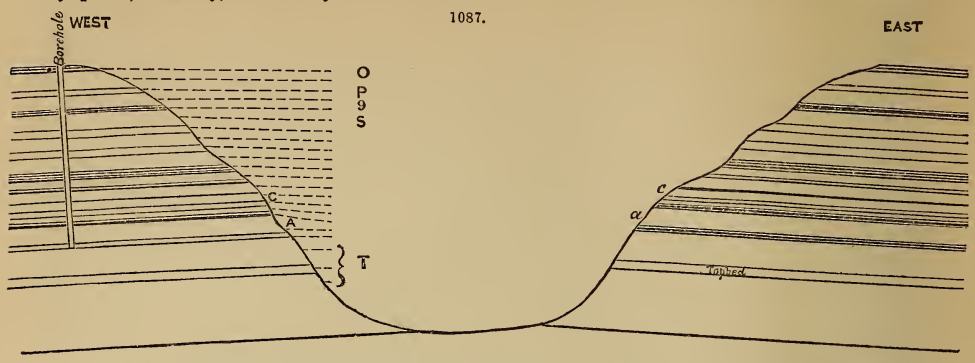
We give an example of boring for minerals, from the 'Transactions of the North of England Institute of Mining Engineers,' vol. vii. The paper which furnishes this example was read by the justly-celebrated Nicholas Wood; we give it and the discussion thereon, without any material alterations, to show the baseless fabric upon which the so-called science of geology is made to rest.

*Nicholas Wood, President of the Institute of Mining Engineers, on the Deposit of Magnetic Ironstone in Rosedale.*—In John Marley's very elaborate and very able account (says *Wood*) of the Cleveland Ironstone District, communicated to this Institute at its meeting of June, 1857, and published in vol. v. of the 'Transactions,' he states:—"The only special district to which I think necessary now to allude is the Rosedale Abbey district, the ironstone from which has attracted a large amount of attention, on account of its large percentage, immense deposit, and magnetic properties."

Marley then gives a history of the discovery of this bed of ironstone, its position in the series, as well as in the district generally, and adds all the information which had then been elicited with regard to the particular features and character of such deposit, which he illustrates by a diagram, showing the explorations which had been made by drifts and pits towards such elucidation; and he then concludes by saying:—"I have no doubt that this seam is the same as the seam at the point *A*, Fig. 1087, as also the same as that found on the east side of Rosedale, in Captain Vardon's property, of varied thickness, as well as the same seam as that at Grosmont, Fryupdale, Swainby, and Boltby, known as *the top seam* of Cleveland—the nine inches of coal in the pit sunk agreeing with *Beckhole*, near Grosmont, in particular; so that the only doubtful point is as to the portion from the outcrop at *A* to the so-called magnetic quarry; the most feasible solution being that it is a disjointed patch of the regular seam, known as the *top seam*, and not a vein, as has been said; and, with all deference to the parties who have had more opportunity for examining this district than I have, I propose leaving the *extent* of the *magnetic and extra percentage* tract as an *unsolved problem*, as it may vary from one or two acres to any indefinite extent, not being at all proved to the south."

This is a very clear and correct account (says *Wood*) of the information then existing on this

deposit, Marley's opinion being that it represented the top seam, as developed at Grosmont Fryupdale, Swainby, and Boltby.




*Reference:*—O, Shale and ironstone ramble. P, Brown and grey sandstone. 9, Coal and shale. S, Shale and sandstone. T, Sandstone; top bed, of iron and lias respectively, not proved by the bore-hole.

*A Section of the Strata at Grosmont is given by Marley as follows:—*

| | Ft. | In. | | | Ft. | In. |
|---|---|---|---|---|---|---|
| Sandstone .. .. .. .. | 25 | 0 | | Ironstone band and shale .. .. .. | 29 | 0 |
| Ironstone, top seam .. .. | 12 | 0 | | "Pecten" band, part of the Cleveland thick seam .. .. .. .. | 5 | 10 |
| Lias shale .. .. .. .. | 92 | 0 | 198 0 | Shale .. .. .. .. .. .. .. | 17 | 4 |
| Various strata, not identified | 51 | 0 | | "Avicula" band, Cleveland seam .. | 6 | 4 |
| Lias shale .. .. .. .. | 55 | 0 | | | | |

Another section near Grosmont gives the top seam 11 ft. 6 in., then 187 ft. of shale and ironstone, and then the Cleveland band.

*The Section at Fryupdale is as follows:—*

| | Ft. | In. | | Ft. | In. |
|---|---|---|---|---|---|
| Freestone .. .. .. .. .. .. | 55 | 0 | "Pecten" band, Cleveland main seam | 6 | 0 |
| Top seam .. .. .. .. .. .. | 12 | 0 | Shale .. .. .. .. .. .. .. | 30 | 0 |
| Jet, cement, and alum rocks .. .. | 202 | 0 | "Avicula" band, Cleveland main seam | 4 | 4 |
| Shale .. .. .. .. .. .. .. | 60 | 0 | | | |

*The Section at Swainby is as follows:—*

| | Ft. | In. | | Ft. | In. |
|---|---|---|---|---|---|
| Shale .. .. .. .. .. .. | 13 | 0 | Shale .. .. .. .. .. .. | 132 | 6 |
| Top seam .. .. .. .. .. | 23 | 0 | Cleveland main bed .. .. | 9 | 3 |

*And at Felix Kirk, near Boltby, the Section is:—*

| | | | Ft. | In. | |
|---|---|---|---|---|---|
| Brown, yellow, &c., gritstone .. .. .. .. .. | | | 0 | 0 | |
| Boltby and Rosedale iron rock .. .. .. .. | | | 7 | 0 | |
| Alum shale, or upper lias shale .. .. .. .. | | | 116 | 0 | |
| Upper band of nodular ironstone .. .. | 0 | 7 | 4 | 1 | Type of Eston or Cleveland main seam. |
| Thin seam of soft shale .. .. .. .. | 3 | 0 | | | |
| Lower band of nodular ironstone .. .. | 0 | 6 | | | |

*Section of Strata in the Hills at Swainby Mines.*

| | | | Ft. | In. | |
|---|---|---|---|---|---|
| Soil, &c. .. .. .. .. .. .. .. | | | 3 | 0 | |
| Freestone .. .. .. .. .. .. .. | | | 24 | 0 | Near the limekiln this is 100, with 9-in. ironstone balls in it. |
| Slaty coal .. .. .. .. .. | 0 | 9 | | | |
| Shale .. .. .. .. .. .. .. | 1 | 0 | | | |
| Sandstone .. .. .. .. .. | 4 | 0 | | | |
| Slaty coal .. .. .. .. .. | 0 | 9 | | | |
| | | | 6 | 6 | |
| Shale .. .. .. .. .. .. .. .. | | | 5 | 0 | |
| Coarse freestone .. .. .. .. .. | | | 3 | 6 | |
| Shale, with occasional nodules of ironstone .. .. .. .. .. .. .. | | | 13 | 0 | |
| Ironstone, good .. .. .. | 2 | 0 | | | |
| Ironstone .. .. .. .. .. | 21 | 0 | | | |
| | | | 23 | 0 | |
| Carried forward .. .. .. | | | 78 | 0 | |

*Section of Strata in the Hills at Swainby Mines*—continued.

