THE GEOLOGY OF THE COUNTRY AROUND HOLMFIRTH AND GLOSSOP

CHAPTER I

INTRODUCTION

The area represented on Sheet 86 and described in the present memoir includes parts of four counties, the West Riding of Yorkshire, Lancashire, Cheshire and Derbyshire, and is drained by tributaries of the Ouse, Mersey and Trent, The boundaries both of the natural division into river-basins and of the civil division into counties are somewhat anomalous. The primary watershed between the North Sea and the Irish Sea enters the area from the north about a mile and a half from the western margin and runs south-east to Black Hill (1,908 ft. above O.D.), Wike Head and Featherbed Moss; from the north it is followed by a parish boundary (and therefore shown on the map) as far as Wessenden Head Moor, and from Black Hill to Wike Head by the county boundary between Yorkshire and Cheshire. From Wike Head to Featherbed Moss the watershed runs in a gentle curve, not coinciding with any boundary shown on the map, but then bends westward and is followed by a parish boundary past Swains Head, where it crosses the Yorkshire-Derbyshire boundary at right angles, to Bleaklow Head (2,061 ft. above O.D.). Here it turns sharply south and takes an irregular course, shown by the parish boundary, to Devil's Dike, where it passes out of the area and goes south-west to Ashop Head.

On the western side of this line the drainage is to the Mersey by the rivers Tame and Etherow; the basin of the latter forms a salient projecting some seven miles east of the general run of the North Sea—Irish Sea divide (see map, Fig. 1). To the east the drainage is to rivers entering the Humber; the Marsden Brook and the Holme with their tributaries join the Calder; the Dearne, Little Don and Ewden Beck all join the Don, of which the main stream rises around Dunford Bridge and flows through Penistone. A small area on the south is drained by the Derwent and its tributaries and so forms part of the basin of the Trent. The boundary between this river and the Etherow from Featherbed Moss to Devil's Dike is given above; between it and the Don the line runs from Featherbed Moss to Howden Edge, Rocking Stones, Margery Hill and another Featherbed Moss (see below) near the southern margin of the area.

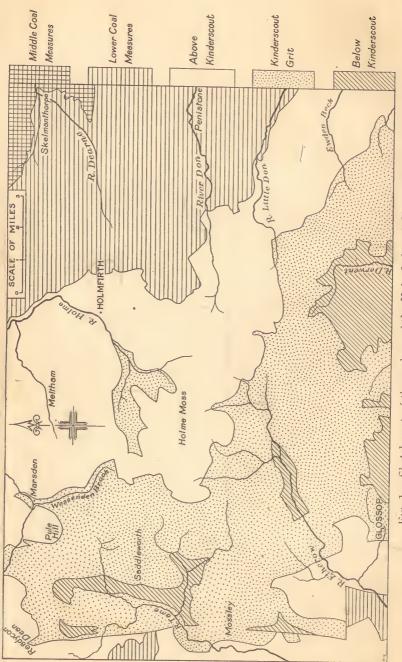


Fig. 1.—Sketch-map of the geology of the Holmfirth and Glossop area.

Yorkshire (West Riding) covers the whole of the area draining to the Ouse, but also extends westwards beyond the margin of the map. A tiny corner of Lancashire is cut off at the northwest, south of which Yorkshire continues southwards to between Greenfield and Mossley; here the boundary with Lancashire enters from the west, crosses the River Tame at right angles and, ascending the left bank, follows the southern margin of the basin of the Greenfield Brook. Near Ormes Moor Lancashire gives place to Cheshire, and the boundary of that county with Yorkshire continues, through yet another Featherbed Moss, to Black Hill and along the Pennine watershed. From Wike Head it descends to the Salter's Brook, the headwaters of the Etherow. Where the Yorkshire boundary leaves it to ascend to Swains Head the river becomes the boundary between Cheshire and Derbyshire, which follows it till it leaves the area shown on the map. From Swains Head the Yorkshire-Derbyshire boundary descends to the River Derwent, which it then follows. Yorkshire, in addition to the area draining to the Ouse, includes the upper basin of the Tame, a small part of that of the Etherow and the left bank of the Derwent. The Cheshire-Lancashire boundary follows no natural feature: from Ormes Moor it descends the Ogden Brook for a short distance, crosses to the valley of the Swineshaw Brook, turns north over the moor to Bucktonvale, descends to the River Tame, just south of Mossley, follows that river for half a mile and turns west to pass out of the

The dominant feature of the district is the high moorland which here composes the 'Pennine Range'; it rises to heights of 1,450 ft. in the north and over 2,000 ft. in the south. Between Marsden and Diggle in the north the moors barely exceed two miles in width, but south-eastwards the width increases rapidly up to twelve miles along the southern margin of the area. This stretch is, however, interrupted by the valley of the Etherow, known as Longdendale; the interruption is not great, despite the depth of the valley, as the banks maintain a moorland character almost to water-level. The Derwent valley forms a depression in the south-east, but the river and its tributaries remain typical moorland streams for some distance beyond our boundary.

This great tract of country is everywhere formed by the Millstone Grits, that is to say by a long succession of grits and sandstones alternating with soft shales and mudstones. The most massive part of the Millstone Grit sequence is the Kinderscout Grit series, which almost everywhere occupies the highest ground (see Fig. 1). The lower beds are found as inliers in the basins of the Tame, Etherow and Derwent, and to the east of Glossop. Those above the Kinderscout Grits occupy a belt of ground striking south-eastwards from between Marsden and the valley of the Holme, broken, however, by an inlier of Kinderscout Grits in the Upper Holme valley. On the west the beds, on account of the

position and asymmetrical character of the main axis (see Chapter V) occupy only small and irregular areas.

Throughout the Millstone Grits the harder rocks tend to form level or gently sloping surfaces, according to the dip (see Plate IIIB). In many cases these plateaux terminate in lines of wild crags or groups of isolated stacks called 'Edges,' 'Stones' or 'Rocks' (see frontispiece), all testifying to prolonged exposure to wind and rain. The more massive and closely cemented beds of the grits stand out prominently, and in some cases the undercutting of the less durable beds has resulted in the formation of 'Rocking Stones,' as for instance those shown on the map overlooking the left bank of the Derwent, though several of these have been displaced in recent years. The softer shales and mudstones form concave slopes, often marshy, between successive grit plateaux, locally known as 'slacks.'

