See Glassia.																	
Atrypa flexuosa, *n. sp.* - -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— reticularis, *Linn.* - -	..	..	..	..	W	..	K	KW	..	..	..	..	..	..	..	..	Collinfield (?), Cowan Head (Bann. Slates).
Chonetes lata, V. Buch. See C. striatella.																	
——— minima, *Sby.* - -	..	..	..	..	..	..	K	..	..	..	..	..	..	..	..	..	
——— striatella, *Dalm.* - -	S	..	..	KW	SW	..	K	KW	..	..	S	S	S	..	..	..	Cowan Head.
Dayia (Rhynchonella) navicula, *Sby.*	..	..	..	K	K	S	K	SKW	..	..	S	..	..	..	..	..	High Crag, Reston (Ludlow), Cowan Head, Potter Fell, and Lincoln's Inn Bridge (Bann. Slates).
Discina, *sp.* - - - -	..	..	..	..	..	S	..	..	..	..	..	..	..	..	..	..	
——— *Forbesii, Dav. See* Orbiculoidea.																	
——— rugata, *Sby.* - -	S (?)	..	..	KW	..	..	..	W	..	..	..	..	..	..	..	..	Potter Fell.
——— striata, *Sby.* - -	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Varions.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Glassia obovata, *Sby.*	..	..	..	..	..	..	..	W	..	..	..	..	..	..	..	..	Sunny Bank (Grayrigg).
Hemithyris navicula, Sby. *See* Dayia.																	
——— *nucula, Sby.* *See* Rhynchonella.																	
Leptæna quinquecostata, *McCoy*	..	..	..	..	..	..	..	..	..	..	..	..	K	..	M	M	Troutbeck, Spengill, Torver Beck.
——— segmentum, *Angelin*	..	..	..	..	..	..	..	..	K	..	..	..	..	..	..	..	
Lingula cornea, *Sby.*	..	..	..	KW	S	S	..	..	..	..	..	..	..	..	..	..	Keastwick, Cowby Gill.
——— lata, *Sby.*	..	..	..	KW?	..	..	..	..	..	..	..	..	..	..	..	..	
——— Lewisii, *Sby.*	..	..	..	KW?	..	..	..	..	..	..	..	..	..	..	..	..	
——— minima, *Sby.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
——— Symondsii, *Salt.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
Meristella crassa, *Sby.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	..	Spengill.
——— *didyma, Dalm.* *See* Meristina.																	
——— *tumida, Dalm.* *See* Whitfieldia.																	
Meristina didyma, *Dalm.*	..	..	..	..	..	..	..	..	..	..	..	..	W	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Orbiculoidea Forbes, *Dav.*	..	..	..	K	..	..	..	..	..	..	..	..	W	..	..	..	Middleton Fell (Con. Grits).
Orthis crispa, *McCoy*	..	..	..	..	..	..	..	..	K	..	..	..	..	..	..	..	
—— elegantula, *Dalm.*	S	..	..	..	S	..	..	..	..	..	S	..	..	K	..	..	Three Mile House, Crosslands, Gatebeck, Homescales, Cowby Gill.
—— Lewisii, *var.* Hughesii, *Dav.*	..	..	..	..	..	..	..	..	..	..	..	S	S	..	..	..	Langdale Beck.
—— lunata, *Sby.*	..	..	..	KW	K	..	K	..	..	..	S(?)	..	..	..	..	..	Red Scar.
—— orbicularis	..	..	..	..	S	..	..	..	..	..	S (?)	..	..	..	..	..	Low Scales.
—— *sp.*	..	..	..	..	..	..	..	..	..	..	..	M	..	M	..	..	
—— vespertilio, *Sby.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	K	
Pentamerus (?)	..	..	..	..	..	..	K	K	..	..	..	..	..	..	..	..	Tullethwaite Hall.
Rhynchonella borealis, *Schloth.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
—— Lewisii(?), *Dav.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Middleton Fell (Con. Grits).
—— *navicula, Sby. See* Dayia																	
—— nucula, *Sby.*	S	..	..	KW	SW	S	K	KW	..	..	S	..	..	..	..	..	Hutton Bridge End, Crosslands, Lambrigg, Collinfield, Gatebeck, Cowby Gill, Homescales (Ludlow); Long Sleddale and Cowan Head (Bann. Slates).