| | | | | Ft. | In. | |
|---|---|---|---|---|---|---|
| | Brought forward .. .. .. | | | 78 | 0 | |
| | Shale .. .. .. .. .. .. .. .. .. | | | 132 | 6 | |
| Not Wrought | Ironstone .. .. .. .. .. .. | 2 | 8 | | | |
| | Shale .. .. .. .. .. .. .. | 1 | 0 | | | |
| | | 3 | 8 | | | |
| | Ironstone .. .. .. .. 2 5 | | | | | |
| | Shale .. .. .. .. .. 1 8 | 5 | 7 | | | |
| | Ironstone .. .. .. .. 1 6 | | | 9 | 3 | Scarthnick bed or seam. |
| | Shale .. .. .. .. .. .. .. .. .. | | | 9 | 3 | |
| | Ironstone .. .. .. .. .. .. | 1 | 3 | | | |
| | Shale .. .. .. .. .. .. .. | 0 | 6 | | | |
| | Ironstone .. .. .. .. .. .. | 1 | 3 | | | |
| | | | | 3 | 0 | |
| | Shale .. .. .. .. .. .. .. .. .. | | | 16 | 6 | |
| | Ironstone .. .. .. .. .. .. .. .. | | | 1 | 6 | |
| | Supposed shale, but unproved down to the level of the bottom of Crook beck | | | 335 | 0 | |
| | | | | 585 | 0 | |

*Section of the Strata at Eston Nab, showing the top seam, and the main or Cleveland band, where the latter is in perfection.*

| | | Ft. | In. | Ft. | In. | |
|---|---|---|---|---|---|---|
| Approximated. | Soil, and other strata unproved .. .. .. .. | | | 50 | 0 | |
| | Freestone .. .. .. .. .. .. .. .. .. .. .. | | | 60 | 0 | |
| | Shivery post, patches of jet and clay .. .. .. | | | 54 | 0 | |
| Seam called the "Top Seam." | Nodular ironstone .. .. .. .. .. .. | 0 | 1 | 6 | 0 | Measured working section. |
| | Shale .. .. .. .. .. .. .. .. .. | 2 | 3½ | | | |
| | Nodular ironstone .. .. .. .. .. .. | 0 | 3 | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 0 | 7 | | | |
| | Nodular ironstone .. .. .. .. .. .. | 0 | 0½ | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 0 | 10 | | | |
| | Nodular ironstone .. .. .. .. .. .. | 0 | 1 | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 0 | 6 | | | |
| | Nodular ironstone .. .. .. .. .. .. | 0 | 1 | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 0 | 6 | | | |
| | Ironstone band (varies) .. .. .. .. .. | 0 | 9 | | | |
| | Aggregate of ironstone, 15½ inches. | | | | | |
| Approximated. | Lias shale, including jet rock at bottom .. .. | | | 210 | 0 | |
| | Ironstone band .. .. .. .. .. .. | 0 | 2 | 10 | 0 | Measured section. |
| | Shale .. .. .. .. .. .. .. .. .. | 2 | 5 | | | |
| | Ironstone band .. .. .. .. .. .. | 0 | 2 | | | |
| | Shale, mixed with nodules of ironstone | 1 | 10 | | | |
| | Ironstone band .. .. .. .. .. .. | 0 | 3 | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 1 | 0 | | | |
| | Shale, inclining in some parts to a fire-clay nature .. .. .. .. .. .. | 4 | 2 | | | |
| | Aggregate of ironstone, 9 inches. | | | | | |
| Cleveland Main or Thick Bed or seam of Ironstone. | Top block, left as roof .. .. .. .. | 0 | 11 | 17 | 0 | Measured section. |
| | Parting regular at outcrop, but not so after. | | | | | |
| | Second block (left as roof near outcrop) | 2 | 3 | | | |
| | | 3 | 2 | | | |
| | Main parting (a good one near the outcrop, but lost farther in). | | | | | |
| | Main block and uniform .. .. .. | 12 | 0 | | | |
| | Parting (lost after leaving outcrop). | | | | | |
| | Bottom block (varies) .. .. .. .. | 1 | 10 | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 7 | 0 | 15 | 6 | |
| | Ironstone band (called 2-ft. band) .. | 1 | 8 | | | |
| | Shale .. .. .. .. .. .. .. .. .. | 6 | 0 | | | |
| | Ironstone band .. .. .. .. .. .. | 0 | 10 | | | |
| | Blue shale .. .. .. .. .. .. .. .. | | | 36 | 0 | |
| | Various beds of grey post and metal stone, &c. .. | | | 93 | 6 | |
| | Total .. .. .. .. .. .. .. | | | 552 | 0 | |

The main features of the sections given by Marley as assimilating to the Rosedale bed, are,

1st. The top seam, varying from 12 to 23 ft. in thickness.
2nd. Lias shale and other strata, 132 ft. to 220 ft.
3rd. The Cleveland main band, 9 to 12 ft.

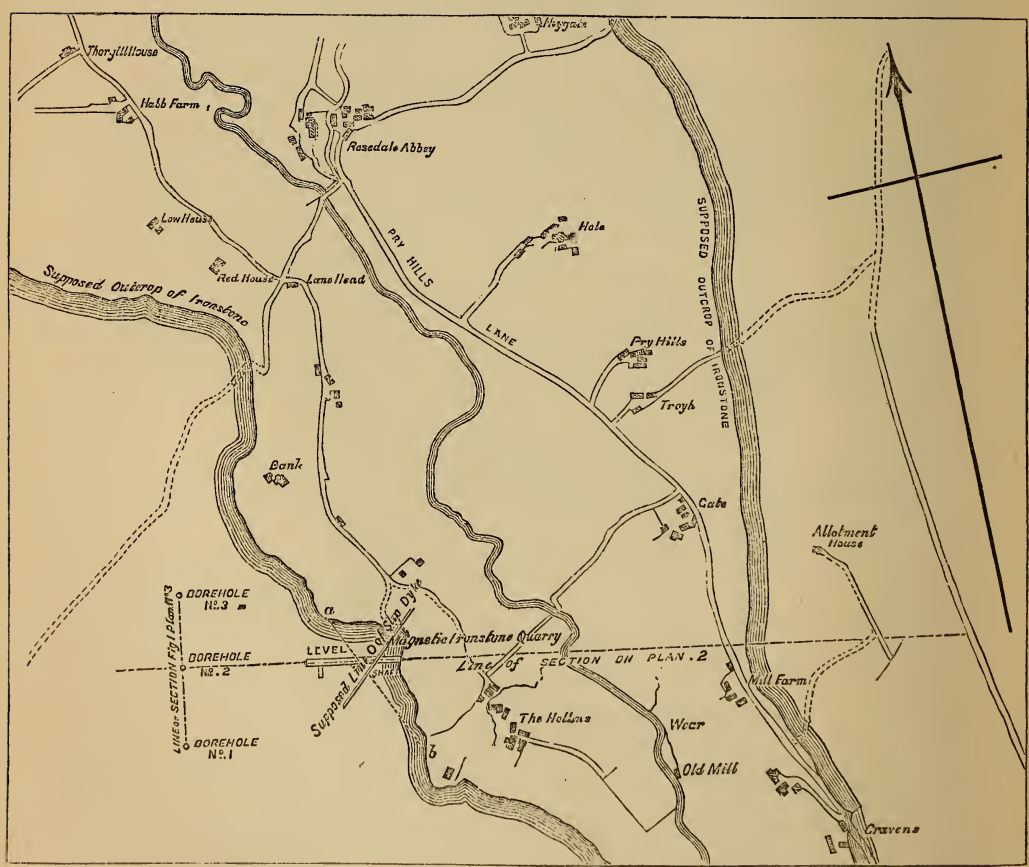
But in all these sections there are no beds of ironstone between the top seam and the Cleveland main band.

