

## ON THE MINERAL RESOURCES OF THE ROSEDALE ABBEY DISTRICT.

BY CHARLES PARKIN.

WITH the exception of the ironstone, including the famous magnetic deposit, the Rosedale Abbey district has received very little attention, but although the mineral described may be considered of the first importance, the extensive beds of limestone and freestone, together with the presence of alum shale, jet, cement stones, road metal (inferior limestone), lead, clays, coal, and valuable peat beds, render the neighbourhood worthy of more notice than it has attracted hitherto. The supply of ironstone and limestone from this quarter into the Cleveland iron and steel trade will, no doubt, in the future be considerable. It is intended in this paper to remark on each of the minerals separately.

### 1.—IRONSTONE.—DESCRIPTION OF PAST OPERATIONS.

The geological formation of the ironstone has been repeatedly described, and it is therefore unnecessary to say more on this part of the subject, except to refer those who wish for further details to the papers read before the members of this Institute by Mr. John Marley in June, 1857,\* by Mr. Joseph Bewick in December, 1857,† by Mr. N. Wood in February, 1859,‡ and by Mr. John Marley again in August, 1870.||

The oolitic rocks of England extend from Redcar, near the mouth of the Tees, to Filey Bay, on the East Coast, a distance of nearly 50 miles, and reach westward to Stokesley, Northallerton, Thirsk, and Easingwold, and form the surface strata of the Rosedale Abbey district.

According to Dugdale's Monasticon, Vol. I., page 507, an inspeximus dated at York the 26th February, 1328, the 2nd of Edward III., recites a grant made on the 16th of August, 1209, by Robert de Stuteville, of a meadow in Rosedale, to the nuns of that place *near to his forge*. This circumstance, and the presence of numerous heaps of slag and remains of ancient works, having the appearance of hearths where charcoal has been burnt, afford ample proof that iron was manufactured here early in the thirteenth century.

In the year 1859, the late Mr. George Leeman and Partners obtained a lease of the extensive royalty of West Rosedale and Spaunton, containing about 8,000 acres, for a period of sixty years, Plate VIII. and the portion coloured green, belonging to Henry Darley, Esq.; and in the same year the

\* Vol. V., page 165.    † Vol. VI., page 15.    ‡ Vol. VII., page 85.    || Vol. XIX., page 193.

North-Eastern Railway Company applied for and obtained an Act of Parliament empowering them to construct a branch line from Battersby Junction to the West Rosedale Mines for the transit of the ironstone, which was chiefly sent to the Ferryhill Iron Works. Five years afterwards, Mr. Leeman and his Partners became associated with the late Mr. James Morrison of Newcastle-upon-Tyne, under the style of "The Rosedale and Ferryhill Iron Co.," and having purchased the Rosedale Abbey Estate, they opened up the ironstone on the east side of the dale, and the Rosedale Branch Railway was extended for the carriage of it, Plate IX. In 1874, the Company further increased their output by sinking Sherriff's Pit on the west side to the north of the magnetic workings. In 1879 the mines were stopped owing to the depression in trade; but in 1880 Sherriff's Pit and West Rosedale Mines were bought by the West Rosedale Ironstone Company, Limited, and a small output of magnetic ironstone is now being vended. Messrs. Navery and Company opened the Farndale Mines in 1873 (adjoining the West Rosedale Royalty), from which a considerable quantity of ironstone has been quarried, but the mines are closed at present.

The following statistics, kindly supplied by Robert Hunt, Esq., F.R.S., of the Mining Record Office, show the output of ironstone from the Rosedale Mines since their commencement in 1859, up to the end of last year :—

Date.	Tons.	Where from, etc.
1861 ... ..	79,786	Magnetic.
1862 ... ..	219,123	Do.
1863 ... ..	224,889	Do.
1864 ... ..	297,579	Do.
1865 ... ..	250,000	Do.
1866 ... ..	233,382	Do. and East Mines.
1867 ... ..	178,227	Do. Do.
1868 ... ..	210,082	Do. Do.
1869 ... ..	269,595	Do. Do.
1870 ... ..	317,060	Do. Do.
1871 ... ..	314,394	Do. Do.
1872 ... ..	450,350	Do. Do.
1873 ... ..	560,668	Do. Do.
1874 ... ..	473,140	Do. Do.
1875 ... ..	383,914	Do. Do.*
1876 ... ..	383,828	Do. Do.*
1877 ... ..	347,486	Do. Do.
1878 ... ..	234,150	Do. Do.
1879 ... ..	25,593	Do. Do.†
1880 ... ..	Nil.	Mines closed.
1881 ... ..	6,079	Sherriff's Pit reopened.
Total	5,459,325	

\* And Sherriff's Pit † Mines closed in March.

This output, with the exception of about 32,000 tons from Sherriff's pit, was nearly all calcined at Rosedale, kilns for that purpose being erected both at the east and west mines.