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Spirifera crispa, *His.*	..	..	..	..	S	..	K?	..	..	..	S	..	..	..	..	..	Gatebeck.
——— elevata, *Dalm.*	..	..	..	KW	SW	..	..	W	..	..	S	S	S	..	..	..	Homescales, Hutton Bridge End, Keastwick (Ludlow); Potter Fell (Bann. Slates); Leck Beck (Con. Grits).
——— *subspuria, D'Orb.* *See* S. elevata.																	
Spirigerina reticularis, Linn. *See* Atrypa.																	
Strophomena depressa, *Dalm.*	..	..	..	..	..	..	..	..	..	..	..	..	M	..	..	..	Troutbeck.
——— eugylpha, *His.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	K	
——— filosa, *Sby.*	..	..	..	..	..	..	..	KW	..	..	..	..	..	..	..	..	Cowan Head (K.), Tulleth-waite Hall (W.).
——— pecten, *Linn.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	K	
——— rhomboidalis, *Wilck.*	..	..	..	..	..	..	..	..	K	..	..	..	..	..	..	..	
——— siluriana, *Dav.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	..	Spengill.
——— *sp.* (with pure striæ)	..	..	..	..	..	..	..	..	..	..	..	..	..	M	..	..	
Whitfieldia tumida, *Dalm.*	..	..	..	..	..	..	K	..	..	..	..	..	..	..	..	M	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Varions.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Lamellibranchiata.																	
Anodontopsis augustifrons, *McCoy* -	..	..	..	KW	W	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.
——— bulla, *McCoy* - -	..	..	..	K	W	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.
——— (Pseudaxinus) securiformis, *McCoy.*	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
Arca (Palæarca) Edmondiiformis, McCoy. See Ctenodonta.																	
——— *primitiva, Phill. See* Ctenodonta.																	
Avicula Danbyi, *McCoy* - -	..	..	..	KW	K	..	..	..	..	..	..	..	..	..	..	..	
Cardiola interrupta, *Broderip* -	..	..	..	..	S	..	..	..	K	W	S	SKW	SM KW	..	..	..	Homescales, Leck Beck, Low Wood, Straight Bridge, Casterton Fell, Middleton Fell, Troutbeck, Cautley.
Ctenodonta, *sp.* - - -	..	..	..	..	..	..	..	..	..	..	..	W	..	..	..	..	
——— anglica, *D'Orb.* - -	..	W	..	..	W	..	W	W	..	..	..	..	..	..	..	..	
——— Edmondiiformis, *McCoy* -	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— primitiva, *Phill.* - -	..	..	..	W	..	..	W	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Cucullella antiqua, *Sby.*	S	..	..	K	S	..	..	..	..	..	..	..	..	..	..	..	Crosslands ?, Gatebeck ?.
——— Cawdori, *Sby.*	..	..	..	..	..	..	..	S	..	..	..	..	..	..	..	..	Lincoln's Inn Bridge.
——— coarctata, *Phill.*	..	K	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— ovata, *Sby.*	..	W	..	W	W	..	..	..	..	..	..	..	..	..	..	..	Derby Arms (Kendal).
Goniophora cymbæformis, *Sby.*	..	..	..	K	S	..	..	..	..	..	..	..	..	..	..	..	Lupton.
Grammysia cingulata, *His.*	..	..	..	KW	S	..	W	..	..	..	..	..	..	..	..	..	Mansergh.
——— ——— *var.* triangulatæ, *Salt.*	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
——— extrasulcata, *Salt.*	..	..	..	KW	K	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.
——— rotundata, *Sby.*	..	..	..	KW	W	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.
Leptodomus. *See* Orthonota.																	
Modiolopsis planata, *Salt.* (?=lævis)	..	..	..	KW	SW	..	..	..	..	..	..	..	..	..	..	..	Lupton.
——— *solenoides Sby.* *See* M. planata.																	
Nucula. *See* Ctenodonta.																	
Orthonota affinis, *McCoy*	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— amygdalina, *Sby.*	..	W	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
——— ——— *var.* globulosa, *McCoy.*	..	..	..	KW	W	..	..	..	..	..	..	..	..	..	..	..	Tenter Fell, Kirkby Moor.

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

———	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Orthonota angulifera, *McCoy* -	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
——— decipiens, *McCoy* - -	..	..	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
——— prora, *Salt.* - -	..	..	..	K	W	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.
——— *semisulcata, Sby. See* O. prora.																	
——— *solenoides, Sby. See* Modiolopsis.																	
——— truncata, *McCoy* - -	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— undata, *Sby.* - -	..	..	..	W	..	S	..	..	..	..	..	..	..	..	..	..	
Orthonota (*Tellinites*).																	
Pterinea *Boydi, Conrad. See* P. Sowerbyi.																	
——— lineata, *Goldf.* - -	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— megaloba, *McCoy* - -	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
——— pleuroptera, *Conrad.* -	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	
——— retroflexa, *Wahl.* - -	S	..	..	K	SW	..	W	..	..	..	..	..	..	..	..	..	Lupton, Hutton Bridge End, Crosslands, Kirkby Moor, Cowby Gill, Homescales, Reston.
——— ——— ——— *var.* demissa, *Conrad.*	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Pterinea retroflexa, *Wahl. var.*, crecta, *McCoy.*	..	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	Laverock Lane, Kirkby Moor.
——— ——— *var.* hians -	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
——— Sowerbyi, *McCoy* -	..	W	..	K	..	..	..	..	..	..	..	S	..	..	..	..	
——— subfalcata, *Conrad* -	..	..	..	KW	..	..	..	..	..	..	..	S(?)	W	..	..	..	Howgill Fells (Con. Grits).
——— tenuistriata, *McCoy* -	..	..	..	KW	..	S	..	S	..	..	..	SW	SW	..	..	..	Bowderdale, Wyegarth Gill, (Bann. Slates); Casterton Fell (Con. Grits), Middleton Fell, Ravenstonedale, High Hollins, Cautley.
Sanguinolites. See Orthonota.																	
Tellinomya anglica (?), *D'Orb.* -	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
Tellinites. See Orthonota.																	
Gasteropoda.																	
Bellerophon, *sp.* - - -	..	..	..	..	..	..	..	..	..	..	S	..	..	..	..	..	
——— expansus, *Sby.* - -	..	K	KW	KW	SK	S	..	..	..	..	..	..	..	..	..	..	Red Scar, Hutton Bridge End (Ludlow).
——— Ruthveni, *Salt.* - -	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Bellerophon trilobatus, *Sby.*	S	K	K	K	SK	..	..	..	..	..	..	..	..	..	..	..	Red Scar, Low Fields, Gatebeck, Cowby Gill, Homescales.
Ecculiomphalus, *sp.*	..	K	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Acroculia, *sp.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
Cyclonema corallii, *Sby.*	..	..	..	KW	..	S	..	..	..	..	..	..	..	..	..	..	
——— octavia, *D'Orb.*	..	K	..	K	KW	..	W	..	..	..	..	..	..	..	..	..	Meal Bank.
——— lævis, *Sby.*	S	..	..	..	S	..	..	..	..	..	..	K	..	..	..	..	Homescales.
Holopella, *sp.*	..	..	K	..	S	..	..	..	..	..	..	..	..	..	..	..	Beckfoot.
——— cancellata, *Sby.*	..	..	..	..	W	..	..	..	..	..	..	..	..	..	..	..	Lambrigg.
——— conica, *Sby.*	S	..	..	..	S	..	..	..	..	..	..	..	..	..	..	..	Lily Mere, Homescales.
——— gregaria, *Sby.*	S	..	..	K	SW	..	..	W	..	..	S	..	..	..	..	..	Beckfoot, Cowby Gill, Homescales.
——— intermedia, *McCoy*	..	..	..	..	..	..	W	..	..	..	..	..	..	..	..	..	
——— obsoleta, *Sby.*	..	..	..	KW	S	..	K	..	..	..	..	..	..	..	..	..	Crosslands.
Littorina. *See* Cyclonema.																	
Loxonema elegans, *McCoy*	..	..	..	K	..	..	..	..	K	..	..	..	..	..	..	..	
Murchisonia, *sp.*	..	..	..	..	S	S	..	..	..	..	..	..	..	..	..	..	Gatebeck.
——— articulata, *Sby.*	..	..	..	W	W	..	..	..	..	..	..	..	..	..	..	..	Lambrigg Fell.
——— corallii, *Sby.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