Bewick, in a paper presented (says *Wood*) to the Institute, and printed in vol. vi. of the 'Transactions,' gives drawings, and an account of the deposit of Rosedale, and concludes with these remarks,—" My object in thus troubling the members of this Institution with the foregoing remarks is twofold. First, to show that the iron ore of Rosedale, instead of being a large mineral field, as was first asserted, and still believed to be so by many, is nothing more than a volcanic dyke; and secondly, that the ironstone lately opened out in this locality is not, as it is reputed to be, the main seam now being worked in the Cleveland and Grosmont districts, but it is my opinion, if Marley will permit me to say so, the top seam."

I shall now (observes *Wood*) give an account of the operations concluded by Professor Phillips and myself towards the investigation and development of this bed of ironstone.

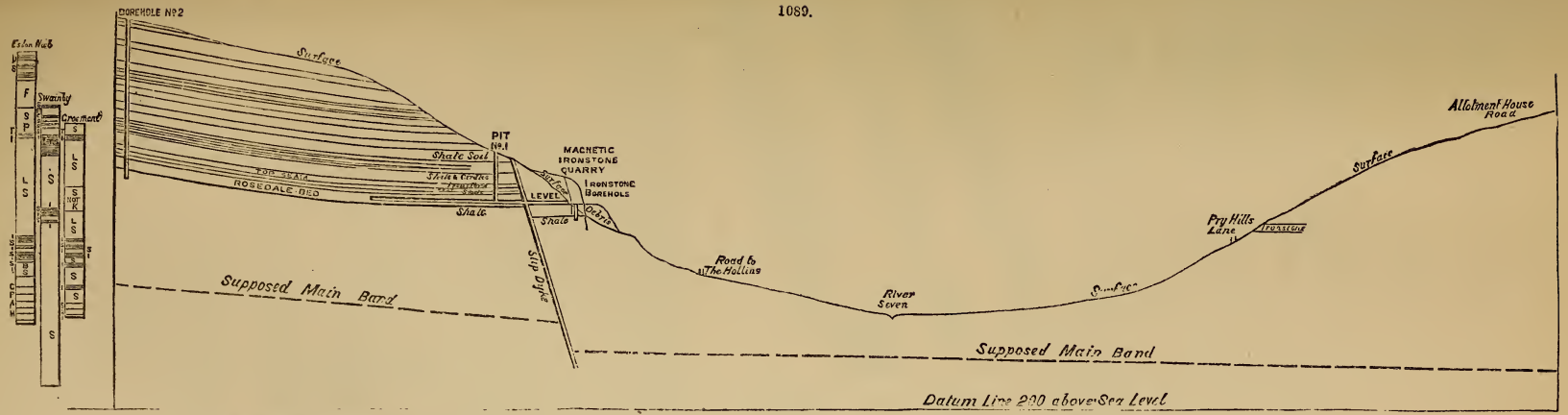
The first discovery of this deposit of ironstone was at a quarry on the south-west side of the valley of Rosedale, about a mile south from Rosedale Abbey, and shown, Fig. 1088. When this

1088.



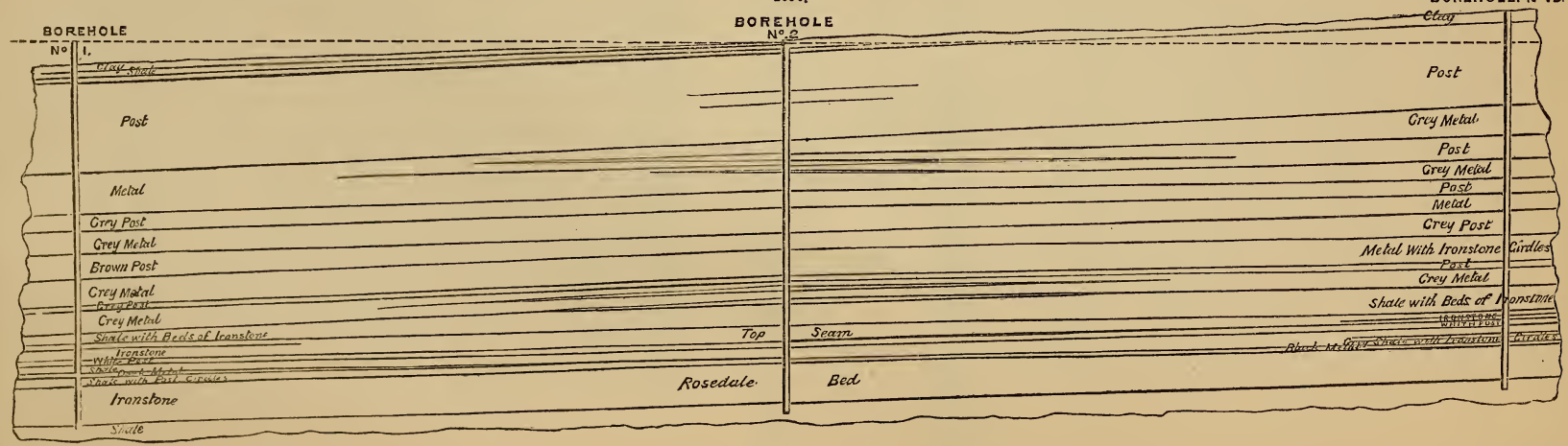

quarry was opened out it was found to consist of apparently a confused mass of ironstone boulders of an ellipsoidal structure, and of gigantic size, often 3 or 4 ft. in diameter; the central part of these boulders being generally blue, and consisting of a solid dark oolitic magnetic iron ore, with, in many cases, sandy and solid ironstone crusts around it; and, in receding from the centre, the iron ore becomes paler, alternating with dark brown purplish layers; the layer then becomes pale brown, and the magnetic quality is lost. In most cases, however, the nodules are quite solid, and a slight stratification exists, though very obscure; and in several cases, likewise, the oolitic structure is merged into compact brown iron ore. In some parts also, where exposed to the water and to the weather, the iron ore is partly washed away, and a gritty ferruginous crust remains. These great variations do not occur where the ironstone is under cover, or covered by other strata, but appears to assume those different phases in consequence of its extreme susceptibility to change by exposure to air and water; and it is somewhat remarkable that the magnetic property is

1089.




*Reference to side sections:*—F, Freestone. S, Shale. I, Ironstone. G, P, M, Grey post and metal. L, S, Lias shale. S, P, Shivery post. C, Coal.

1090.



strongest where the mass is thickest, and scarcely shows any magnetism in places where it is thin, or where it has little cover, and, consequently, more exposed to decomposition or change.

The great characteristic difference of composition between this ironstone and the top and main band of Cleveland is, the entire absence of shells, the structure being entirely of an oolitic character, being entirely composed of small round concretions of iron ore, cemented together with extremely thin siliceous or arenaceous films, and in its magnetic properties exhibiting polarity, and likewise in its greater richness than the ordinary ironstone of Cleveland.