Apart from the exposures of bare rock mentioned above the moors are largely covered with peat, up to 8 ft. in thickness, consisting mainly of cotton-grass (*Eriophorum*) which flourishes exceedingly on the ill-drained ground, almost to the exclusion of sphagnum mosses. Locally, however, these cotton-grass areas are termed 'mosses'; the name 'Featherbed Moss' which, as noted above, occurs three times on the one-inch map is an allusion to the appearance when the cotton-grass is in fruit. Another characteristic plant of these damp areas is the cloudberry, from the Danish term for which the name Meltham is, perhaps, derived. Heather flourishes only on the better drained slopes and clough sides where it is accompanied by bilberry, cranberry, bracken, etc., the names Cranberry Clough, Bilberry Clough and Wimberry Moss allude to these plants. On less elevated ground the prevalent grass gives rise to such names as Good Bent, near Holme.

Coal Measures are found on both sides of the central outcrop of the Millstone Grits, but, owing to the steep westerly dips on the west and the gentle east-north-east dip on the east, the two areas are of very different character and extent (Fig. 1). On the west the areas occupied by Coal Measures south-west of Delph' and around Mottram are almost negligible in size, but the structure is brought out by the outcrops of the Rough Rock, the uppermost member of the Millstone Grits, which is coloured reddish-brown on the map. At Stalybridge this outcrop is within three-quarters of a mile of that of the Shale Grit which underlies the Kinderscout Grits. On the east the minimum figure for this distance is about three miles. On this side the Coal Measures occupy some fifty square miles, or about a quarter of the area shown on the map. In general outline the ground is not unlike that of the Millstone Grits in that the several sandstones form a series of dip-slopes with intervening scarps; but the proportion of sandstones to shales, the elevation and the rainfall are all less. Consequently this country is much less wild than that of the central uplands. Natural

Goodall, A., 'Place Names of South-West Yorkshire,' Cambridge, 1914.

exposures of bare rock seldom occur on the scarps; the dip-slopes are usually grassy, when they are referred to as commons in the local place names: sometimes a heather association is found, when the term 'moor' is used in distinction from the wet cotton-grass 'mosses.' Trees are a prominent feature of the landscape; "the oak, ash, elm and sycamore flourish abundantly. Such a profusion of vegetation is not found on the Lancashire side of the Pennine Chain, where trees are rarely found except in sheltered places."2 The valleys of the Coal Measures country, the Dearne through Denby Dale, the Don below Hazlehead and their tributary streams are well wooded, in contrast with the wild defiles, sheltering occasional thorns, birches and mountain ash, known as 'cloughs' in the Millstone Grit country. The contrast is well seen on comparing Plates I, II and III with Plate IV. The streams rising in the moors are subject to remarkable changes of volume according to the weather: W. Watts states that the Little Don at Langsett in seasons of drought is reduced in volume of flow to 028 cubic feet per second per 100 acres drained, and swells out in time of maximum flood to 30 cubic feet per 100 acres, a rise of nearly 1,100 per cent. (op. cit., p. 264). The high rainfall on the moors, over 50 in. per annum, is the main cause. The difference on the lower ground of the Coal Measures, where the prevalent westerly winds have already dropped the main part of their burden in crossing the Pennines, is a remarkable feature. At Woodhead the yearly average rainfall is 50.18 in., but at Ingbirchworth, less than eight miles distant, 38-89.3

On the whole, the district is sparsely inhabited, the population being mainly concentrated in the valleys converging towards Huddersfield and in that of the Tame, sparse on the uplands and practically absent on the high moors. It is a noteworthy point that in ancient times the relative proportions were reversed; this proportion held from the earliest human settlements (see pp. 136, 137) to the end of the Roman occupation. The change came with startling suddenness when the 'Saxon' group of nationalities arrived. The contrast is well brought out for our area by the maps of the Huddersfield Museum Handbooks, Nos. 2, 3 and 4. These show the district in the times of early man, of the Romans and of the Angles, Danes and Norse respectively. The change appears to be due to the fact that the earlier inhabitants required open country, however poor the soil, whereas the Saxon peoples were accustomed to living in forest clearings and settled in the thickly wooded lowlands. The contrast has to some extent been deliberately increased in recent years; the corporations owning large reservoirs endeavour to avoid contamination in the gathering

¹ Woodhead, T. W., 'The Scenery of Huddersfield and its Significance,' *Huddersfield*, 1923, p. 14.
² Watts, W., 'Excursion to Langsett,' *Trans. Manchester Geol. Soc.*, vol. xxvi, 1901,

p. 263.

* Moss, C. E., 'Vegetation of the Peak District,' Cambridge, 1913.

* See R. G. Collingwood, 'Town and Country in Roman Britain,' Antiquity, vol. iii, 1929, pp. 261-276.

grounds by reducing the number of possible sources, and many of the dwellings on their property are now derelict.

The district was, and to some extent still is, more or less isolated. There is no easy route through the Pennines comparable with the valley of the Calder or the Skipton-Clitheroe gaps to the north. The two east and west railway routes traversing it both involve tunnels of three miles or over, and the great north and south routes lie outside it on either side. To this isolation Mr. Walter Haigh has attributed the many archaic characteristics which the local dialect still retains.1 For many centuries all traffic was carried by pack-horse, and many relics of this method still exist. There is a considerable number of the typical narrow pack-horse bridges, of which one near Penistone is shown in Plate IVB; another fine example is in Red Brook Clough, one and a half miles west of Marsden, where the paved way can be seen. Many of the routes can be traced by the sunken ways over the lower ground, or by moorland paths such as Cut Gate, connecting the Derwent valley with Langsett, or Doctor's Gate east of Glossop.2 A fine sunken way, paved with the original stones, much worn, can be seen between the Hall and the Dam at Gunthwaite. The name ' Jagger Lane ' from jagger, a pedlar or pack-horse driver, occurs several times in the district. Along these ways were carried such commodities as salt from Cheshire, remembered in the name Salter's Brook, lime from Derbyshire and the local woollen products (see below). A slight increase in the facilities of transport is indicated in the name Dunford Bridge, written 'Dunneford' in 1282, meaning the ford, later replaced by a bridge, over the Don.3

INDUSTRIES

The industries that can be regarded as indigenous to the area are not of great importance. To the north lies the woollen district of Yorkshire, to the west the cotton district of Lancashire; the outskirts of both penetrate the valleys and account for a large proportion of the industrial activity within our boundaries. Similarly, it is only the outer margins of the Yorkshire and of the Lancashire-Cheshire coalfields that are covered by the map; the amount of coal now produced is much less than even local requirements.