———	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					P ale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Murchisonia Lloydii, *Sby.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
——— —— torquata, *Mc Coy*	..	..	..	KW	W	..	..	..	..	..	..	..	..	..	..	..	Spital.
Natica. See Naticopsis.																	
Naticopsis glaucinoides, *Sby.*	..	..	..	KW	KW	..	..	..	..	..	..	..	..	..	..	..	Beckfoot, Hutton Common.
——— parva, *Sby.*	..	..	..	KW	W	..	..	..	..	..	..	..	..	..	..	..	Beckfoot.
Platyschisma helicites, *Sby.*	S	..	..	K	S	..	..	..	..	..	..	..	..	..	..	..	Crosslands, Cowby Gill (?).
Pleurotomaria crenulata, *McCoy*	..	W	..	..	K	..	..	..	..	..	..	..	..	..	..	..	Red Scar.
Raphistoma (?) macromphala (?), *McCoy.*	..	..	..	..	..	..	..	..	..	K	..	..	..	..	..	..	
Turbo. See Cyclonema.																	
Pteropoda.																	
Conularia, *sp.*	..	..	..	..	..	..	K	..	..	..	..	..	..	..	..	..	
——— *cancellata. See* C. Sowerbyi.																	
——— Sowerbyi, *Defr.*	..	..	W	W	..	..	W	..	..	..	..	..	..	..	..	..	
——— subtilis, *Salt.*	..	W	..	KW	..	..	..	..	..	..	..	..	..	..	..	..	
Cornulites serpularius, *Schloth.*	..	W	..	KW	S	..	..	..	..	..	..	..	..	..	..	..	Lowfields, Crosslands (Ludlow), Cautley (Con. Grits).
——— *sp.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	..	Spengill.

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Crossdale Beck Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Tentaculites anglicus, *Salt.*	..	..	..	..	..	..	..	..	..	..	..	..	W	..	..	..	Ravenstonedale.
——— *annulatus, Schloth.* *See* T. anglicus.																	
——— tenuis, *Sby.*	..	..	..	W	SW	..	..	..	..	..	..	..	S	..	..	..	Lupton, Kirkby Moor (Ludlow); Cautley (Con. Grits).
Theca Forbesii, *Sharpe*	S	..	K	KW	W	..	..	..	..	..	..	..	..	..	..	..	Lambrigg Fell, Gatebeck.
Cephalopoda.																	
Cycloceras	..	..	..	..	..	..	..	..	..	..	..	M	..	..	..	..	
Cyrtoceras elegans, *Barr.*	..	..	..	..	..	..	..	..	..	..	..	K	..	..	..	..	
——— isca, *Blake*	..	..	..	..	..	..	..	..	K	K	..	..	K	..	..	..	Troutbeck.
Hortolus. *See* Lituites.																	
Lituites, *sp.*	..	..	..	..	..	..	..	..	..	..	..	..	S	..	..	..	Casterton Fell.
——— *giganteus.* *See* Trochoceras																	
——— ibex, *Sby.*	..	..	W	..	..	..	W	..	..	..	..	..	..	..	..	..	
Orthoceras angulatum, *Wahl.*	S	W	KW	K	..	..	..	..	K	K(?)	..	S	..	..	..	..	
——— araneosum, *Barr.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M	
——— baculiforme, *Salt.*	..	W	..	..	..	..	..	..	..	..	..	..	..	..	..	..	

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Beck Crossdale Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolite Mudstones).	The Localities referred to in the preceding columns, headed Various.
Orthoceras bilineatum	..	..	..	..	..	..	..	..	..	..	..	M	M	..	..	..	Coniston.
—— bullatum, *Sby.*	..	..	K	K	SW	..	K	..	..	K	..	..	..	..	..	..	Lowfields, Lambrigg Fell, Laverock Lane.
—— dimidiatum, *Sby.*	..	W	..	K(?)	W	..	..	..	..	..	..	W	..	..	..	..	Derby Arms (Kendal).
—— distans, *Sby.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
—— elongatocinctum, *Portl.*	..	W	..	W	..	..	..	..	..	..	..	MW	MW	..	..	..	Coldwell, Troutbeck, Randy Pike.
—— excentricum, *Sby.*	..	..	..	K	..	..	..	..	..	..	..	..	..	..	..	..	
—— filosum, *Sby.*	..	..	..	K	..	..	..	..	..	..	..	..	W	..	..	..	Coldwell (Con. Flags).
—— ibex, *Sby.* (not Salter's Camb. Foss., p. 71, &c.).	..	..	..	KW	W	..	K	W	..	..	..	..	S	..	..	..	Kirkby Moor (Ludlow), Meal Bank (Bann. Slates), Cautley (Con. Grits).
—— imbricatum, *Wahl.*	..	..	..	K	W	..	..	..	..	..	..	..	..	..	..	..	Kirkby Moor.
—— *lacqueatum, Salt. See* O. lineatum.																	
—— lineatum, *His., var.* tenuistriatum, *Münst.*	..	..	..	..	W	..	..	..	..	K	..	..	MW	..	..	..	Kirkby Moor, Coldwell, and Troutbeck (Con. Flags).
—— ludense, *Sby.*	..	..	..	..	..	..	K	..	..	..	..	S	S	..	..	..	High Hollins.