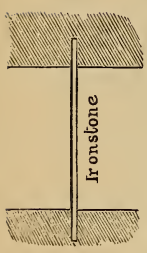
This quarry has been excavated so as to form a face of 60 ft. in thickness; to which must be added 11 ft. of blue magnetic stone, 2½ ft. red ironstone, slightly magnetic, bored down below the bottom in magnetic stone, and 3 ft. of shale.

Soon after the quarry was discovered, it was thought advisable to drive a drift into the side of the hill, to ascertain the extent of this deposit, the quarry being about 600 ft. from the bottom of the valley, and about 300 ft. below the utmost level range, or plateau of moors, lying on the south-west side of the valley. This drift, together with a pit sunk upon it, is shown by a drawing in Marley's paper. Since then, it has been driven to a much greater distance, and three *bore-holes* have been put down from the surface to the Rosedale bed of ironstone.

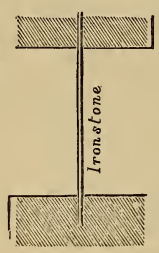
Fig. 1088 shows the position of this drift, the distance and direction in which it has been driven into the hill, and also the position of the three bore-holes and the quarry. And Fig. 1089 also shows the section of the same drifts, and the section of the borings, together with their depths from the surface, and the beds of ironstone which they have proved. I have carried such section across the valley, for the purpose of showing the position of the ironstone band on the opposite side of the valley.

Fig. 1090 shows, on a larger scale, the strata bored through in the three bore-holes above alluded to, and the ironstone beds which they have proved; Figs. 1091 to 1093, bore-holes, Fig. 1094, facing drift, and Fig. 1095, side drift—show the thickness of the lower bed of ironstone in the several bore-holes in the face of the drift, and also in the side of the drift.

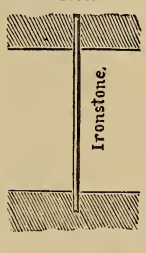
1091.



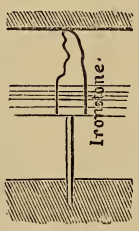

1092.



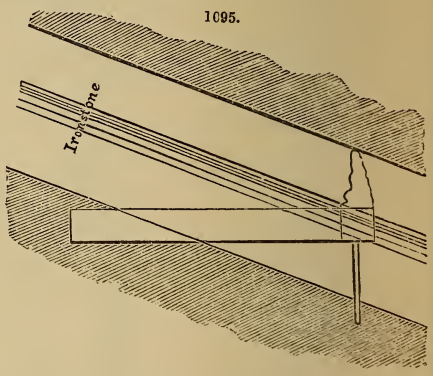

1093.




1094.




1095.




It is necessary to remark that, where the drift was first set away in the side of the hill, it met with shale, and it continued in shale for a distance of about 80 yds., when the ironstone was found. The drift continued in the ironstone for a distance of 180 yds. farther, making a total distance of 260 yds. from the face of the hill. Fig. 1089 is a section of the ironstone at the face or farthest extremity of the drift, showing an entire thickness of 32 ft. of ironstone, namely, 6 ft. 2 in. of drift, 11 ft. 9 in. above the drift, and 14 ft. below it. And, what is important to mention, the ironstone was here distinctly stratified, as shown by the lines across the section, Fig. 1094.

400 yds. in advance of the extreme end of the drift, and 660 yds. from the side of the hill, a *bore-hole*, No. 2, Fig. 1089, was put down; and at right angles to the line of this bore-hole from the drift two other bore-holes were put down from the surface, as shown, Figs. 1089, 1090, each 200 yds. distant from No. 2 bore-hole, or 400 yds. separate; and the following are sections of the strata passed through in these bore-holes.

*Account of the Boring No.* 1, *Fig.* 1090, *or South Bore-hole, on Rosedale Moor.*—1858.

| No. | | Fms. | Ft. | In. |
|---|---|---|---|---|
| 1 | Clay .. .. .. .. .. .. | 0 | 5 | 0 |
| 2 | Metal or shale .. .. .. | 1 | 1 | 0 |
| 3 | Brown freestone water .. | 12 | 5 | 6 |
| 4 | Metal or shale .. .. .. | 6 | 1 | 6 |
| 5 | Brown and grey post .. .. .. | 2 | 0 | 0 |
| 6 | Grey metal .. .. .. .. | 3 | 2 | 0 |
| 7 | Brown and grey post .. .. | 3 | 4 | 8 |
| 8 | Grey metal .. .. .. .. | 3 | 4 | 9 |
| 9 | Grey post .. .. .. .. | 0 | 5 | 6 |
| 10 | Grey metal .. .. .. .. | 3 | 1 | 10 |
| | | 38 | 1 | 9 |
| 11 | Ironstone, magnetic .. .. | 0 | 4 | 0 |
| 12 | White shale mixed with ironstone .. .. .. | 0 | 5 | 0 |
| | Carried forward .. .. | 39 | 4 | 9 |

| No. | | Fms. | Ft. | In. |
|---|---|---|---|---|
| | Brought forward .. .. | 39 | 4 | 9 |
| 13 | Ironstone, magnetic .. .. | 0 | 5 | 0 |
| 14 | Shale mixed with ironstone | 1 | 0 | 9 |
| 15 | White post .. .. .. .. | 0 | 2 | 4 |
| 16 | Shale .. .. .. .. .. | 1 | 1 | 0 |
| 17 | Dark metal .. .. .. .. | 0 | 3 | 0 |
| 18 | Shale with post girdle .. | 1 | 5 | 3 |
| | | 45 | 4 | 1 |
| 19 | Ironstone, magnetic .. .. | 5 | 2 | 0 |
| 20 | Intc. shale .. .. .. .. | 0 | 1 | 6 |
| | Total depth, fathoms .. | 51 | 1 | 7 |

*Account of the Boring, the Middle Hole, or No. 2, Fig. 1090, on Rosedale Moor.*—1857.

| No. | | | Fms. | Ft. | In. |
|---|---|---|---|---|---|
| 1 | Freestone ramble .. .. | | 0 | 3 | 0 |
| 2 | Metal .. .. .. .. .. .. | | 0 | 4 | 0 |
| 3 | Brown post .. .. | 5 2 0 | 12 | 1 | 0 |
| 4 | Grey post .. .. | 1 3 0 | | | |
| 5 | Brown post .. .. | 5 2 0 | | | |
| 6 | Metal .. .. .. .. .. .. | | 5 | 3 | 0 |
| 7 | Post with water .. .. .. | | 0 | 5 | 0 |
| 8 | Metal .. .. .. .. .. .. | | 0 | 5 | 0 |
| 9 | Coal .. .. .. .. .. .. | | 0 | 0 | 4 |
| 10 | Metal .. .. .. .. .. .. | | 0 | 2 | 6 |
| 11 | White post with water .. | | 0 | 3 | 0 |
| 12 | Metal .. .. .. .. .. .. | | 2 | 1 | 6 |
| 13 | Grey and brown post .. .. | | 2 | 3 | 0 |
| 14 | Metal .. .. .. .. .. .. | | 3 | 2 | 0 |
| 15 | Brown post .. .. .. .. | | 2 | 3 | 6 |
| 16 | Metal .. .. .. .. .. .. | | 3 | 5 | 0 |
| 17 | White post .. .. .. .. | | 0 | 4 | 0 |
| 18 | Metal .. .. .. .. .. .. | | 0 | 5 | 5 |
| | Carried forward .. | | 37 | 3 | 3 |