#### PRESENT AND FUTURE DEVELOPMENT.

The magnetic ironstone, so far as present discoveries are concerned, will soon be all worked out, so, in the absence of new discoveries, the future working must be from the regular seam or seams. The seam now worked at the mines in this district is what is termed in Mr. Marley's paper the top seam of the lias formation, and overlies the magnetic deposits; the average thickness workable may be taken at 6 feet, although it varies very much at the different points opened up. The beds dip south about 1 in 22, and the specific gravity of this ironstone is about 2·35, or equal to 15 cubic feet per ton. As the seam is followed to the dip it takes off materially both in quality and thickness; this is particularly illustrated at Sherriff's pit, where, at the drift mouth, the seam is 8 feet thick, but at the extremity of this drift, about 460 yards in from the outcrop, it is only 3 feet 8 inches thick, and the percentage of the stone only 29·50 per cent. The gradual falling off will be seen by the figures below :—

	Seam.	Iron.
At entrance to drift . . . . .	8' 0"	35·44
„ 3rd bord to left . . . . .		33·80
„ 12th „ right . . . . .		32·60
„ pit bottom (42 fms. deep) . . . . .		29·95
„ end of drift . . . . .	3 8	29·50
		<hr/>
Average of the five places . . . . .		32·26
		<hr/>

The overlying strata is principally sandstone or freestone, through which the water rapidly passes, causing an excess of moisture in the ironstone during wet weather which is somewhat detrimental to the sale of it. This drawback, however, is much less in the summer months, as the following assays of train loads sampled as received at the furnaces prove:—

	Iron in wet state.	Moisture.	Dried at 212° F.
Average of three winter months . . . . .	29·53	14·08	34·37
„ three summer „ . . . . .	33·20	10·42	37·07

The output per man per shift of eight hours is less here than in Cleveland, owing, to some extent, no doubt, to the beddy nature of the seam

which militates against successful blasting. The Cleveland men average about  $5\frac{1}{4}$  tons per shift, whilst the Rosedale miner only averages about  $3\frac{1}{4}$  tons per shift; consequently, it is obvious that the latter must be paid an extra tonnage rate in order to make wages equal to the Cleveland men. The present price is 1s. 2d. per ton at Rosedale, with extra yard money and consideration paid for working the magnetic ironstone deposit. The cost per ton for timbering runs from 4d. to 6d., and the royalty paid is 4d. per ton for ironstone under 40 per cent., and 6d. per ton for that yielding over 40 per cent.

Now comes the all-important question as to what may be safely assumed the average percentage of the Rosedale ironstone as supplied to the market, and although the writer has no hesitation in stating that samples taken in certain districts of any of these mines will yield up to 35 per cent. of iron, yet he is bound to add that in other places the yield will not exceed 20 or 25 per cent. On Plate X. will be found the percentage of ten working places in the Rosedale East Mines, taken at points which embrace the whole area of the workings. The average of these eight places give a seam of 6 feet 6 inches thick, and a yield of 29·35 per cent. of iron. The seam has been analysed also midway between Sherriff's pit and the West Mines on the west side of Rosedale, and the result arrived at as under may be considered as a fair average of the district :—

			Seam.		Iron.
			Ft.	Ins.	
Average of ten working places	East Mines	...	6	6	29·35
„ five	„ Sherriff's Pit	...	5	10	32·25
Midway between	West Mines and	„	6	0	24·50
Average of Rosedale district			6	1	28·70

It must be remembered that if great care is taken, and the operations confined to certain districts where the stone yields well, it is possible to supply ironstone of a higher percentage than the average here given, and, as it is, the Rosedale stone compares fairly with the average of the Cleveland mines. It may not be out of place to give a few complete analyses of some of the mines in Cleveland, Lincolnshire, and Rosedale, showing each element contained in the stone. The writer would not wish it to be inferred that the following results are an average of each mine, but the analyses given are from *bonâ fide* samples taken from each place :—



ELEMENT—RAW STONE.	ROSEDALE DISTRICT.				CLEVELAND DISTRICT.							LINCOLNSHIRE DISTRICT.			
	West Rosedale Magnetic.	Sherriff's Pit.	East Rosedale.	Farndale.	Kirk-leatham.	Upleatham.	Brotton.	Craggs Hall.	Lothhouse.	Stanghow.	Shapewath.	Whitecliff.	Allesbury.	Blissworth.	Mild. Lincoln.
Peroxide of iron ... ..	12.14	17.92	26.57	49.57	21.85	9.21	6.11	2.14	3.07	1.00	2.62	2.79	5.35	14.85	46.07
Protoxide of do. ... ..	14.33	28.67	18.19	..	23.40	33.10	35.21	36.64	35.35	34.64	30.72	33.10	24.42	35.16	trace
Peroxide of manganese ... ..	...	...	...	.63	...	...	...	...	...	...	...	...	...	...	...
Alumina ... ..	8.55	8.52	9.84	2.02	11.04	11.92	12.71	13.53	11.70	12.43	10.83	13.53	18.05	8.40	8.15
Line ... ..	2.52	4.97	6.24	3.70	5.29	5.37	5.65	5.54	4.62	5.93	5.06	3.75	12.46	4.59	4.67
Silica ... ..	16.80	10.80	18.55	11.83	9.20	11.90	12.35	14.10	15.75	13.70	18.85	18.70	3.22	5.98	22.20
Phosphoric acid ... ..	1.63	2.00	1.43	.48	2.26	1.53	1.39	1.02	1.10	1.69	1.37	.70	2.99	1.40	1.98
Sulphur ... ..	trace	.10	.03	.52	trace	.38	.70	trace	.28	.37	3.88	trace	1.40	.50	trace
Magnesia ... ..	1.15	3.10	2.91	3.18	2.56	3.42	1.65	3.56	2.79	3.33	3.42	4.33	10.90	2.28	.61
Moisture, etc. ... ..	12.50	23.50	11.10	25.03	24.15	22.80	24.13	22.70	25.40	26.79	23.15	22.70	20.65	26.65	17.00
Metallic iron ... ..	40.65	34.85	32.75	34.07	33.50	32.20	30.00	30.00	29.65	28.20	27.55	27.35	24.25	37.75	32.25