Stone quarrying is more important; large quarries working the Rough Rock and the Greenmoor Rock send, or have sent, their products to distant parts of the country; fireclay goods and ganister are also sent out of the district (see Chapter VIII).

^{1 &#}x27;The Dialect of the Huddersfield District,' Oxford Press, 1928.
2 'Gate' is the old Yorkshire term for a road or street, cf. the street names in York and her towns

³ For place names in general see A. Goodall, op. cit.; for pack-horse routes cf. W. B. Crump, 'Ancient Highways of the Parish of Halifax,' Journ. Halifax Antiq. Soc., 9 parts, 1924 to 1929. A similar account of those in this area is in preparation by the same author for the Huddersfield Museum.

AGRICULTURE AND SOILS

Throughout the whole area the soils are characterized by their poverty in lime, which greatly restricts the agricultural possibilities. The only natural sources of lime are the occasional bullions in some of the marine bands in the Millstone Grits and above the Halifax Hard Bed Coal. Mr. W. H. Burrell informs us of the discovery in Rake Dike, near Holme, of a moss, Hypnum commutatum and a liverwort, Pellia fabbroniana, both calciphil species, and we were at once able to identify the exact localities as the outcrop of the mut. β marine band (see p. 51); the water trickling from this spot showed a hardness, in a field test, of 9 to 10 degrees, whereas the normal stream water of the district gives 3 to 4 or less. The acidity of the soil is increased by the smokiness of the atmosphere. Liberal treatment with lime is therefore essential, both on the Millstone Grits and on the Coal Measures. The nearest sources of lime are the Carboniferous Limestone of Derbyshire and the Magnesian Limestone of east Yorkshire. Lime was formerly brought thence by pack-horse. At the time of the resurvey little liming was done, but during the last two or three years has been more frequent, presumably because of the convenience of transport by motor lorry from kiln to field.

On account of the poverty of the soils sheep raising has always been of more importance than arable farming. In former times all holdings were small and nearly every household wove its own wool on hand looms; the weavers' houses, with windows occupying almost the entire length of the walls, are a typical feature in the older villages.¹ Such work passed in turn to mills worked by the rapidly flowing streams and to those in the main valleys dependent on coal for their power. The industry now gains from the absence of lime, in that the local water supplies are soft and well fitted for cleaning and dyeing processes. The dependence upon sheep is reflected in the prevalence of such place names as Shepley, Shibden, Ramsden, etc. The original woollen goods were mostly coarse, in fact Penistone gives its name to a coarse

frieze, or woollen cloth with a nap on one side.

Small crops of hay and oats were raised, sufficient to make the farms self-supporting, but not in any quantity for sale. Recently poultry-farming, making no demand on the quality of the soil, has become important, as also has dairy-farming, the neighbouring

industrial areas affording a ready market.

On the moorlands some attemps at afforestation have been made in the catchment areas of many of the reservoirs, but the smokiness of the atmosphere is a serious drawback; considerable success has been met with in the Derwent valley, but the plantations are mostly south of the boundary of the Glossop map. Grouse-shooting on the moors has now become largely a 'commercial proposition.'

¹ For a fine example see Huddersfield Museum Publications, no 1, 1921, fig. 9.

The soils of the Coal Measures are on the whole better than those of the Millstone Grits, though they suffer from the same lack of lime. The shales often give a heavy clay soil, which is mostly under grass, but the sandstones give lighter loams. Wheat, oats and potatoes are perhaps the most satisfactory arable crops; swedes and turnips are apt to suffer from 'finger and toe' disease, unless liming is liberal. The Coal Measures are better wooded than the Millstone Grits, oak and elm being prevalent instead of birch, and the fields are often divided by hedgerows, in contrast with the dry stone walls of the Grits. On the latter the older buildings are of local gritstone, roofed with the more fissile flagstones; on the former fine examples of timber construction may sometimes be seen, the barn at Gunthwaite being famous. Presentday construction of brick, concrete, asbestos, etc., though possibly necessary for economic reasons, is apt to produce eyesores, though it has been pointed out that these can largely be avoided by a suitable choice of colours.2

TABLE OF FORMATIONS

The following table summarizes the geological formations and their subdivisions which are represented on the map. The thicknesses are generalized from data collected in various parts of the area. On the map the shales and sandstones of the Lower and Middle Coal Measures are distinguished by colour, and the more important sandstones and coals are individually indicated by letters. In the Millstone Grits the shales are coloured uniformly throughout, but the grits and sandstones are shown by four colours for the main groups, viz., The Rough Rock Series, the Middle Grits, the Kinderscout Grits and the Shale Grit. These again are individually distinguished by letters.

	Superficial Formations
	(Alluvium
Recent:—	{ Peat
Pleistocene:	—{Sand and Gravel Boulder Clay
	\ Boulder Clay
	SOLID FORMATIONS

Upper Carboniferous:—

Middle Coal Measures:—(top of division not present)

Miaate Coat Measur	es .—(top c	-	ппоср	nesentj	. !!	Ft.
Thornhill Rock						504
S Measures						35
JOAN COAL						
					• • •	50
FLOCKTON THICK COAL Measures with Emley Rock						35
FLOCKTON THIN			• • •		• • •	33
Measures with Pa		k				70
PARKGATE COAL						
Measures with Le	epton Edge	Rock				45

¹ Robertson, G. C. A., 'Farming in Yorkshire,' Journ. R. Agric. Soc., vol. lxxxix (for 1928), 1929.

<sup>1928), 1929.

2 &#</sup>x27;The Threat to the Peak,' Council for Preservation of Rural England (Sheffield and Peak District Committee), Sheffield, 1931.

INTRODUCTION.