| No. | | Fms. | Ft. | In. |
|---|---|---|---|---|
| | Brought forward .. | 37 | 3 | 3 |
| 19 | White post .. .. .. .. .. | 0 | 1 | 3 |
| 20 | Metal .. .. .. .. .. .. | 1 | 3 | 6 |
| 21 | White post .. .. .. .. .. | 0 | 3 | 3 |
| 22 | Metal ironstone girdles .. | 2 | 5 | 0 |
| | | 42 | 4 | 3 |
| 23 | Ironstone .. .. .. .. .. | 2 | 1 | 3 |
| 24 | White post mixed with whin | 1 | 2 | 0 |
| 25 | Metal with ironstone girdles | 1 | 1 | 6 |
| 26 | Black metal mixed with ironstone .. .. .. .. .. .. | 0 | 4 | 0 |
| | | 48 | 1 | 0 |
| 27 | Ironstone .. .. .. .. .. | 5 | 2 | 0 |
| 28 | Inte. grey shale .. .. .. | 1 | 1 | 0 |
| | Total depth, fathoms .. | 54 | 4 | 0 |

*Account of the Boring, No. 3 Hole, Fig. 1090, or North Hole, on Rosedale Moor.*—1858.

| No. | | Fms. | Ft. | In. |
|---|---|---|---|---|
| 1 | Clay .. .. .. .. .. .. | 1 | 1 | 0 |
| 2 | Brown post .. .. .. .. .. | 11 | 5 | 0 |
| 3 | Grey metal .. .. .. .. .. | 4 | 1 | 0 |
| 4 | Brown post .. .. .. .. .. | 3 | 3 | 6 |
| 5 | Grey metal .. .. .. .. .. | 2 | 0 | 0 |
| 6 | Brown post .. .. .. .. .. | 2 | 1 | 0 |
| 7 | Grey metal .. .. .. .. .. | 2 | 5 | 0 |
| 8 | Brown or grey post .. .. | 3 | 0 | 0 |
| 9 | Grey metal ironstone girdles | 4 | 1 | 0 |
| 10 | Grey post .. .. .. .. .. | 0 | 4 | 6 |
| 11 | Grey metal .. .. .. .. .. | 2 | 5 | 6 |
| | | 38 | 3 | 6 |
| 12 | Ironstone, magnetic .. .. | 0 | 4 | 6 |
| 13 | White shale, mixed with ironstone .. .. .. .. .. | 1 | 1 | 0 |
| | Carried forward .. | 40 | 3 | 0 |

| No. | | Fms. | Ft. | In. |
|---|---|---|---|---|
| | Brought forward .. | 40 | 3 | 0 |
| 14 | Ironstone .. .. .. .. .. | 0 | 3 | 0 |
| 15 | Shale, mixed with ironstone | 0 | 5 | 9 |
| 16 | Gullity post .. .. .. .. | 0 | 0 | 9 |
| 17 | Ironstone, magnetic .. .. | 0 | 5 | 6 |
| 18 | Light-coloured ironstone .. | 0 | 3 | 0 |
| 19 | White post, mixed with whin | 1 | 1 | 0 |
| 20 | Ironstone, magnetic .. .. | 0 | 3 | 0 |
| 21 | Grey shale, mixed with ironstone and post girdles .. | 1 | 2 | 6 |
| 22 | Black metal.. .. .. .. .. | 0 | 2 | 6 |
| | | 47 | 0 | 0 |
| 23 | Ironstone, magnetic .. .. | 4 | 5 | 3 |
| 24 | Inte. shale .. .. .. .. .. | 0 | 4 | 0 |
| | Total depth, fathoms .. | 52 | 3 | 3 |

It will be seen, therefore, that for a distance of 580 yards from the pit, No. 1 on the section, Fig. 1089, to the boring No. 2 on the same section, the thickness of this bed of ironstone is nearly the same, and that this is the case likewise at the other two bore-holes, Nos. 1 and 3, at right angles to the above line of section, the respective thicknesses being as follows:—

| | Ft. | In. | | Ft. | In. |
|---|---|---|---|---|---|
| Drift .. .. .. .. | 32 | 0 | No. 2 bore-hole .. .. | 32 | 0 |
| No. 1 bore-hole .. .. | 32 | 0 | „ 3 „ .. .. | 29 | 3 |

These borings and sections show two distinct beds of ironstone, stratified with great regularity; and they prove most conclusively that neither of them is at all like what Bewick terms "nothing more than a volcanic dyke."

It will be seen by the map of the district, Fig. 1088, that a border is traced around the edge of the valley; this is undoubtedly the outcrop of what is called the "top seam" of ironstone, as it can be traced south and east into Eskdale, and towards Grosmont and Fryupdale; and also north towards Swainby and Boltby, in which localities Marley has given sections of the top seam, and also of the Cleveland main band. Supposing this outcrop in the Rosedale valley to be the top seam, then the upper bed in the sections, Figs. 1089, 1090, is unquestionably the top seam likewise; and we there have a bed of ironstone upwards of 30 ft. thick, lying parallel to and strictly conformable with the "top seam" (and separated therefrom only by a thin bed of shale), of an entirely different character from either such top seam or the main band of Cleveland.

I have (says *Wood*) laid down on plan, Fig. 1089, a section of the strata given by Marley, at Grosmont to the south-east, and at the Swainby mines to the north; and I have added the section at Eston Nab. It should be observed, also, in corroboration of the upper bed of ironstone, Fig. 1089, being the top seam, that a bed, or rather three or four beds, of ironstone intermixed with shale occur in the brook of Rosedale and crops out in the bank, which is generally believed to be the representative of the Cleveland main band, though the ironstone is very inferior, and not workable. I have laid down on the section, Fig. 1089, the position of this bed of ironstone, which agrees pretty well with its position in the other sections, making allowance for the variation in the thickness of the lias shale as found in the several localities.

I have (observed *Wood*) likewise, in Figs. 1088, 1089, shown the position of the quarry, which

appears to have slipped down below the level of the beds, as shown by the drift and borings. This appears to have been occasioned by a slip-dyke which crosses the drift near the pit, as shown on the plan, Fig. 1088. It will be seen by this plan that the drift passed through alluvial soil and shale up to near the pit, when this dyke was crossed and the ironstone cut, as shown on the plan, This dyke is supposed to run in the direction shown on the plan, crossing the drift near the pit, and throwing the strata down on the south-west side, and, consequently, the strata comprising the quarry; and it appears that the quarry itself is much broken, and has very much the appearance of a disjointed slip, the elliptical nodules being in a mass of confusion, as shown on the plan.