Table showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Crossdale Beck Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Orthoceras mocktreense (?), *Sby.*	..	..	..	K	..	..	..	..	..	K	..	..	..	..	..	..	
——— *perelegans, Salt.* See Lituites ibex.																	
——— primævum, *Forbes*	..	..	..	K W	..	..	..	S	..	K	..	S	S M	..	..	..	Crook of Lune (Bann. Slates), High Hollins and Leck Beck (Con. Flags), Castley Knot (? Con. Flags).
——— subannulatum, *Münst.*	..	W	..	..	..	..	..	..	..	..	..	W.	M	..	..	..	Coldwell.
——— subundulatum, *Portl.*	..	..	W	K(?)	..	..	..	S(?)	..	..	..	S M W	S M K W	..	..	..	Troutbeck, Borrans, Casterton Fell (Con. Grits), Castley Knot, Howgill Fell, Coldwell.
——— tenuiannulatum, *McCoy*	..	W	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
——— *tenuicinctum, Portl.* See O. elongatocinctum.																	
——— *torquatum, Salt.* See O. primævum.																	

Tables showing the distribution of Fossils in the Upper Silurian Rocks—*cont.*

	Kirkby Moor Flags.					Bannisdale Slates.			Coniston Grits and Flags.					Pale Slates.			The Localities referred to in the preceding columns, headed Various.
	Killington.	Brigsteer.	Underbarrow.	Benson Knot.	Various.	Crossdale Beck Houses.	High Thorns.	Various.	Wansfell.	Applethwaite.	Winder.	Dent.	Various.	Skelgill.	Various.	Skelgill (Graptolitic Mudstones).	
Orthoceras tracheale, *Sby.* - -	..	..	..	KW	SW	..	..	..	..	..	..	W	W	..	..	..	Lily Mere, Kirkby Moor (Ludlow), Howgill Fells (Con. Flags and Grits).
——— undulocinctum (?), *Blake*	..	..	..	..	..	..	..	..	K	..	..	..	K	..	..	..	Laterigg, Coldwell, Troutbeck.
——— *virgatum, Sby. See* O. angulatum.																	
Trochoceras giganteum, *Sby.* - -	..	..	..	..	..	..	..	..	..	..	..	..	S	..	..	..	Cautley.

TABLE III.

TABLE SHOWING THE DISTRIBUTION OF GRAPTOLITES, by Prof. Charles Lapworth, LL.D., F.G.S. 1886.

The Skelgill Shales of this Table are the Graptolitic Mudstones described on p. 11.

—	Geological Range in Wales or Scotland.				Synonyms.	Geological Range in Westmoreland.
	Llandovery.	Tarannon.	Wenlock.	Lower Ludlow.		
Rastrites distans, *Lapw.*	..	×	..	..	? var. of R. Linnæi, *Barr.* (Nicholson, Q.J.G.S. vol. xxiv., Pl. xix. and xx.).	Highest zones of the Skelgill Shales.
——— peregrinus, *Barr.*	×					
Monograptus argenteus, *Nich.*	×					
——— argutus, *Lapw.*	×	..	..	..	- - - - -	Skelgill Shales.
——— attenuatus, *Hopk.*	×	..	..	..	M. Nilssoni, *Barr.* M. discretus, *Nich.* M. tennis, *Portl.*	Skelgill Shales.
——— Beckii, *Barr.*	×					
——— bohemicus, *Barr.*	..	..	..	×	- - - - -	Higher zones of the Coniston Flags only.
——— colonus, *Barr.*	..	..	×	×	- - - - -	Higher zones of the Coniston Flags.
——— convolutus, *His.*	×	×	..	..	M. Sedgwickii, *Portl.* M. triangulatus, *Harkn.* (Nicholson, *loc. cit.*).	Skelgill Shales.
——— crispus, *Lapw.*	..	×	..	..	- - - - -	Pale Slates.
——— cyphus, *Lapw.*	×	..	..	..	G. sagittarius, *His.* (Nicholson) -	Lower zones of the Skelgill Shales.
——— exiguus, *Nich.*	..	×	..	..	M. lobiferus, *McCoy* (Nicholson, Fig. 27).	Pale Slates.
——— fimbriatus, *Nich.*	×	..	..	..	- - - - -	Lower zones of the Skelgill Shales.
——— Flemingii, *Salt.*	..	..	×	..	- - - - -	Coniston Flags.
——— gregarius, *Lapw.*	×	..	..	..	M. Nilssoni, *Barr.* (Nicholson, Fig. 19).	Skelgill Shales.

The Distribution of Graptolites—*cont.*

—	Geological Range in Wales or Scotland.				Synonyms.	Geological Range in Westmoreland.
	Llandovery.	Tarannon.	Wenlock.	Lower Ludlow.		
Monograptus Hisingeri, *Carr.*	×	×	..	..	M. sagittarius, *His.* (Nicholson)	Skelgill Shales.
—— intermedius, *Carr.*	×	..	..	..	M. Nilssoni, *Barr.* (Nicholson)	Skelgill Shales.
—— lobiferus, *McCoy*	×	..	..	..	} May be varieties of M. Beckii, *Barr.*	Skelgill Shales.
—— Nicoli, *Harkn.*	×	..	..	..		
—— priodon, *Bronn.*	..	×	×	×	M. ludensis, *Murch.*	Coniston Flags and Grits.
—— Rœmeri, *Barr.*	..	..	..	×	—	? Highest beds of the Coniston Flags or Grits.
—— spinigerus, *Nich.*	×	..	..	..	—	Skelgill Shales.
—— spiralis, *Geinitz.*	×	×	..	..	var. of M. convolutus, *His.*	Pale Slates.
—— tenuis, *Portlock*	×	..	..	..	M. discretus, *Nich.*	Lower zones of the Skelgill Shales.
—— triangulatus, *Harkn.*	×	..	..	..	—	Skelgill Shales.
—— turriculatus, *Barr.*	×	×	..	..	—	Pale Slates.
—— vomerinus, *Nich.*	..	..	×	×	G. priodon, *Bronn.* (Nicholson)	Coniston Flags and Grits.
Cyrtograptus Murchisoni, *Carr.*	..	..	×	..	—	Lower zones of the Coniston Flags.
Dimorphograptus confertus, *Nich.*, sp.	×	..	..	..	Dip. confertus, *Nich.*	Skelgill Shales.
Diplograptus *conf.* folium, *His.*	×	..	..	..	D. palmeus, *Barr.* in part; in part new species.	Skelgill Shales.
—— Hughesii, *Nich.*	×	..	..	..	—	Skelgill Shales.
—— modestus, *Lapw.*	×	..	..	..	(Not D. pristis, *His.*)	Skelgill Shales.
—— palmeus, *Barr.*	×	×	..	..	—	Skelgill Shales.