Midway between West Mines and Sherriff's pit, under the sub-soil, is about 30 feet of good freestone, followed by about 70 feet of sandstone beds intermixed with blue shale; under this is the seam of ironstone locally known as "the top seam of the district," which is separated from the seam now being worked at the mines by about three feet of soft blue shale, with coal pipes, and one foot of dogger band. The "top seam" at this point yields 29 per cent. of iron, but is very siliceous, and contains many pure blocks of freestone, enveloped in a thin ironstone shell; it is about eight feet thick here, whilst the seam below is only six feet thick, and very poor, yielding only 20 per cent. It is also very sandy, consisting of round blocks of light blue ironstone, very similar to the Cleveland stone, incrustated in brown sandstone. It is worthy of notice that where the "top" seam is rich, the bottom one is correspondingly poor, for instance, near Sheriff's pit, the "bottom" or working seam yields 32 per cent., whilst the "top" seam yields only 24 per cent.

The railway carriage to the Cleveland and other furnaces is a heavy item, the current rates paid being as follows :—

District.	Ironworks.	Rate per Ton.	Remarks.
		s. d.	
Middlesbro' ... ..	Tees ... ..	1 7 $\frac{1}{4}$	These rates are from Sherriff's pit, the rates from the other mines ranging from 1d. to 2d. per ton more. 5 per cent. discount is allowed on payment of carriage account.
South Bank ... ..	Clay Lane ... ..	1 8 $\frac{1}{4}$	
Stockton ... ..	Tees Bridge ... ..	1 9 $\frac{1}{4}$	
North Yorkshire ... ..	Glaisdale ... ..	1 9 $\frac{1}{4}$	
Redcar ... ..	Redcar ... ..	1 10 $\frac{1}{2}$	
Whitby ... ..	Grosmont ... ..	1 11 $\frac{1}{4}$	
Durham ... ..	Witton Park ... ..	2 10	
Ditto ... ..	Consett ... ..	3 7 $\frac{1}{4}$	

These are high rates when compared with the carriage from the Cleveland Mines to the furnaces, but whether it would answer to erect furnaces at Rosedale is questionable; the ironstone and limestone would be close at hand, but on the other hand the coal and coke would have to be got from the Durham district, and there would be the carriage of the pig iron back to Middlesbro'. A rough estimate of the cost of making one ton of pig iron at Rosedale, on a production of 800 tons per week, would be about as follows:—

3½ tons ironstone	...	...	...	...	at	s. d. 3 0	s. d. 10 6
1½ .. coke	...	...	...	...	at	14 0	15 9
$\frac{2}{3}$ .. limestone	...	...	...	...	at	2 0	1 4
$\frac{1}{4}$ .. coal	...	...	...	...	at	5 6	1 4½
Works, repairs, and stores...	...	...	...	...	...	...	1 4
Management, etc.	...	...	...	...	...	...	1 0
Labour (say)	...	...	...	...	...	...	3 3½
Cost per ton at the ironworks							<u>£1 14 7</u>

The railway carriage of a ton of pig iron to Middlesbro' would be about 3s., and to make 800 tons of pig iron per week would require 2,800 tons of ironstone per week.

In addition to the ironstone seams mentioned, the Cleveland Main Seam crops out at several places in the dale; at one point a sample was analysed by Messrs. Stead and Pattinson, of Middlesbro', giving the following result:—

	Per Cent.	Per Cent.
Iron	25·20	11·00 oxygen.
Silica	30·00	
Loss by calcination	21·58	76·70
Iron in calcined state	<u>32·10</u>	<u>87·70</u>

The seam is thin, ranging from 1 to 2 feet thick only, at the various outcrops visible.

## 2.—LIMESTONE.

The limestone under observation is that which is worked at Pickering, Cropton, and district lying south-west of Rosedale. Plate XI., Fig. 1, is a section taken from one of the largest of the Pickering quarries, where the limestone is wrought and sent to the Grosmont Iron Works, and worked here, and elsewhere in the district, for agricultural purposes. The working beds are laid 8 or 9 feet from the surface, about 45 feet thick, divided into blocks 3 feet, 2 feet 6 inches, and 2 feet in thickness, and in colour light grey and blue black; under this is 13 feet of hard limestone of poor quality, locally termed "road metal," and used for repairing roads and building purposes; below which is 18 inches of cockle-shell post, overlying 17 feet of yellow sandstone. This sandstone bed in other localities is found to be loose, dry sand. Under this again is 2 feet of very hard blue flinty post overlying another bed of grey limestone, the thickness of which is not visible. Analyses of the beds wrought here give not more than 84 per cent. of carbonate of lime, but at the Deepdale quarries, situated between Hutton-le-Hole and Appleton Common, it appears to improve in quality. Here the beds, of similar size and colour to those at Pickering,

yield 93 per cent. of carbonate of lime or 9 per cent. more than the Pickering stone. The Pickering and Kirbymoorside railway passes in close proximity to the south end of the dale, and the West Rosedale branch railway is situated about four miles from the north end quarries. The beds visible on each side of the vale of Deepdale are about 150 feet in thickness, intermixed with sandstone. Samples taken from six of the Deepdale beds, assayed by Mr. Alfred Procter, Middlesbro', yield as follows:—

	1.	2.	3.	4.	5.	6.
Sand, clay, etc. ...	9.00	6.40	5.10	3.00	4.10	6.60
Carbonate of lime ...	89.40	92.40	94.40	96.20	94.50	92.50
Carbonate of magnesia ...	.50	.75	.75	.20	.70	.50
Moisture ...	1.10	.45	.45	.60	.70	.40
	<u>100.00</u>	<u>100.00</u>	<u>100.70</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Nos. 1, 2, 3, and 4, follow successively in beds 6 feet thick; No. 5 is a sample of 20 feet of limestone, and No. 6 of 10 feet.