It has been supposed by some parties that this dyke has given the magnetic character to the ironstone; but it is well known that the character of the ore must be changed from a peroxide to a protoxide to become magnetic, which the crossing of the dyke through the strata could scarcely accomplish; and then we have the entire absence of shells in the lower bed, while the matrix of the upper bed or top seam is entirely calcareous and filled with shells. The concretionary nature of the stone, and the much greater percentage of iron produced by this deposit over that of either the top seam or the Cleveland main band, are also characteristic of this bed of ironstone; the analysis given by Marley of the Rosedale stone being upwards of 50 per cent. of metallic iron, while the top seam and main band are about 32 to 35 per cent.; and the produce of a large quantity smelted at Consett gave 55 per cent. from the calcined ore, and 45 per cent. from the raw stone.

Whatever opinion may, therefore, be formed of the cause of this deposit, we certainly have the fact that, for a width of 400 yds. and a length of 580 yds., we have a bed of ironstone highly magnetic, of an almost entirely uniform thickness, totally different in its mineralogical character from the ordinary stone of the district, and yielding in produce nearly 20 per cent. more iron in the furnace. To what extent this bed may exist beyond the extent already proved will be the subject of further investigation; but it will be a very extraordinary anomaly in geology if a bed of such uniform thickness should not extend to considerable distances. It has been stated that a similar bed has been discovered in other and distant localities; not being myself cognizant of the facts, and my information not being very precise, I abstain (says *Wood*) from giving such information at present. The importance of such discoveries are of too great interest in the district, and too valuable in a commercial point of view, to remain long unexplored, and therefore we may hope that at some future period the Institute will be favoured with an account of such deposits.

The President's paper on the Rosedale Ironstone having been read, a discussion thereon was taken.

*Bewick* said the magnetic ore in the quarry was a casual deposit in the shape of a dyke or vein.

*Marley.*—I understand, since I was at Rosedale Abbey, that which the President stated to be the top seam had been discovered in a regular stratified state on the south side of the magnetic quarry. At the last discussion we had on the subject, I admitted if that bed of ironstone had been discovered keeping on its uniform rise and dip, from the north side of the quarry to the south, I had been mistaken in supposing the magnetic seam to be the same as that of the seam then discovered on the north side of the quarry. Then, as to whether it was a vein or a bed, or whether, what I supposed at the last meeting, it was an overflowing between soft strata, similar to "flats" in lead veins, I had not an opportunity of forming an opinion, for want of the *three bore-holes*, which have now been given.

The *President.*—What you stated was quite correct. The top seam had not then been found on the south side of the quarry. It is now found on the south side as well as the north side; but I do not think we have yet discovered the magnetic stone on the south side of the quarry, except in the drifting and borings.

*Marley.*—When I made my examination, preparatory to reading my paper, the top seam at the point *A* on Fig. 1087, therein referred to, was lost, and no continuation was found south of the magnetic quarry; but, by competent witnesses, I have been informed it is now found south of the said magnetic quarry. But, if the magnetic stone is a bed, it is extraordinary so large an extent of country should give no trace of it, as at Grosmont and other places we have not the slightest trace of it. At Ingleby they are putting three bore-holes down, with a view of proving the existence or otherwise of the magnetic ironstone there. They are now, I believe, past the top-seam position, but have got nothing but shale yet. These borings will prove about 100 fathoms of strata. I have hitherto been of opinion that the round particles, in the specimens of magnetic ore, are oolitic shells.

The *President, N. Wood.*—No. I believe they are iron, with a siliceous matrix.

*Marley.*—Has one of those globules ever been analyzed by itself, and found to be pure iron?

*Wood.*—I do not know; but I believe there is no calcareous matter in those particles which there would be if it were shells.

*Marley.*—Unless it is some peculiar formation.

*Wood.*—Then the shell is gone, and the iron left.

*Boyd.*—The chemical part of the shell remains in the Cleveland stone.

*Marley.*—The magnetic stone is not in analogy with the Cleveland.

*Wood.*—It has changed its character from a peroxide to a protoxide.

*Marley.*—I acknowledge the magnetic stone is free from "pectens."

*Bewick.*—After hearing what has been stated by our President, I am bound to say our opinions are as much opposed as ever; and I shall endeavour to show you that the ironstone beds they have BORED THROUGH at Rosedale Abbey are not the same as the magnetic ore and top bed found by the side of the valley, that, in fact, the borings have not reached those deposits by several feet, and that, therefore, *they have not as yet proved anything more respecting them.* The strata they have bored through are quite above them, and you will find on looking at the table of the borings,

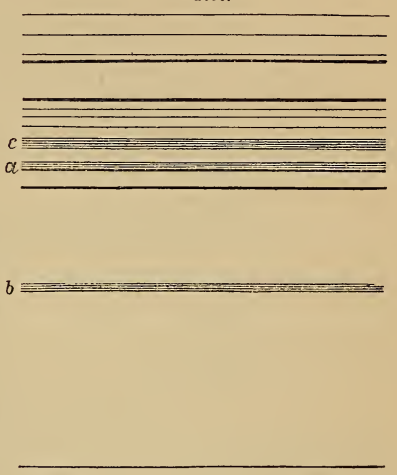
published with the July discussion, that an important member of the series, which immediately overlies the top bed, is wanting. I allude to the great sandstone rock, which is seldom under 50, and sometimes met with 100 ft. thick. This rock does not appear in the borings at all.

*Wood.*—Yes, it does, namely:—

| | | Fms. | Ft. | In. | |
|---|---|---|---|---|---|
| Brown freestone .. | No. 1 bore-hole .. .. | 12 | 5 | 6 | with other beds of post, mixed with shale. |
| Brown and grey post | „ 2 „ .. .. | 12 | 1 | 0 | |
| Brown post .. .. | „ 3 „ .. .. | 11 | 5 | 0 | |

*Bewick.*—That is not the sandstone I allude to. That rock is found higher in the series, and belongs to the coal measures, which your *bore-holes* have gone through; but, as I have just said, they have not yet reached the other sandstone, and cannot, therefore, have touched the top bed. In this section, Fig. 1096, you have, in my opinion, a type of the ironstone you have gone through in your borings. The seams here are thin and divided, and the shale between them is interspersed with iron nodules; and, as you admit the seams are split in the last *bore-hole*, it but serves to confirm my opinion that they are one and the same. They occupy the same geological position in the series—that is, they intervene the great sandstone rock and the coal measures in the oolitic series.

1096.

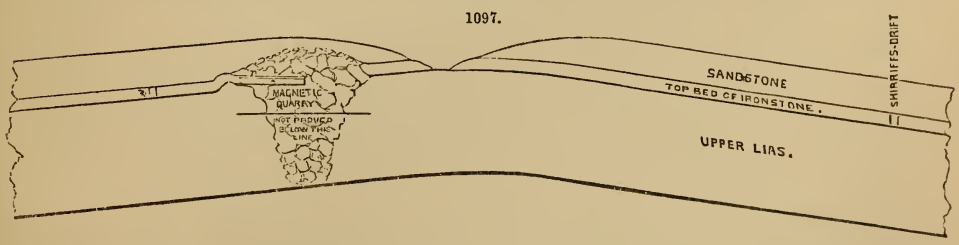



*Reference:*—1, 2, 3, Sandstone, shale, and coal. 4, Sandstone. 5, Upper lias. *a*, *b*, *c*, Ironstone.

*Wood.*—Do you purpose giving the sections for publication?