	SOLID FORMATIONS—continued.		Ft.
	GREEN LANE COAL		
	Measures		45
	NEW HARDS COAL		15
	Measures		40
	WHEATLEY LIME OR CLAYTON COMMON COAL		'
	Measures with Falhouse Rock		65
	SILKSTONE OR BLOCKING COAL		
	Lower Coal Measures :—		
	Measures with Black Band Coal and Sandstones		125
	Whinmoor Coal		
	Measures		30
	CUMBERWORTH THIN COAL		9
	Measures with Penistone Flags and thin coals		130
	GRENOSIDE SANDSTONE COAL		5
	Grenoside Sandstone		50
	BLACK BED COAL (in north only)		
	Measures		7.5
	BETTER BED COAL (in north only)		, 0
	Measures with Greenmoor Rock (Elland Flags in ne	orth)	210
	UPPER OR EIGHTY YARDS BAND COAL	. ,	
	Measures		80
	LOWER OR HARD BED BAND COAL		
	Measures		65
	HALIFAX HARD BED COAL		~
	Measures		30
	MIDDLE BAND COAL		5
	Measures		30
	SOFT BED COAL (BASSY MINE in Lancashire		5
	Cheshire)		
	Measures with Woodhead Rock or Soft Bed Flags		75
	POT CLAY COAL (SIX INCH MINE in Lancashire		
	Cheshire)		
	Millstone Grits:—(base not seen).		
	Rough Rock and Rough Rock Flags	40 t	0 140
	Shales (with Upper Haslingden Flags in Lan-	400	0 140
	cashire)	50 t	0 140
	Upper Meltham Coal (Holcombe Brook Coal	3	
	in Lancashire)		
	Huddersfield White Rock (Holcombe Brook		
	Grit in Lancashire)	- 60 t	0 100
iddle			0 2 5 0
rits	Pule Hill Grit, Rivelin Grit or Heyden Rock,	30 0	- 5
100	(Gorpley Grit in Lancashire)	60 t	0 1 50
	Shales with Readycon Dean Series		0 300
	Kinderscout Grits with interbedded shales		0 700
	Grindslow Shales		0 350
	Shale Grit		0 450
	Shales	P	15-
	5114165		

REFERENCES

References to geological literature dealing with the area will be found at the appropriate places in the text. It has not been thought necessary to include a separate bibliography. In 1915 Mr. T. Sheppard published a complete bibliography of Yorkshire geology to the end of the previous year as volume xviii of the Proceedings of the Yorkshire Geological Society, and has continued it annually in subsequent volumes. These lists have proved invaluable in the preparation of the memoir.

(695)

M

CHAPTER II

MILLSTONE GRITS

Introductory

This formation is composed of many thick alternating beds of shale and sandstone, with an exposed thickness of at least 2,000 ft. The outcrop covers more than three-quarters of the area of the

map, including the most elevated parts.

The shales are similar to those of the Coal Measures; the commonest types are grey and blue clay-shales and mudstones (the 'binds' of the coalfield), but highly micaceous silty and sandy shales and black shales are common. All these types are usually barren except for plant fragments and, near the top of the series, freshwater lamellibranchs. These shales, together with the sandstones, are evidently of freshwater or estuarine origin. There occur, in addition, several thin but well-defined 'marine-bands,' composed of shale which is either dark blue and of a soapy texture or sooty black. These bands are usually crowded with flattened impressions of goniatites and other marine fossils, and occasionally contain impure limestone nodules in which the same fossils occur uncrushed.

Coal seams resting on thin seat-earths are not uncommon and usually but not invariably lie just above sandstone beds. They are for the most part thin and worthless, the notable exception being the Upper Meltham, Holcombe Brook or Simmondley Coal.

Most of the sandstones are coarse and sometimes conglomeratic, and are known as grits,2 or locally as 'rocks.' They should properly be termed 'arkoses,' being composed of quartz and felspar, chiefly microcline, with small quantities of white mica; the last constituent may be absent, and is never abundant. Several heavy minerals occur, garnet being the commonest. There has been no minute petrological examination of the grits in this area, such as was made by Professor Gilligan in the country to the north.3 The constituent grains are of various sizes, and in the commonest type of grit some of the quartz occurs as pebbles up to half an inch in diameter, scattered through a finer groundmass. Less frequently the pebbles only occur abundantly on certain bedding-The cementing material may be silica, carbonates of iron,

for 1919, 1920, pp. 251-294.

¹ See for instance, H. C. Sorby, Proc. Geol. and Polytech. Soc. W. Riding Yorks., vol. iii, 1859, pp. 669-675; A. H. Green, 'Geology of the Yorkshire Coalfield' (Mem. Geol. Surv.), 1878, p. 23; A. Gilligan, Quart. Journ. Geol. Soc., vol. lxxv, for 1919, 1920, p. 276.

² The term 'grit,' denoting relatively coarse grain rather than angularity of particles, appears to be applied universally to the coarser Carboniferous sandstones.

³ 'The Petrography of the Millstone Grit of Yorkshire,' Quart. Journ. Geol. Soc., vol. lxxv,

calcium or magnesium, and in certain cases barytes. Finer-grained sandstones, similar to those of the Coal Measures, are common; they usually contain white mica, often in abundance, and are sometimes flaggy. Both grits and sandstones are usually false bedded.