The Distribution of Graptolites—*cont.*

—	Geological Range in Wales or Scotland.				Synonyms.	Geological Range in Westmoreland.
	Llandovery.	Tarannon.	Wenlock.	Lower Ludlow.		
Diplograptus sinuatus, *Nich.*	×	..	..	..	D. putillus, *Hall.* (Nicholson).	Skelgill Shales.
—— —— tamariscus, *Nich.*	×	..	..	..	– – – – –	Skelgill Shales.
—— —— vesiculosus, *Nich*	×	..	..	..	– – – – –	Skelgill Shales.
Retiolites geinitzianus, *Barr.*	..	×	×	..	– – – – –	Coniston Flags.
—— perlatus, *Nich.*	×	..	..	..	– – – – –	Skelgill Shales.
Climacograptus scalaris, *His.*	×	..	..	..	var. C. normalis, *Lapw.*	Skelgill Shales.

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On the Geological Distribution of the Rhabdophora, by Ch. Lapworth. *Ann. & Mag. Nat. Hist.*, 1879–80.

TABLE IV.

List of Carboniferous Limestone Fossils in the Kendal Museum, from the neighbourhood of Kendal. Identified by Mr. R. B. Newton, F.G.S., in 1885.

The Synonyms (printed in italics) have been revised by Messrs. G. Sharman and E. T. Newton, F.G.S.

The localities are indicated by the following numbers, and are taken in geographical order from south to north:—

1. Arnside.
2. Grange.
3. Blawith Point.
4. Meathop.
5. Sedgwick.
6. Brigsteor.
7. Helsington.
8. Underbarrow Scar.
9. Barrowfield Wood.
10. Ash Fell.
11. Kendal Fell.
12. Serpentine Walks.
13. Kettlewell.
14. Helsfell.
15. Halhead Nab.
16. Plumgarths.
17. Grayrigg.
18. Orton.
19. Crosby Fell.
20. Shap.

Plantæ.

Lepidodendron (Knorria, condition of), 10, 11, 16.
Lycopodites (Sigillaria) Vanuxeni, *Gœppert* (new to Britain), 20.
Stigmaria ficoides, *Brongn.*, 13.

Rhizopoda.

Endothyra Bowmanni, *Phillips*, 11.

Actinozoa.

Alveolites (Chætetes) septosus, *Fleming*, 7, 18, 19.
Amplexus, 1, 18.
Campophyllum giganteum, *Michelin*, 1.
Clisiophyllum coniseptum, *Keyserling*, 1.
Cyathophyllum archiasis, *Ed. & Haime* ?
———— dianthoides, *McCoy*, 1.
———— expansum (?), *McCoy*, 1.
———— regium, *Phillips*, 7, 20.
———— Stutchburyi, *Ed. & Haime*, 3, 10.
Diphyphyllum, 13.
Lithostrotion affine, *Fleming*, 11, 13.
———— basaltiforme, *Con. & Phillips*, 11, 13.
———— irregulare, *Phillips*, 13.
———— junceum, *Fleming*, 12.
———— Martini, *Ed. & Haime*, 11.
———— maccoyanum, *Ed. & Haime*, 20.
———— Phillipsii, *Ed. & Haime*, 10, 11.
———— Portlockii, *Ed. & Haime*, 18.
Lonsdaleia rugosa, *McCoy*, 1.
Michelinia favosa, *Goldfuss*, 10.
———— megastoma, *Phillips*, 1.
Monticulipora, 1, 13.
Thysanophyllum, 20.
Syringopora geniculata, *Phillips*, 11.
———— ramulosa, *Goldfuss*, 1, 10.
———— reticulata, *Goldfuss*, 4, 11.

Echinodermata.

Palæchinus sphæricus, *Scouler*, 5.

Annelida.

Serpula, 10.
Microconchus carbonarius, *Murch.*, 10.
Annelid tracks, 13.

Crustacea.

Cythere, 13.
Phillipsia gemmulifera, *Phillips*, 1, 11, 13.

Polyzoa.

Fenestella membranacea, *Phillips*, 20.
Ptylopora flustriformis, *Phillips*, 13, 14.

Brachiopoda.

Athyris expansa, *Phillips*, 1, 6, 11, 20.
——— planosulcata, *Phillips*, 11.
——— Royssii, *L'Eveillé*, 1.
Chonetes papilionacea, *Phillips*, 1, 11.
Cyrtina septosa, *Phillips*, 1, 13.
Orthis Michelini, *L'Eveillé*, 1, 6.
——— resupinata, *Martin*, 1, 6.
Productus cora, *D'Orb*, 11.
——— fimbriatus, *Sby.*, 11.
——— giganteus, *Martin*, 1, 11, 16.
——— punctatus, *Martin*, 11.
——— pustulosus, *Phillips*, 6.
——— scabriculus, *Martin*, 1, 11.
——— semireticulatus, *Martin*, 8.
Rhynchonella angulata, *Linn.*, 4.
——— pleurodon, *Phillips*, 4, 11.
——— pugnus, *Martin*, 4, 13.
Spirifera elliptica, *Phillips*, 8.
——— glabra, *Martin*, 1, 17.
——— lineata, *Phillips*, 11, 13.
——— ovalis, *Phillips*, 10.
——— pinguis, *Sby.*, 13.
——— planata (?), *Phillips*, 1.
——— striata, *Martin*, 13.
——— trigonalis, *Martin*, 11.
Spiriferina cristata, *Schloth.*, 10.
Streptorhynchus crenistria, *Phillips*, 1, 6.
Syringothyris distans, *Sby.*, 4, 13.
Terebratula sacculus, *Martin*, 1, 11.