*Bewick.*—Yes; I intend leaving the whole of the sections with you for that purpose. The thickness of every stratum, in the diagram representing a cross-section of the vale of Rosedale, is taken from the table of the borings before referred to, in which I may here observe there is an error of 3 fathoms 2 ft. The total ought to be 48 fathoms 2 ft. instead of 51 fathoms 4 ft.; and if you take from this 1 fathom 1 ft. for the grey shale they have left off in, below the ironstone, it leaves 47 fathoms 1 ft. from the top of the bore-hole to the bottom of the ironstone. I am thus particular because I have taken a line of levels, commencing at the south drift, by the side of the hill, and terminating at the *south bore-hole;* and I find there is a difference in the height of the level, and the depth of No. 2 *bore-hole*, Fig. 1090, of 64 ft., fully corroborating what I have before stated, namely,—That the *bore-holes* have not yet reached the sandstone which overlies the top bed; and if you will allow me to explain my sections, I think they will prove to you that the ironstone they have cut through belongs to that which we call the oolitic beds, and which are found in different localities in the Grosmont district, not so thick, it is true, neither are they magnetic; but they are found, as I before stated, occupying the same geological position, and accompanied by the same description of strata. Section, Fig. 1096, is taken between Goathland Mill and Beckhole, near Grosmont, which, you will observe, contains the same alternating strata of sandstone, shale, coal, and ironstone, as you see in section, Fig. 1087, which is a transverse section of the vale of Rosedale, representing the strata they have bored through there. The ironstone beds *a* and *c*, in section, Fig. 1096, are, in my opinion, the same as those marked *a* and *c* in section, Fig. 1087. The bed *c* is very irregularly diffused throughout this portion of the oolitic district. It is found in the nodular form. In some places you find it of considerable thickness, and then, again, entirely wanting. Sometimes of good quality, but more frequently coarse and inferior, and gradually alternating with the sandstones. The bed *a* is more regular, but thinner, and of very good quality; its upper portion consists of a nodular bed averaging from 3 to 6 in.; and the lower portion a bed averaging from 12 to 18 in. in thickness. Wherever I have met with those beds, however, I have always found them so variable, both in extent and thickness,

1097.




as to afford no reasonable prospect of their paying for working. They may certainly be found different at Rosedale; but I would just observe that I consider *boring a most fallacious mode of proving ironstone deposits in strata* such as that which these borings have gone through, you are so liable to mistake a nodule for a bed, or a portion of a bed. I shall be much surprised if you do

not find the section of your shaft, should you sink one, very different from the section of your *bore-hole.*

*Wood.*—Then it is a question of policy, in Bewick's view of the case, commercially considered, whether the borings should not be continued. With regard to the identity of the position in the series of the bed of ironstone ranging around the Rosedale valley, as shown in Fig. 1097, and also in Fig. 1087, it appears to be undoubtedly the top bed of Cleveland. All parties admit this. Then the question is, Is the bed of ironstone proved at the pit No. 1, Fig. 1089, and the bed corresponding therewith and proved in the bore-holes Nos. 1, 2, and 3, and therein designated by me as the top seam, the same bed of ironstone? Bewick thinks not, and that the borings have not yet reached this bed. I can, of course, only refer to the borings, driftings, and the section of pit No. 1, and I must add that there appears to me no doubt whatever on the subject; and the fact that, according to Bewick's plan, Fig. 1097, we have the top bed on both sides of the magnetic quarry, ranging as accurately as can be conceived with this bed in the borings, confirms this supposition, in my opinion. It is true that this bed is at a lower level at the south or left-hand drift than on the north side, but this is clearly the effect of the dyke shown in Fig. 1087, which throws down the strata in that direction. With regard to the supposed want of what Bewick calls the thick sandstone strata immediately above the top bed of ironstone, and shown on the section, Fig. 1096, to be 100 ft. thick, I have looked carefully over the sections given in Marley's paper, and I do not find in any one of them, except at Eston Nab, the extreme northern point of the district, any bed of sandstone approaching to that thickness, and there the section given is

| | Ft. | In. |
|---|---|---|
| Freestone .. .. .. .. .. .. .. .. .. .. .. | 60 | 0 |
| Shivery post, patches of jet, and fire-clay .. .. .. | 54 | 0 |
| Top seam, exclusive of shale bands .. .. .. | 1 | 3 |

At Rosedale Cliffs, between Staiths and Runswick Bay, we have

| | | |
|---|---|---|
| Freestone .. .. .. .. .. .. .. .. .. .. .. | 26 | 0 |
| Fire-clay .. .. .. .. .. .. .. .. .. .. .. | 4 | 6 |
| Freestone shale .. .. .. .. .. .. .. .. .. .. | 5 | 5 |
| Blue shale .. .. .. .. .. .. .. .. .. .. .. | 0 | 10 |
| Top seam, exclusive of shale bands .. .. .. | 4 | 7 |

Still farther south, the sandstone at Wreck Hill is only 10 ft., with 2 ft. 6 in. of shale covering the top seam; and at Grosmont, Marley gives 25 ft. of sandstone, and another section at 58 ft. 6 in., which he says varies in thickness and quality. At Fryupdale, the thickness of sandstone is given at 55 ft., and at another place, namely, Swainby, the following is the section:—

| | Ft. | In. | Ft. | In. | |
|---|---|---|---|---|---|
| Soil, &c. .. .. .. .. .. .. .. .. .. .. | | | 3 | 0 | |
| Freestone .. .. .. .. .. .. .. .. .. .. | | | 24 | 0 | Near the limekiln this is 100, with 9-inch ironstone balls in it. |
| Slaty coal .. .. .. .. .. .. .. .. | 0 | 9 | | | |
| Shale .. .. .. .. .. .. .. .. .. | 1 | 0 | | | |
| Sandstone .. .. .. .. .. .. .. .. | 4 | 0 | | | |
| Slaty coal .. .. .. .. .. .. .. .. | 0 | 9 | | | |
| | 6 | 6 | | | |
| Shale .. .. .. .. .. .. .. .. .. | 5 | 0 | | | |
| Coarse freestone .. .. .. .. .. .. .. | 3 | 6 | | | |
| Shale, with occasional nodules of ironstone | 13 | 0 | | | |
| Top seam .. .. .. .. .. .. .. .. | | | 28 | 0 | |

Considering, therefore, that in the borings there is about 60 ft. of sandstone, there does not appear to me any substantial difference between the shale in those borings and in the other parts of the district to justify the supposition that the upper bed of ironstone is not the top seam. Bewick thinks the bore-holes have not reached the sandstone he describes. If so, he should like to ask Bewick what seam of ironstone that is in the district which has been bored to?

*Bewick.*—It is, in my opinion, as I have previously stated, the ironstone found in the oolitic series.

*Wood.*—Where does it occur in the other districts? Where do you find another similar deposit in Mr. Marley's sections?

*Marley.*—Dr. Verity gives a variety of ironstone seams. If you refer to my paper, you will find there are several ironstone seams lying over the seam, which we agree to be the top seam of Cleveland. Professor Phillips said that, with the exception of the classification of names, this section was practically correct.

*Wood.*—Do you think the ironstone which crops out all around the valley of Rosedale is the top seam?

*Bewick.*—I think so; I have no doubt about it.