The limestone now used at the Cleveland furnaces contains from 96 to 97 per cent. of carbonate of lime.

The railway carriage on this limestone to the Middlesbro' Iron Works from Pickering would be about 2s. 6d. per ton, and from Deepdale about 2s. 10d. per ton.

### 3.—ROAD METAL (INFERIOR LIMESTONE).

The material used for repairing roads is an inferior hard flinty limestone, the extensive beds in this district present the opportunity of carrying on a successful trade in road metal, provided the necessary but small extension of railway accommodation was made. The only point to which the writer would draw particular attention is the Spindlethorne Hill beds, situated about a mile west of Rosedale bank top, on the Spaunton Moor, where the stone has been largely quarried for highway purposes. These beds are quite separate from the general limestone beds of the district which have just been under notice, and are laid above the freestone and ironstone of Rosedale. Plate XI., Fig. 2, is a section of one of the quarries; first there is about 5 feet of isolated boulders of the stone, of various shapes, but principally oblong, through which may be found round water holes of different dimensions; these blocks are embedded in brown soft sand; below these boulders is a compact bed of the stone about 4 feet thick; under this again is 3 or 4 inches of fossilized post overlying a bed of light blue shale. The beds crop out in Loskey Beck on the Spaunton Moor, from the bed of which the writer took the following observations, which will show the strata surrounding the Spindlethorne beds.



The water in the Deepdale beck (as well as others in the immediate neighbourhood) disappears below the surface during dry weather, in some places leaving the bed of the river perfectly dry for two or three miles and flowing out again at some distance further on. The writer presumes this is caused by swallow holes, which are of common occurrence in the limestone formation in various parts of Yorkshire and elsewhere. The discussion on Mr. J. B. Simpson's paper "On Natural Pits in the Coal Measures of Belgium," read before the members of this Institute in December, 1873, (Vol. XXIII., page 74) deals with this phenomenon.

## COMMENCING AT FOOTPATH TO DARLEY LODGE.

	Feet.
1.—Freestone ... ..	5
2.—Shale, light sandy ... ..	3
3.—Freestone, soft brown ... ..	6
4.—Freestone, hard brown ... ..	2
5.—Shale, soft, sandy, yellow ... ..	6
6.—Shale, light blue with 3 in. coal pipe ... ..	4*
7.—Flinty limestone, compact ... ..	4*
8.—Sandstone soft ... ..	1*
9.—Flinty limestone boulders enveloped in brown sand ... ..	4*
10.—Sandstone, alternate beds of white and yellow ... ..	20
11.—Sandstone, full of small round water holes ... ..	2
12.—Shale, soft blue ... ..	2
13.—Sandstone, very light yellow ... ..	3
14.—Shale, grey and blue soft ... ..	6
15.—Dogger band, hard red ... ..	3
16.—Shale, strong blue ... ..	4
17.—Sandstone and loose sand ... ..	4
18.—Blue shale and sand ... ..	16
19.—Hard flinty post ... ..	2
20.—Shale, soft blue ... ..	12
Total ... ..	109

Left off at Loskey Bridge.

\* See Section of Spindlethorne Quarries, Plate XI.

Analyses of this stone give:—

Iron ... ..	7·05
Silica ... ..	2·15
Carbonate of lime ... ..	78·05

## 4.—FREESTONE.

The freestone and flagstone beds are laid about 70 feet above the "top seam" of ironstone; there are several good quarries of freestone in the district presenting a face of from 20 to 30 feet thick, and the stone is found very suitable for building purposes; the flagstone from the Rosedale quarries is exceptionally good.

## 5.—CEMENT STONES.

The cement stones occur in round balls; the band containing them is immediately above the top ironstone seam and is about 2 feet thick. Up to the present time they have not been worked here.

## 6.—ALUM SHALE, JET, AND CLAYS.

The writer having already read a paper on the jet and alum shale before the members of this Institute (see Transactions Vol. XXXI., page 51) it is unnecessary to describe these well-known minerals, both of which are found here in fully-developed beds and deposits. Above the cement stone band is a bed of good clay suitable for brick making purposes.

Owing to a change in the manufacture of alum,  $\text{Al}(\text{H}_4\text{N})(\text{SO}_4)_2$ , has of late years been substituted for that made from the common alum shale or alum chist.