Lamellibranchiata.

Allorisma sulcata, *Fleming*, 11.
Aviculopecten anisotus (?), *Phillips*, 11.
——— arenosus (?), *Phillips*, 6.
——— concavus, *McCoy*, 6.
——— deornatus (?), *Phillips*, 11.

Aviculopecten dissimilis, *Fleming*, 6, 11.
——————— elongatus, *McCoy*, 6.
——————— granosus, *Sby.*, 6.
——————— interstitialis, *Phillips*, 11.
——————— Ruthveni, *McCoy*, 11.
Conocardium aliforme, *Sby.*, 1, 11.
Cucullæa tenuistria, *McCoy*, 11.
Edmondia unioniformis, *Phillips*, 11.
Myalina crassa, *Fleming*, 11.
——————— Verneuilii, *McCoy*, 11.
Mytilus Flemingii, *McCoy*, 11.
Nucula gibbosa, *Fleming*, 11.
Pinna flabelliformis, *Martin*, 6.
Sanguinolites clavus, *McCoy*, 11.
——————— subcarinatus, *McCoy*, 11.
——————— variabilis (?), *McCoy*, 11.
Schizodus, 11.
Solemya, 11.
Solenopsis pelagicus (?), *Goldfuss*, 1, 6.

Gasteropoda.

Bellerophon apertus (?), *Sby.*, 1, 10.
——————— costatus, *Sby.*, 11, 15, 20.
——————— sulcatus, *Sby.*, 11.
——————— tangentialis (?), *Phillips*, 11.
——————— tenuifascia, *Sby.*, 13.
Bellerophon (Bucania) cornuarietis, *Sby.*, 11.
Buccinum sigmilineum, Phillips. *See* Macrochilina.
Capulus trilobatus, *Phillips*, 11.
Crassidorsa, 6.
Dentalium, 6.
Eulima, 10, 11, 13, 14.
Euomphalus crotolostomus, *McCoy*, 6, 11, 15.
——————— pentangulatus, *Sby.*, 11.
——————— (Omphalotrochus) tabulatus, *Phillips*, ?.
——————— (Phymatifer) pugilis, *Phillips*, 11.
——————— (Straparollus) acutus, *Sby.*, 11.
——————— ——————— acutus (?), *Sby.*, 13.
——————— ——————— pentagonalis, *Phillips*, 10.
——————— ——————— Dionysii, *Montf.*, 11.
Loxonema rugifera, *Phillips*, 8.
——————— sp. ?, 11, 13.
Macrochilina acuta (?), *Phillips*, 11.
——————— sigmilinea, *Phillips*, 1.
Microdoma biserrata, *Phillips*, 1.
Murchisonia, *var.* Kendalensis, 11.
——————— vittata, *Phillips*, 6, 20.
Naticopsis ampliata, *Phillips*, 1, 6, 11.
——————— elliptica, *Phillips*, 1, 11, 13.
——————— elongata, *Phillips*, 6, 11.
——————— *n. sp.*, 2, 6.
Palasmæa, 6.
Phanerotinus cristatus, *Sby.*, 15.
Platyschisma helicoides, *Sby.*, 6, 11, 13.
——————— tiara, *Sby.*, 6.
Pleurotomaria, n. sp., 6.
Schizostoma catillus, *Martin*, 11.

Cephalopoda.

Discites discus, *Sby.*, 11.
——— lévellianus, *Koninck* 11.
——— sulcatus, *Sby.*, 11.

Goniatites, 11.
Nautilus ingens, *Martin*, 6, 11.
Orthoceras Gesneri, *Martin*, 11.
———— giganteum, *Sby.*, 11.
Posterioceras ventricosum, *McCoy*, 11.
Temnocheilus (allied to cariniferus, *Sby.*), 11.

Pisces.

Deltodus sublævis, *Agassiz*, 11.
Helodus (?), 4, 11, 20.
Polyrhizodus porosus, *Agassiz*, 6.
Gyracanthus (?) palatal tooth, 6.
———————— fragments of teeth, 4.

INDEX.

D.

E.

F.

G.

M.

N.

O.

P.

Q.

R.

S.

T.

U.

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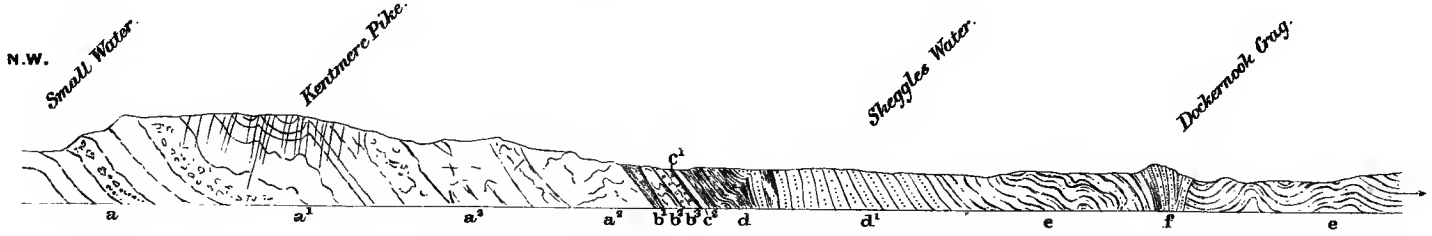