The denudation of the Millstone Grits, composed of alternations of thick beds of resistant sandstone and soft shale cropping out

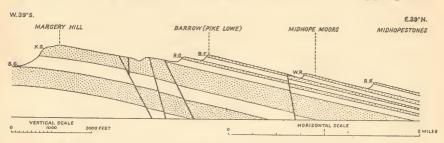


Fig. 2.—Section from Margery Hill to Midhopestones.

in an upland area, has resulted in two pronounced types of topography, a modification of the 'ridge and furrow' type and a 'dissected plateau' type. The first is impressed on areas where the dip is appreciable and the faulting is not intense. The hard sandstones form prominent escarpments and dip-slopes, and the shales crop out in the lower slopes of the escarpments and the hollows between. The uncultivated parts of these areas support luxuriant heather, owing to the free drainage of the peat; they form the best grouse moors in the district. This type of topography is seen at its best in the country south of Langsett (Fig. 2). The second type is that seen in the highest parts of the area, particularly

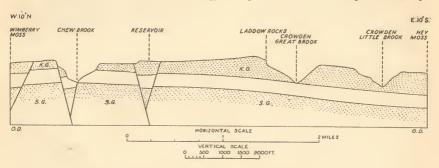


Fig. 3.—Section across the moors north of Crowden.

in the Kinderscout Grit country of the western half of the sheet (see Fig. 3). Here the dips are low, and the thick grit beds form high peat-covered plateaux; in these the larger streams have cut deep, steep-sided valleys where the rock scenery is often of surprising wildness and grandeur. These plateaux are drained by large numbers of channels with steep crumbling sides, which start in the peat on the highest ground, and as they descend cut down first

into the clayey layer beneath the peat and then to the grit; eventually they join the larger valleys already mentioned. Sometimes the channels form an intricate maze on broad hilltops, enclosing moundy areas of wasting peat, or running together into wide patches floored with gravel and rock. The streams sweep across flat areas in small meanders, laying down strips of alluvial gravel and sand, which are converted temporarily into tiny terraces by local rejuvenation. Miniature river-captures are common in such areas. The peat of such plateaux is badly drained and the dominant plants are cotton-grasses (see pp. 135, 136).

A great part of the Millstone Grit country forms uninhabited moorlands at altitudes of 1,000 to 2,000 feet with an average rainfall of over 50 in., and is an excellent gathering-ground for water supplies; practically all the moorland area and much of the pastureland on its flanks is used as such, the chief consumers being the industrial towns on both sides of the Pennines (see pp. 168, 169).

The detailed classification of the Millstone Grits in the table on p. 13 has been made possible by Mr. Bisat's work on the goniatite fauna of the marine bands.¹ These bands are definite horizons which can be traced over wide areas, and are therefore invaluable in correlating the grits and other barren strata which lie between them, a task which has hitherto been impossible. They do not, however, in themselves constitute the zones and subzones to which the names of the goniatites are applied, as the limits of the zones cannot be defined in this region.

The base of the Millstone Grits in this area was at the time of the original survey drawn at the base of the Kinderscout Grit; it has since been repeatedly relegated to lower horizons, so that the present somewhat uncertain base lies far below the rocks described in this memoir. Prior to the publication of the Geology of the Yorkshire Coalfield in 1878 all beds below the Kinderscout Grit were correlated on lithological grounds with the Yoredale Beds of Phillips, the Shale Grit being called the 'Yoredale Grit.' Green, in discussing North Derbyshire and the adjacent parts of Yorkshire2 showed that the 'Yoredale Grit' could not be separated on lithological grounds from the grits above, and lowered the base of the Millstone Grits to include it. He called it the Pendle or Pendle Hill Grit, or Shale Grit, the latter being the name given to it originally by Farey.3 The name Yoredale Series was retained for all the beds below the Shale Grit down to the Carboniferous Limestone. The older nomenclature was, however, not changed on the published maps. Wheelton Hind first showed that the shales between the Shale Grit and the Carboniferous Limestone are of newer age than the Yoredale Series of Wensleydale,4 and the

¹ Bisat, W. S., 'Carboniferous Goniatites of N. England,' *Proc. Yorks. Geol. Soc.*, vol. xx, 1924, p. 40.

² 'Geology of the Yorkshire Coalfield' (Mem. Geol. Surv.), 1878, p. 33, and 'Geology of North Derbyshire' (Mem. Geol. Surv.), 1887, p. 6.

^{3 &#}x27;General View of the Agriculture and Minerals of Derbyshire,' vol. i, 1811, p. 228.

⁴ Geol. Mag., 1899, pp. 91, 159-169, 205-213.

Table of Classification and Thickness of the Millstone Grit Series

		M1.	LLSTONE	GRITS.			13
	Ft.	130 to 140	100	250	60-70 150 to 170	500	300 450+
S.E. of Sheet 86	Rough Rock and Rough Rock Flags Shale Cumbriense marine band Shale	Cancellatum marine band Shale Upper Meltham Coal	Huddersfield White Rock Shale with mut. γ marine) band Sandstone (Beacon Hill	~~	Rivelin Grit 60-70 Shale (mut. β band absent) 150 to	Mut. α marine band Kinderscout Grit	Grindslow Shales Shale Grit
	Ft. 60-90	50-120	60-120	80-125	60-80 150 to 300	009	300 150+
Centre of Sheet 86	Rough Rock Shale Cumbriense marine band Shale	Cancellatum marine band Shale Upper Meltham Coal	Huddersfield White Rock	band	Heyden Rock Shale Mut. & marine band Shale with Readycon Dean Series (Sandstone, etc.)	Mut. & marine band Kinderscout Grit	Grindslow Shales Shale Grit
	Ft. 70-140	125	70-80	250	100-150 150 to 200	200	350 250+
N.W. of Sheet 86	Rough Rock and Rough Rock Flags Shale Cumbriense marine band Shale	Cancellatum marine band Shale Upper Meltham Coal	Huddersfield White Rock Shale with mut. γ marine band Beacon Hill Flores	Shale Late mut. β marine band	Pule Hill Grit Shale Mut. β marine band Shale with Readycon Dean Series (Sandstone, etc.) Early mut. β marine band	$\begin{array}{c} \operatorname{Mut}\alpha\operatorname{marine}\operatorname{band}\\ \operatorname{Kinderscout}\operatorname{Grit} \end{array}$	Grindslow Shales Shale Grit
Subzones	Crenulatum and Cumbriense	Cancellatum and mut. γ	Reticulatum, mut. γ		Reticulatum, mut. ß	Reticulatum, mut. α	Reticulatum, type.
Zones	© satrioceras	9		SLIS	ದ · əsolusitəA ಜ್ಹ		R ₁
Stage			nsirt	Lancas			

Geological Survey later adopted Farey's name, Limestone Shales, for them.2

The recent work of Mr. Bisat on the Carboniferous goniatites³ has made possible the detailed correlation of Millstone Grit developments in different parts of the Pennines, and the Limestone Shales are shown to be the equivalents of the main part of the Sabden Shales of the Pendle region. Dr. Jackson, in a detailed description of these beds in the Edale district,4 just south of the area here described, shows that they contain in ascending order the middle and upper part of the Eumorphoceras Zone, the Homoceras Zone, and the lowest part of the Reticuloceras Zone. Thus the Shale Grit is of later date than the true Pendle Grit, which belongs to the Eumorphoceras Zone. It is at the same horizon as the thinner Todmorden Grit of the upper Calder, as shown by Messrs. Lloyd and Stephens.5 The Geological Survey have now extended the base of the Millstone Grits down to the faunal break below the base of the Sabden Shales so that all the beds between the Shale Grit and the Carboniferous Limestone in North Derbyshire are now classed as part of the Millstone Grit Series.