## 7.—COAL AND PEAT.

Some seams of inferior coal have been formerly worked on the Rosedale Moors, D.D. Plate IX., the deepest shaft not exceeding 30 yards. The seams are in thickness from 1 inch up to 20 inches, those which have been worked varying from 12 to 20 inches. Before the branch railway was made to Rosedale a considerable trade was carried on both for household purposes and for burning limestone. The coal is of a shaley nature and burns to a white ash. On the moorland surrounding Rosedale there are extensive peat beds, ranging from 1 up to 10 feet thick, and lying usually on a loose white sand foundation. On the West Moor, at a place known as Jewell Mere, there is a peat bed covering an area of about 100 acres, a considerable portion of which averages about 6 feet in thickness, and the West Rosedale railway passes close to the ground, affording every facility for conveying away the peat. That these beds might be utilized both for steam and other purposes is indisputable, and if cut and dried by machinery, similar to the plan adopted with the Dartmoor peat in Devonshire, the peat could be sold to the district at a cheaper rate than the coal is supplied at now. The writer visited a copper mine in Wales some time ago where peat was cut close to the mine for engine purposes; it was prepared for about 6s. per ton, the calorific value of which was about 70 per cent. of coal by weight. The only alteration which it had been found necessary to make at this mine in using peat in lieu of coal was that the grate surface and heating surface of the engine boiler had to be proportioned for the heating power of peat, the surfaces being in proportion, nearly inversely, as 70 to 100.

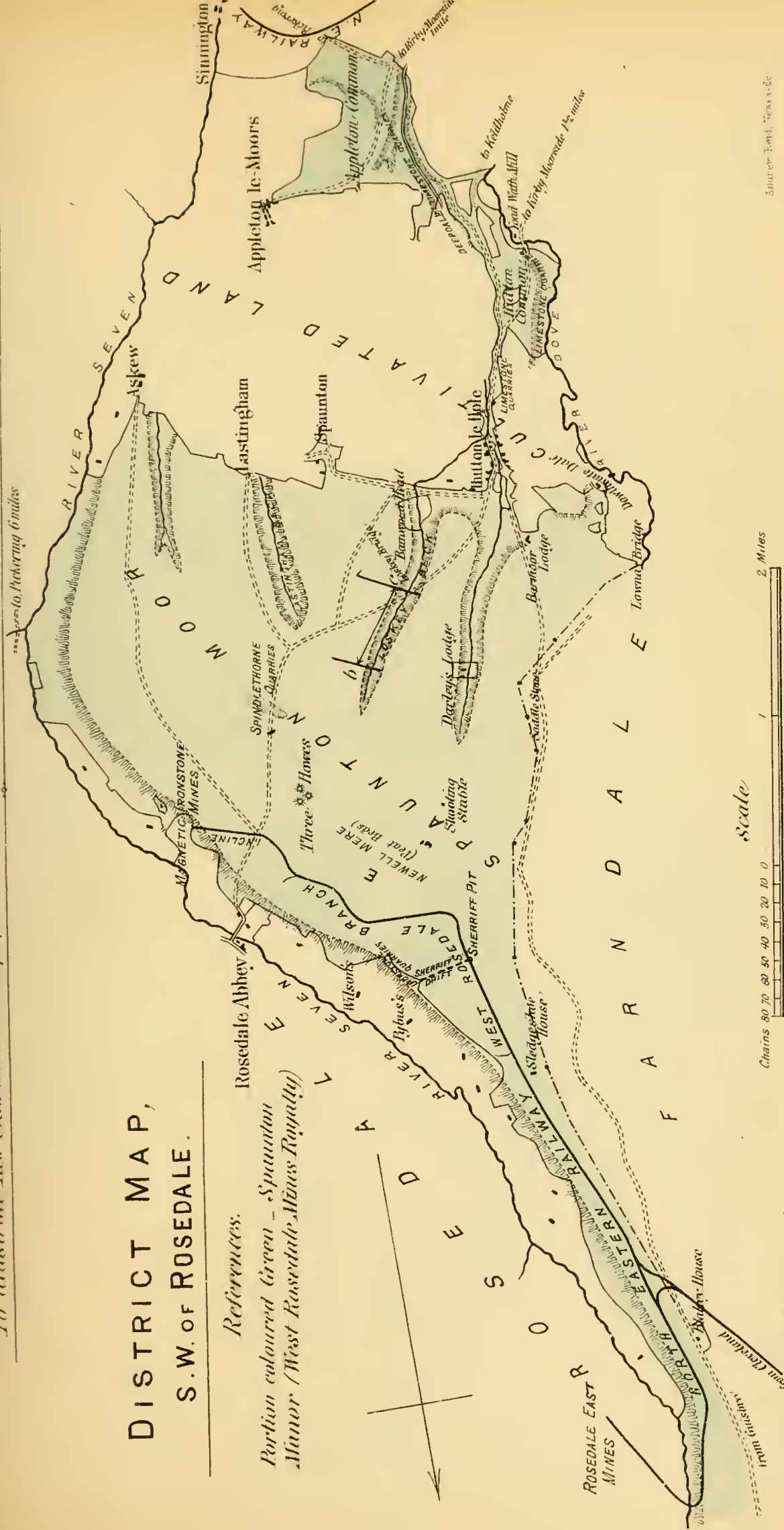
## 8.—LEAD.

The writer would remark on this subject with some degree of reserve at present, as his investigations in the matter are as yet incomplete. Lead ore has been found in different situations of this district, but whether the ore exists in sufficient quantity to pay for working remains to be proved: at some future meeting it may be possible to throw further light on the subject.

The writer is indebted to Mr. John Campion, of West Rosedale, for valuable assistance in preparing this paper.

DISTRICT MAP,  
S.W. OF ROSEDALE.

*Portion coloured Green - Spauwton  
Manor (West-Rosedale Mines Royalty)*





DISTRICT MAP,  
(ROSEDALE AND N.E.DISTRICT.)