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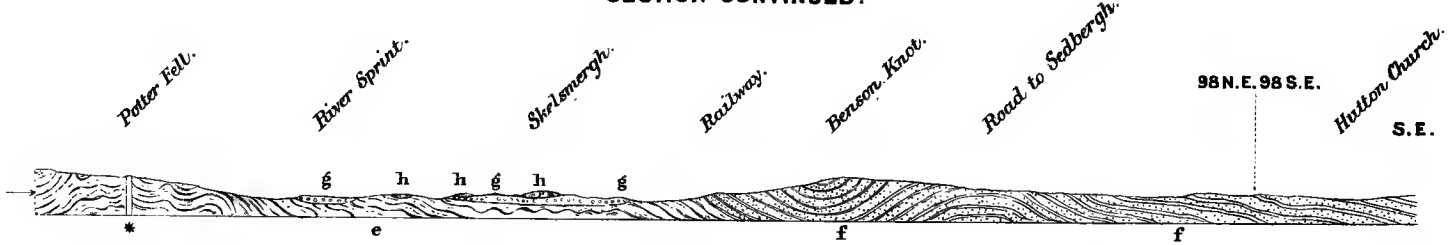

h. *Carboniferous Limestone.*
g. *Carboniferous Basement Beds.*
* *Dyke.*

f. *Kirkby Moor Flags.*
e. *Bannisdale Slates.*
d¹. *Coniston Grits.*
d. *Coniston Flags.*
c³. *Stockdale Shales.*
c¹. *Graptolitic Mudstone.*

b⁴. *Limestone.*
b². *Felspathic Trap.*
b¹. *Shale.*
} *Coniston Limestone Series.*

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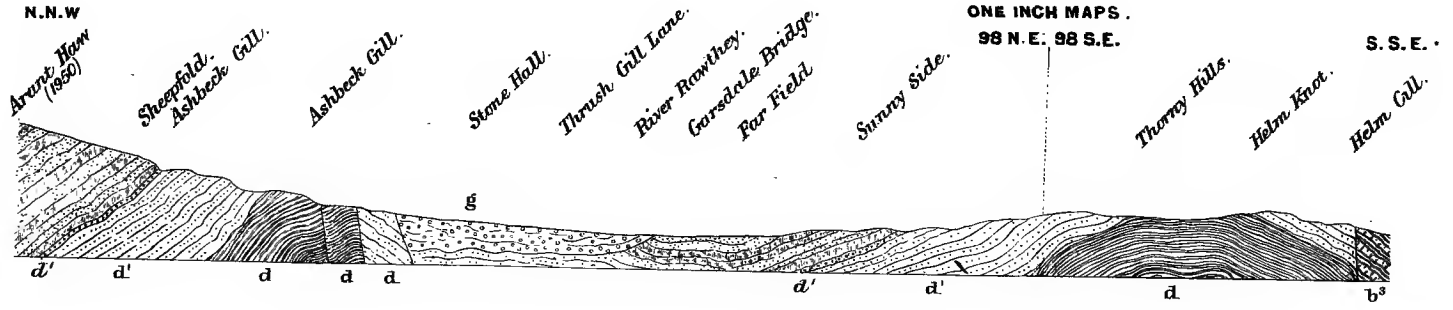

g. *Carboniferous Basement Beds.*

d'. *Coniston Grits with*
d'. *the Winder Grit Band.*

d. *Coniston Flags.*

b³ *Coniston Limestone.*

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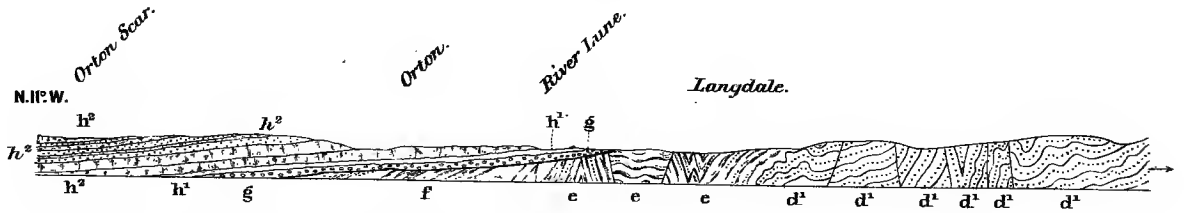

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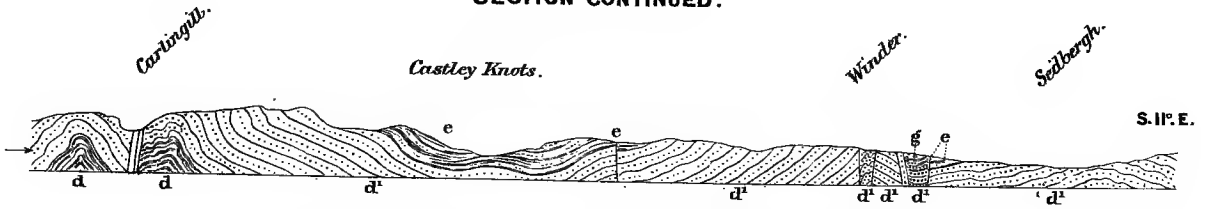

h². *Carboniferous Limestone with h². Sandstone.*
h¹. *Lower Limestone Shale.*
g. *Carboniferous Basement Beds.*
f. *Kirkby Moor Flags.*
e. *Bannisdale Slates.*
d¹. *Coniston Grits.*
d. *Coniston Flags.*

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Scale, one inch to a mile.