GENERAL STRATIGRAPHY

The Shale Grit forms a wide spread on the moors in the southern part of the Sheet, where it is 450 to 550 feet thick. It is also exposed in the valleys of the Etherow and Tame. In the south it consists of grits and sandstones with frequent thin sandy shale beds and less frequent thicker shale beds; in Longdendale the exposed part of the series consists of thicker and more massive grits, but the exposures in the Tame valley show the beds to be more like those in the south.

The grits are often pebbly, but are seldom as coarse or massive as those of the Kinderscout Grit; they usually contain fragments of sandy shale. The sandstones are sometimes ripple-marked, and often show ropy or mammillated bedding-surfaces, which are not, however, confined to the Shale Grit. These surfaces occur where fine-grained sandstones alternate with shales, and are found on the under sides of sandstone beds in contact with shale (see p. 23).

The Grindslow Shales, the equivalents of the Upper Sabden Shales of Calderdale, have been so named by Dr. Jackson, the type-locality being in Edale, 5 miles south of the margin of the map.8

¹ Op. cit., p. 229.

2' Geology of the Southern Part of the Derbyshire and Nottinghamshire Coalfield'
(Mem. Geol. Surv.), 1908, p. 9.

3 Bisat, W. S., op. cit.

4 Journ. Manch. Geol. Assoc., vol. i, Part i, 1927, p. 15. See also The Naturalist, July

^{1926,} p. 205.

Lloyd, W., and J. V. Stephens, 'The Stratigraphical Succession below the Kinderscout Grit in the Todmorden District,' Proc. Yorks. Geol. Soc., vol. xxi, 1927, p. 58.

Geology of the Rossendale Anticline' (Mem. Geol. Surv.), 1927, p. 8.

⁷ Lloyd and Stephens, op. cit.

8 Jackson, J. W., 'The Succession below the Kinderscout Grit in North Derbyshire,'

Journ. Manch. Geol. Assoc., vol. i, part i, 1927, p. 15.

No fossils have yet been found in these shales either by Dr. Jackson in Edale or by the Geological Survey in this area, but a marine bed with Reticuloceras reticulatum (Phill.), type (as defined by Bisat), corresponding to that in the Upper Sabden Shales of Crimsworth Dean was once exposed near Greenfield, and was collected from by Messrs. Holroyd and Barnes.1 It is believed that this marine band is not present south of Greenfield, but as there are no continuous sections in the Grindslow Shales its absence cannot be proved.

The shales, 300 to 350 ft. thick, include mudstones and siltstones with a few inconstant beds of sandstone and grit. are found in the same three areas as the Shale Grit, forming the concave slopes between the top of that grit and the base of the Kinderscout Grit. The rapid erosion of this great thickness of shale has produced the lofty escarpments capped by the basal Kinderscout Grit which dominate the scenery of Derwentdale, Longdendale and the Greenfield valleys (see Fig. 4, p. 16).

The Kinderscout Grit is from 400 to perhaps 800 ft. thick in this area, being thinnest in the north and south-east. It consists of coarse, massive grit with a number of thin shale partings, the lowest of which, however, sometimes attains a local thickness of over 100 ft. The base is well defined lithologically and, although it appears in places to occupy channels of contemporaneous erosion in the underlying shales, is not so irregular as was formerly supposed.2 The top is defined by the marine bed containing Reticuloceras reticulatum, mut. a and late mut. a Bisat, which either lies close above the grit or is separated from it by only a few feet of shalv beds.

In the north of the area a shale bed with Lingula and marine lamellibranchs (the Butterly Marine Band) lies about 50 to 60 ft. below the top of the grit, in a shale parting. Southwards towards Crowden the marine shales appear to wedge out and have not been found farther south. In the country to the north the band can be traced over a wide area, and is taken as the division between the Upper and Lower Kinderscout Grits on the geological map. this sheet of the map such a division has not been made except where this band can be traced in the north (Fig. 7); the older dual classification in which a lower shale bed was used as the division between Upper and Lower Kinderscout Grit,3 has been dropped.

Over most of its outcrop the Kinderscout Grit forms wild moorland plateaux, fringed by rugged escarpments and trenched by deep valleys and gorges, making some of the finest rock scenery of the Central Pennines.

The Middle Grits.—All the sandstone beds in the 700 to 800 ft. of strata between the Kinderscout Grit and the Rough Rock are grouped under this heading. The term was introduced when the

3 Ibid., pp. 27, 47, 48.

^{1 &#}x27;Rocks and Fossils of the Yoredale Series of the Marsden and Saddleworth Valleys,' Trans. Manchester Geol. Soc., vol. xxiv, 1896, pp. 70-99.
2 'Geology of the Yorkshire Coalfield' (Mem. Geol. Surv.), 1878, p. 47.

Kinderscout Grit was regarded as the basal bed of the Millstone Grits; it has lost some of its early significance owing to the downward extension of the Millstone Grit division. The beds are given a distinctive colour on the geological maps.

In this area the four main sandstone beds in the series are, in ascending order, the Readycon Dean Series, the Pule Hill Grit (with its equivalents Heyden Rock, Gorpley Grit and Rivelin Grit), the Beacon Hill Flags and the Huddersfield White Rock (Holcombe Brook Grit in Lancashire). The lowest bed and the Beacon Hill Flags are locally absent, the others are persistent. Other thin local sandstone beds occur, but are not named.

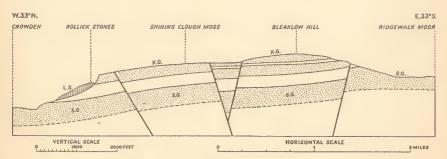


Fig. 4.—Section across the moors south of Longdendale.