*References:-*

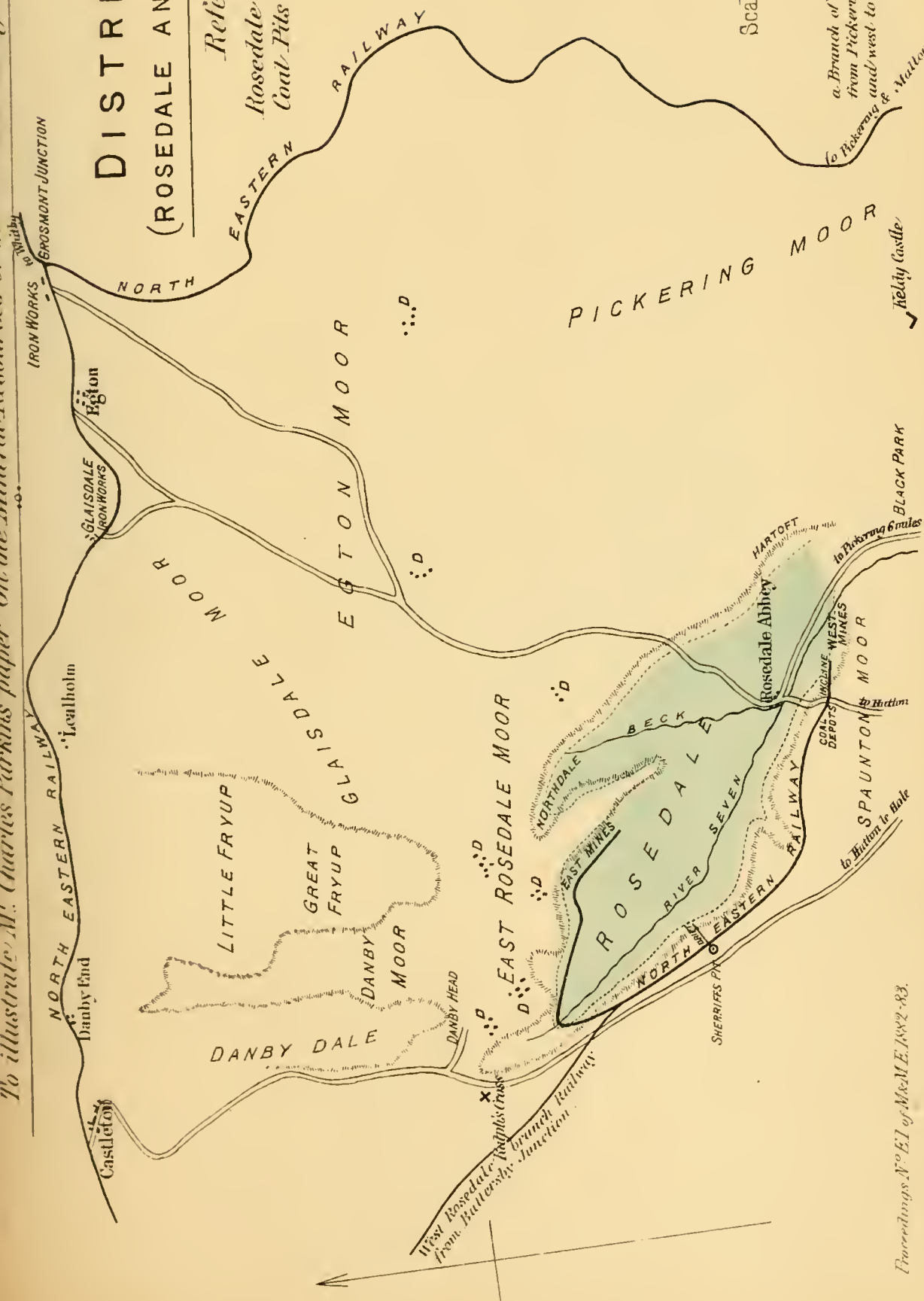
Rosedale Ironstone Outcrop .....D  
Coal Pits " " " " " " " "

Scale 1 inch to 2 Statute miles.