Anglesey, 78 (SW).
Bristol and Somerset, 19, 35.
Coalbrook Dale, 61 (NE & SE).
Clee Hill, 53 (NE, NW).
Flintshire and Denbighshire, 74 (NE & SE), 79 (NE, SE).
Derby and Yorkshire, 71 (NW, NE & SE), 82 (NW & SW), 81 (NE), 87 (NE, SE), 88 (SE).
Forest of Dean, 43 (SE & SW).
Forest of Wyre, 61 (SE), 55 (NE).
Lancashire, 80 (NW), 81 (NW), 89, 88 (SW, NW).
Leicestershire, 71 (SW), 63 (NW).
Northumberland & Durham, 103, 105, 108 (SE), 109 (SW, SE).
N. Staffordshire, 72 (NW), 72 (SW), 73 (NE), 80 (SE), 81 (SW).
S. Staffordshire, 54 (NW), 62 (SW).
Shrewsbury, 60 (NE), 61 (NW & SW).
South Wales, 36, 37, 38, 40, 41, 42 (SE, SW).
Warwickshire, 62 (NE SE), 63 (NW SW), 54 (NE), 53 (NW).
Yorkshire, 88 (NE, SE), 87 (SW), 92 (SE), 93 (SW).

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Lancashire.

Sheet.	Sheet.	Sheet.
15. Ireleth.	73. Todmorden.	97. Oldham.
16. Ulverstone.	77. Chorley.	100. Knowsley.
17. Cartmel.	78. Bolton-le-Moors.	101. Billinge.
23. Aldingham.	79. Entwistle.	102. Leigh, Lowton.
47. Clitheroe.	80. Tottington.	103. Ashley, Eccles.
48. Colne.	81. Wardle.	104. Manchester, Salford.
49. Laneshaw Br.	84. Ormskirk.	
55. Whalley.	85. Standish.	105. Ashton-under-Lyne.
56. Haggate.	86. Adlington.	
57. Winewall.	87. Bolton-le-Moors.	106. Liverpool.
61. Preston.	88. Bury, Heywood.	107. Prescott,
62. Balderstone.	89. Rochdale, &c.	108. St. Helen's.
63. Accrington.	92. Bickerstaffe.	109. Winwick.
64. Burnley.	93. Wigan.	111. Cheedale.
65. Stiperden Moor.	94. West Houghton.	112. Stockport.
69. Layland.	95. Radcliffe.	113. Part of Liverpool.
70. Blackburn.	96. Middleton, Prestwich.	
71. Haslingden.		
72. Cliviger, Bacup.		

Durham.

1. Ryton.	6. Winlaton.	11. Ebchester.
2. Gateshead.	7. Washington.	12. Tantohy.
3. Jarrow.	8. Sunderland.	13. Chester-le-St.
4. S. Shields.	9. ———	18. Hunstanworth.
5. Greenside.	10. Edmondbyers.	17. Waskerley.

Durham—*continued.*

Sheet.	Sheet.	Sheet.
18. Muggleswick.	25. Wolsingham.	38. Maize Beck.
19. Lanchester.	26. Brancepeth.	42. Cockfield.
20. Hetton-le-Hole.	30. Benny Seat.	42. Bp. Auckland.
22. Wear Head.	32. White Kirkley.	46. Hawkshill Ho.
23. Eastgate.	33. Hamsterley.	52. Barnard Castle.
24. Stanhope.	34. Whitworth.	53. Winston.

Northumberland.

44. Rothbury.	80. Cramlington.	98. Walker.
45. Longframlington.	81. Earsdon.	101. Whitfield.
	82. NE. of Gilsland.	102. Allendale Town.
46. Broomhill.	83. Coadley Gate.	
47. Coquet Island.	87. Heddon.	103. Slaley.
54. Longhorsley.	88. Long Benton.	105. Newlands.
55. Ulgham.	89. Tynemouth.	106. Blackpool Br.
56. Druridge Bay.	91. Greenhead.	107. Allendale.
63. Netherwitton.	92. Haltwhistle.	108. Blanchland.
64. Morpeth.	93. Haydon Bridge.	109. Shotleyfield.
65. Newbiggin.	94. Hexham.	110. Wellhope.
72. Bedlington.	95. Corbridge.	111. Allenheads.
73. Blyth.	98. Horsley.	112.
	97. Newcastle.	

Cumberland.

55. Seamess.	65. Dockrave.	74. Westwater.
56. Skiddaw.	69. Buttermere	75. Stonethwaite Fell.
63. Thackthwaite.	70. Grange.	
64. Keswick.	71. Helvellyn.	

Westmorland.

2. Tees Head.	12. Patterdale.	25. Grasmere.
6. Dufton Fell.	18. Near Grasmere.	38. Kendal.

Yorkshire.

	118. Conistone Moor.	280. Honley.
7. Redcar.		281. Kirkburton.
9. ———	133. Kirkby Malham.	262. Darton.
12. Bowes.		263. Hemsworth.
13. Wyoliffe.	184. Dale End.	264. Campsall.
20. Lythe.	185. Kildwiok.	272. Holmfirth.
24. Kirkby Ravensworth.	200. Keighley.	278. Penistone.
	201. Bingley.	274. Barnsley.
25. Aldborough.	202. Calverley.	275. Darfield.
32. Whithy.	203. Seacroft.	276. Brodsworth.
33. ———	204. Aberford.	281. Langeell.
38. Marske.	215. Peeke Well.	282. Wortley.
39. Richmond.	216. Bradford.	283. Wath upon Dearne.
46. ———	217. Calverley.	
47. Robin Hood's Bay.	218. Leeds.	284. Conisborough.
	219. Kippax.	287. Low Bradford.
53. Downholme.	231. Halifax.	288. Ecclesfield.
68. Leybourne.	232. Birstal.	289. Rotherham.
82. Kidstones.	233. East Ardsley.	290. Braithwell.
84. E. Witton.	234. Castleford.	293. Hallam Moors.
97. Foxup.	246. Huddersfield.	295. Handsworth.
98. Kirk Gill.	247. Dewsbury.	296. Laughton-en-le-Morthen.
99. Haden Carr.	248. Wakefield.	
100. Lofthouse.	249. Pontefract.	299. ———
115. Arncliffe.	250. Darrington.	300. Harthill.

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