Associated with these sandstones are several marine beds with the α , β , and γ mutations of *Reticuloceras reticulatum* and in the upper beds species of *Gastrioceras*. All these marine bands are shown in Fig. 8, p. 44, which also shows the distribution and variation of the sandstone beds in the Middle Grits.

The mut. α Band.—A development of shales 40 to 70 ft. thick lies between the Kinderscout Grit and the Readycon Dean Series; where that series is absent shales extend up to the Pule Hill Grit. Except in the central part of the area a thin coal and underclay lie on or close above the Kinderscout Grit. The coal where present is followed closely by the marine bed with *Reticuloceras reticulatum*, mut. α and late mut. α . Occasionally, as at Howels Head (see p. 45), the marine shales rest directly on the grit. The bed appears to be present over the whole area, except possibly around Hollingworth (see p. 47). The distribution of the two mutations found in the bed is discussed in Chapter VII.

Around Marsden an additional marine bed with early mut β is found about 20 to 30 ft. above the mut. α bed, and a bed in the same position but containing late mut. β is seen at Howels Head, on Saddleworth Moor (see p. 45); elsewhere barren shales and mudstones, dark-grey or black in the lower part and becoming gradually sandy towards the top, lie between the mut. α band and the Readycon Dean Series.

^{&#}x27; Geology of the Yorkshire Coalfield' (Mem. Geol. Surv.), 1878, p. 32.

The Readycon Dean Series is a development of sandstones, grits, tilestones and flags with interbedded shales and occasional ganister and fireclay beds; the sandstones sometimes show the ropy and mammillated surfaces mentioned on p. 23. When traced laterally the series is prone to exhibit sudden extreme variations in thickness and character. It is typically developed in Readycon Dean, and on the neighbouring moors, where it ranges up to 300 ft. in thickness. In the central part of the area it is seldom more than 60 ft. thick, and is sometimes absent (see p. 47). In Woodhead Tunnel it swells locally to 270 ft., but it thins away rapidly to the east. It is thin or absent in the west, south-west and south-east.

The mut. 3 Band.—Between the Readycon Dean Series and the Pule Hill Grit is a series of shales usually 60 to 70 ft. thick, of interest mainly because of the marine bed near their base characterized by Reticuloceras reticulatum, mut. B. north-west the bed lies on top of the Readycon Dean Series, but in the centre it is sometimes, as in Heyden Brook, separated from that series by several feet of barren shales. Here two exposures, 30 yards apart, contain respectively mut. β with a few late mut. β and the latter form exclusively, but their exact relation to one another is obscured by slipping. Somewhere in the Saltersbrook Bridge area the bed appears to die out, and it is not seen in the south-east.

The Pule Hill Grit (Heyden Rock, Rivelin Grit).—This is in most places a well-developed bed of grit or sandstone, 60 to over 100 ft. thick. It corresponds to the Third Grit and Main Third Grit of older authors,² and to the Gorpley Grit of east Lancashire.3

Around Pule Hill the bed is a massive fine-grained grit 100 ft. or more thick. In the central area it consists of sandstone with beds of grit and shale and is usually thinner. There is some doubt about its upper limit here, owing to the absence of the overlying late mut. β band and of the Beacon Hill Flags (see pp. 57, 60). In the Heyden valley it is well developed and exposed and its position in the local sequence clearly marked by the \beta band below and the y band some distance above; also the old quarries in it are marked on the map. It is therefore considered expedient to introduce a new name, Heyden Rock, for the bed in this area. In the west it is usually a thick gritty sandstone with a variable amount of flaggy and shaly beds. In the south-east the bed becomes a massive coarse grit 60 to 80 ft. thick, forming strong escarpments. It can be traced southwards beyond our boundary to Strines and Rivelin, and is found to be identical with the Rivelin Grit. This name is now used in the south-east.

¹ Readycon Dean is the valley running in a south-westerly direction, just over a mile north-north-east of Denshaw (see Fig. 6).

² See for instance, 'Geology of the Yorkshire Coalfield' (Mem. Geol. Surv.), 1878, p. 27.

³ 'Geology of the Rossendale Anticline' (Mem. Geol. Surv.), 1927, p. 18.

In the central area and around Meltham a parting of estuarine shale, usually containing abundant *Lingula*, divides the grit into a main lower bed and a thin upper bed. The succession appears to be similar to that in the Horwich district of Lancashire, where an estuarine bed separates the main Third Grit from the overlying Helmshore Grit. The thicknesses, however, are much greater in Lancashire. A parting in a similar position is sometimes seen in the west and in the south-east (see pp. 54, 56) but is badly exposed and has yielded no fossils.

The late mut. β Band.—In the north-west and south-east the shales between the Pule Hill Grit and Beacon Hill Flags contain a marine bed at their base, with mutations of *Reticuloceras reticulatum* varying from mut. β to early mut. γ ; late mut. β is the commonest form. This marine bed is absent in the centre around Black Hill and Holme; in the west it is present at Mossley. The thickness of the shales varies from about 40 ft. in the north-west to over 100 ft. in the south-east. At Mossley, where the Beacon Hill Flags are absent, the late β and the γ beds are only 40 ft. apart.

The Beacon Hill Flags.—The type-locality for these beds is in the area to the north of our boundary.² Around Marsden and Meltham they consist of flaggy sandstone overlain by workable ganister which is up to 12 ft. thick. Their total thickness is up to 30 ft. In the centre of the map the division is absent, or is represented only at certain localities by a thin sandstone bed (see p. 60). It reappears again in the south-east, reaching a maximum thickness on Midhope Moors of about 50 ft. Here it consists of hard pale grey sandstone with a tendency to develop a ganister top. Farther east the bed becomes flaggy and thin, and dies out near the edge of the map. The bed is absent along the western margin, except at Delph where it consists of about 30 ft. of ganister-like sandstone. A flaggy representative is probably present in the Glossop district.

The mut. γ Band.—The shales which overlie the Beacon Hill Flags contain a marine bed which is present over the whole area. Its commonest fossil is *Reticuloceras reticulatum*, mut. γ ; *Gastrioceras? sigma* W. B. Wright and *G. lineatum* W. B. Wright are often found associated with it, usually in the upper part of the band.