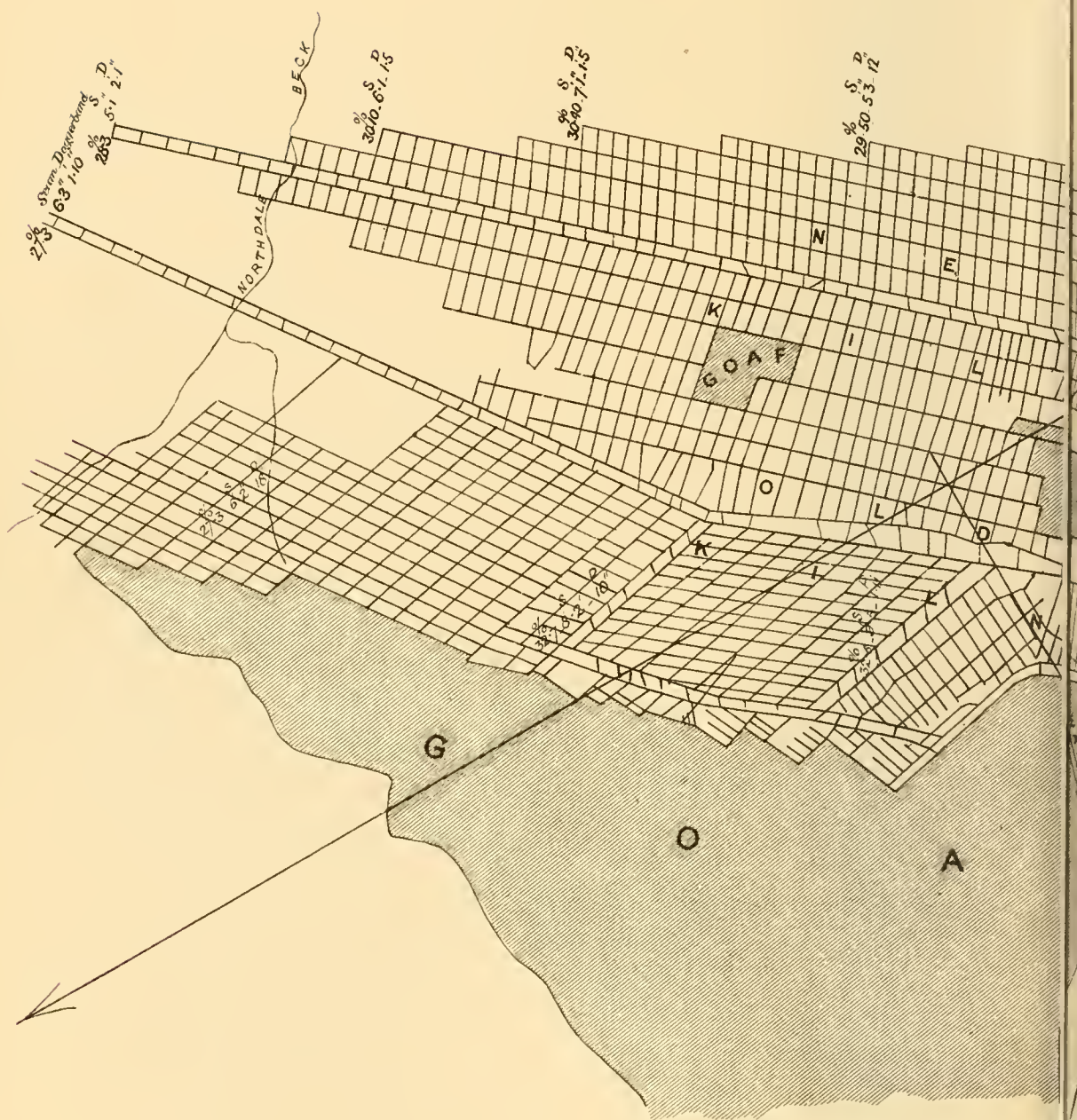
a. Branch of this Railway runs from Pickering, east to Scarborough and west to Helmsley.

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*Proceedings N<sup>o</sup> LII of M&M E. 1882-83.*



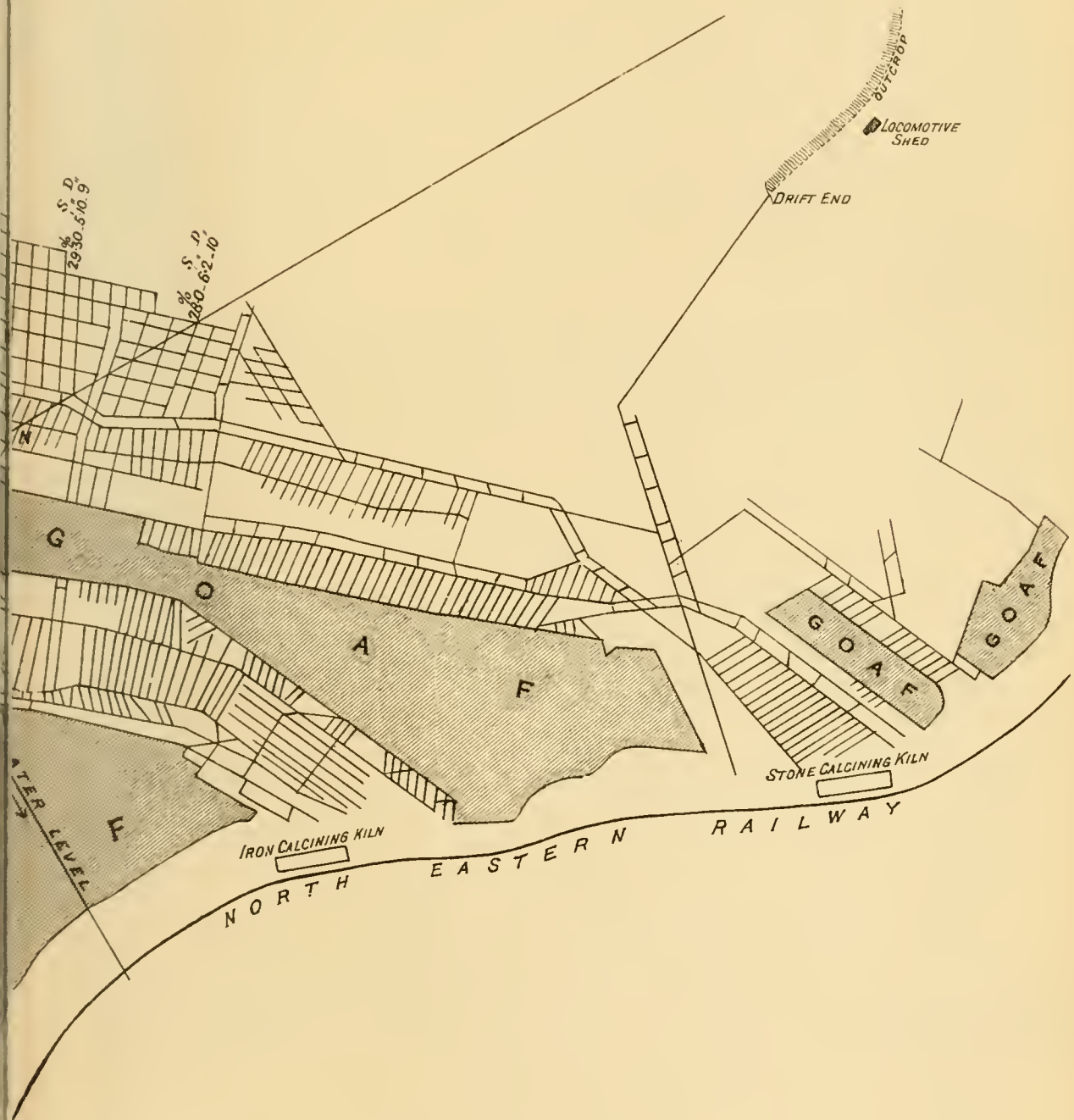
# ROSEDALE



Scale 12

General Resources of the Rosedale Abbey District."

EAST MINES.

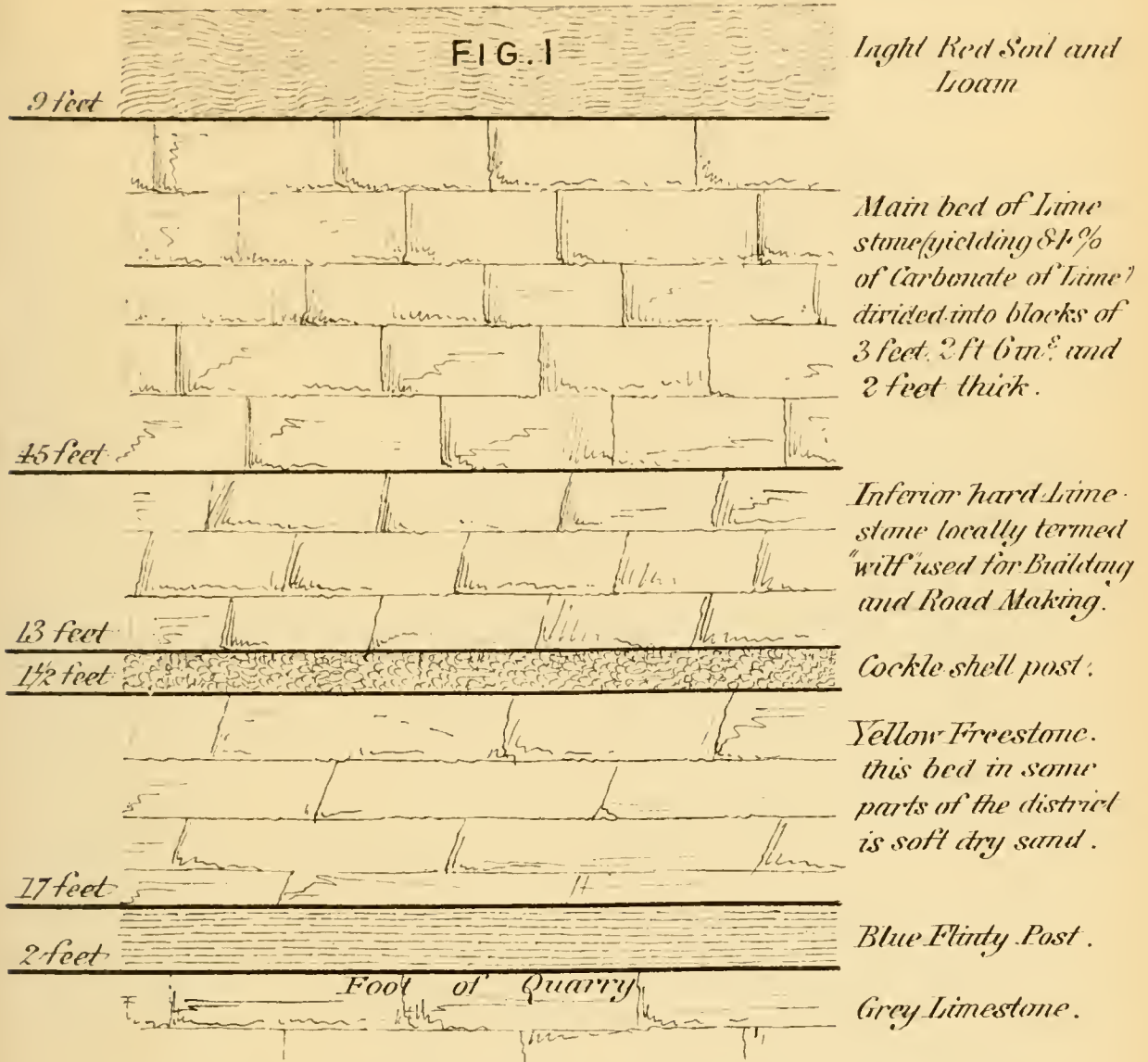


ns to an inch.



To illustrate Mr Charles Parkin's paper "On the Mineral Resources of the Rosedale Abbey District."

# SECTION OF LIMESTONE QUARRY AT PICKERING.



# SECTION OF ROAD METAL QUARRY AT SPINDLETHORN.