The marine band lies within 10 or 12 ft, of the Beacon Hill Flags, where those beds are present. It is succeeded by sandy shales which usually pass up gradually into the Huddersfield White Rock. The thickness of the whole shale series varies round an average of 70 to 80 ft.

The Huddersfield White Rock.—The White Rock is in this area the most important member of the 'Middle Grits'; it is

¹ 'Geology of the Rossendale Anticline' (Mem. Geol. Surv.), 1927, p. 12.
² 'Geology of Huddersfield and Halifax' (Mem. Geol. Surv.), 1930, p. 18.

more uniform in composition and development and occupies a larger surface area than any other, and is in these respects comparable with the Rough Rock.

The upward passage from the shales above the mut. γ marine band to the White Rock is gradual, through alternating layers of shale, sandy shale and flagstone. Accordingly the base of the White Rock is an arbitrary line. The top, however, is perfectly definite; a bed of ganister is succeeded by a few feet of fireclay and a well-marked seam of coal, usually known as the Upper Meltham Coal. The thickness of the rock cannot therefore be definitely stated, but as mapped it is usually about 120 ft. In the Meltham district it has an average thickness of about 80 ft.

At Holmfirth the thickness on the west of the valley is about 80 ft. at Binns Wood, while on the east side it appears to reach 100 ft. In the central plateau, round Holme Moss and Withens Moor, our mapping indicates up to 150 ft., but Green's estimate is 175 ft. In the Dunford Bridge district the figure is 112 ft., but in the south-east it is from 100 down to 70 ft. on the northern side of the Ewden valley.

In composition the rock is normally a medium to coarse-grained sandstone. The lower part is always flaggy, the main mass often thickly bedded. Current-bedding is not often conspicuous, but pillow structures and 'mare-balls' are fairly frequent in the lower beds. In colour it hardly deserves its usual name, given in the Huddersfield area, but is a pale grey: Green (op. cit., p. 53) points out that its appearance is indicated by the names Greystone Edge near the west end of Woodhead Tunnel and Greystones on Sliddens Moss, the latter not marked on the present one-inch map. Shale partings of sufficient size to be mapped occur here and there, as, for instance, to the south and west of West Nab near Meltham.

The top of the White Rock is always a ganister succeeded by a fireclay and the Upper Meltham Coal. West of West Nab the ganister is separated from the main mass by 10 ft. of shale, but south-east towards Upperthong there is no visible sign of such a parting. Across Twizle Head Moss the presence of ganister, indicating the top of the rock, is useful in tracing the position of the important west to east fault.

The economic value of the White Rock is considerable (p. 177); it has been largely used as a building stone in the towns and villages of the Holme valley and its tributaries; there are numerous quarries, for example, on the ridge south of Holmfirth separating the Holme and Ribble (Cartworth) valleys. Important quarries are also found along Banister and Royd Edges south of Meltham where some 30 ft. of fine-grained freestone, white or yellowish in colour, is worked.

^{1 &#}x27;Geology of Yorkshire Coalfield' (Mem. Geol. Surv.), 1878, p. 54.

The Rough Rock Series.—The beds between the top of the White Rock and the base of the Rough Rock Flags are of great interest. The thickness is about 150 ft. in the north, 100 to 120 ft. from Holmfirth to Dunford Bridge and up to 150 ft. north of the Ewden valley. Usually these beds consist of shale, but south of Meltham a sandstone comes in a few feet above the Cancellatum band; it occupies the surface over a considerable area but does not appear to exceed 30 ft. in thickness. At Wolfstones it is succeeded by a thin coal and about 30 ft. of shale on which rests coarse grit of the Rough Rock. In the adjoining areas to the north and east the sandstone is absent or not traceable but it reappears to the west and south of Langsett. This bed corresponds with the impersistent Moorside Flags of the country to the north and the Lower Haslingden Flags of east Lancashire.²

At the base of the series a seam of coal called the Upper Meltham Coal seems to be always present, though only of economic value near the town from which it takes its name; the greatest known thickness of coal is 3 ft. 9 in.; the ganister is 6 in. to 1 ft., and fireclay up to 5 ft. 6 in. Another coal occurs at the top of the impersistent bed of sandstone just mentioned and has been gotten from an open working near Wolfstones.

The chief interest of this series lies, however, not in any economic products, but in the fossils. Two marine bands occur, characterized respectively by Gastrioceras cancellatum Bisat and G. cumbriense Bisat. Though certain forms doubtfully referred to Gastrioceras occur beneath the White Rock in the 'Sigma' band, the Cancellatum band marks the beginning of the dominance of Gastrioceras and of the zone to which it gives a name. The upward limit of this zone has not been defined, but it extends a considerable distance into the Coal Measures. The Cancellatum band is usually about 20 ft. above the White Rock; besides the dominant goniatite it yields Reticuloceras reticulatum (Phill.), mut. y Bisat, Gastrioceras crenulatum Bisat, Homoceratoides divaricatum (Hind), Dimorphoceras sp. and Orthoceras sp. The characteristic lamellibranchs are Posidonomya insignis J. W. Jackson, Posidoniella multirugata J. W. Jackson and Pterinopecten elegans J. W. Jackson. At Brockholes this band yielded portions of a jaw with teeth of Edestus newtoni A. S. Woodward (see Plate V).3

The second marine band, that of G. cumbriense, is normally about 40 ft. above the lower; G. crenulatum is usually more abundant than G. cumbriense; forms closely approaching G. listeri (Martin) also occur. The lamellibranchs are mostly the same as those of the Cancellatum band, but include Pterinopecten papyraceus (J. Sow.). In contrast with the lower band, which may be about 10 ft. thick, the Cumbriense band is not known to

^{1 &#}x27;Geology of Huddersfield and Halifax' (Mem. Geol. Surv.), 1930, p. 21.
2 'Geology of the Rossendale Anticline' (Mem. Geol. Surv.), 1927, pp. 22, 23.
3 Woodward, Sir A. Smith, 'New Species of Edeslus from the Upper Carboniferous of Yorkshire,' Quart. Journ. Geol. Soc., vol. lxxii, for 1916, 1917, pp. 1-6.