*Wood.*—If we are agreed about the deposit of ironstone found cropping out around the valley of Rosedale, as shown in the different plans, then there can be no difficulty in tracing the sandstone overlying that bed to the sandstone first of all sunk through at the pit, Fig. 1089, and thence to the borings Nos. 1, 2, and 3; and these borings having passed through the upper bed of ironstone, below such sandstone, and then through the magnetic bed, there cannot be the least doubt of the geological position of these beds. With reference to the levels, there is no discrepancy whatever

in that respect; there is a rise in beds in the line of the drift, and in the extension of that line to the borings, and the direction of the line between the borings seems to be nearly water-level at that part. There is not, therefore, the least discrepancy on this point. I have taken the Ordnance maps as my guide as regards the levels, and have no doubt they are correct. Whatever opinion may, therefore, be arrived at with respect to the comparison of the beds proved in the borings and in the pit, with the beds at Grosmont, &c., there appears no doubt in my mind that the mass of ironstone of the quarry is a detached portion of the thick or lower bed of ironstone, and that such bed exists *in situ* for a considerable, and, of course, at present, for an unknown extent in the locality of Rosedale.

*Bewick.*—If our President means by pit Fig. 1089 the air-shaft sunk on the main drift, I quite agree with him that the sandstone found in that shaft is the same as that which overlies the top seam; but, I beg to say, I entirely differ from him in supposing it to be the same as that they have gone through in the borings. I am also opposed to his opinion with reference to the direction of the dip and rise of the strata. There can be no doubt, I think, but the strata on the west side of Rosedale, *and to the south of the crown*—that is, the point from whence the strata dip in contrary directions—are dipping in a south-westerly direction, as shown in my section, Fig. 1097, and still more clearly proved by the drift commenced on the south side of the magnetic dyke, and driven in a line with the south bore-hole, running nearly west, but which has been discontinued, owing to the top seam, in which the drift was commenced, dipping so much in that direction, instead of rising, as our President supposes, as, at the distance of not many yards, to be completely under water-level. With reference to the slip-dyke or fault mentioned by that gentleman, I can only state that I have never yet been able to discover any dislocation or disturbance of the strata, other than what has been occasioned by the dyke of magnetic ore in its immediate vicinity. Then, as to the extent of the magnetic ore, all I can say is, I have paid several visits to Rosedale solely for the purpose of examining the strata in that neighbourhood, the many deep ravines which abound there affording ample opportunity for doing so, but I have never been able to trace the magnetic ore beyond the vicinity of the quarry, and every visit only serves to convince me that it is a casual deposit, in the shape of a dyke or vein. A bed, however, of 560 yds. in length, and from 30 to 32 ft. thick, cannot be identified with a casual deposit; nevertheless, I think, very probably there may be a mistake in supposing you have a solid mass of ironstone 32 ft. thick. This may have occurred from the borers having cut through nodules or irregular patches of ironstone, and also from the shale in which it is found being very hard, and of the same colour as the ironstone. From these circumstances it is an easy matter to be misled by borings.

*Wood.*—Whatever may have been the result of investigations on the surface, I do not think I can add any further information to that already given and shown on the plans, to prove that a thick bed of ironstone of about 32 ft. exists over a space of upwards of 560 yds. in length, and 200 yds. in width, with not the least indication of any change or termination of such deposit. It would, indeed, be a most extraordinary occurrence in the annals of boring, to suppose that occasional nodules, or irregular patches of ironstone, should have produced the result recorded in these borings. The boring through the ironstone beds was performed under the immediate inspection of *Stott*, a well-known experienced borer, who kept the specimens brought up the bore-hole; and I can add, that I examined a great many of the specimens myself with a magnet, and found them magnetic. There is not the least pretence for supposing that shale could be mistaken for ironstone. Have you seen any nodular magnetic ironstone in the Grosmont district?

*Bewick.*—Never. You must remember (addressing the President) that you stated at the October discussion in 1857, that Professor Phillips and yourself had discovered the magnetic ore in "two localities two miles apart," namely, at Sheriffs drift and at the Quarry; and, again, in the July discussion of last year, you stated the stone in the drift south of the dyke was magnetic, but on examining it I found this not to be the case as regards both the drifts. I believe the reason why there are so many conflicting opinions with reference to the nature and extent of the magnetic ore is owing to the difficulty there is in distinguishing the ore from the top bed—that is, in separating the igneous portions from the sedimentary; for, although they are both frequently magnetic in the immediate vicinity of the dyke, there is yet a vast difference between them. The igneous portion is harder, heavier, and more compact than the sedimentary; and the former appears to have acted upon the latter whilst in a heated condition, much in the same way as a magnet acts upon a piece of common iron, imparting to it a portion of its peculiar magnetic properties. I may here be permitted to add, that whilst I believe this ore to have been subject to a heat sufficient to evolve the different gases it contained, I yet do not think the heat has been of that intensity so as *entirely* to expel them. We need not, therefore, be surprised at *traces* of carbonic acid being found in the chemical analysis of this ore. Here is a specimen of the igneous portion, which I took from the bottom of the quarry, and, after examining it, no one can doubt, I think, of its having been subjected to heat.

*Wood.*—There is no doubt, as stated by Mr. Bewick, that portions of the top bed in Rosedale are occasionally magnetic, and it was this property which led to the mistake, if there are mistakes, in supposing the magnetic bed to have been discovered at Sheriffs drift, and at the drift south of the magnetic quarry. The explorations at that time had not been sufficiently extended, nor have they yet been prosecuted to such an extent as to ascertain if the magnetic bed exists in those localities. Finding part of the ironstone partaking of magnetic influence led to a supposition that this bed did exist in those localities, and the subsequent explorations have not been prosecuted to an extent to ascertain the fact either one way or the other. To *Bewick.*—From what part of the quarry did you take this specimen?

*Bewick.*—It is from the floor of the quarry. This (showing another specimen) is a sample of the top bed which appears to have been partially burnt, and you will at once be able to detect the difference between them. These (showing other specimens) are samples of the ironstone found in the oolitic rocks, in the neighbourhood of Grosmont, some of the nodules of which are amongst

the richest of the clay or calcareous ironstones. I omitted to state that, with the exception of the first 60 ft., where the ground was so steep that I could not fix my instrument, and from which there may be some slight inaccuracies, I took my levels with a good and safe instrument, and the operation was performed in the ordinary way of back and fore sights. I find the difference between my levels and what I suppose the correct position of the top bed of ironstone, and that shown by the bore-holes, to be 64 ft.

*Wood.*—The question of the difference of the levels rests entirely upon the assumed inclination of the beds; a difference of level of 64 ft. in a distance of 400 yds., accords, in my opinion, with what may be supposed to be the regular inclination of the beds.

*Bewick.*—Yes; but in your section you connect two sandstones which have nothing to do with each other, namely, the sandstone found in the air-shaft immediately overlying the top bed, and the sandstone found in the bore-hole, between which there are several feet of *alternating strata;* and to do which you must of necessity raise your level line, and show the strata to be rising in that direction; but the drift you have driven some distance into the side of the hill, and at the same point as my line of levels, shows the strata to be *dipping in that direction.* I may mention, too, that had another bed of 32 ft. thick really been met with in the bore-hole, it must have been found along the sides of the valley, which are intersected in so many places with mountain streams, all of which have been searched by persons having a fair knowledge of the geology of the immediate neighbourhood, but without the least trace of it having been met with.

*Wood.*—I cannot think that there is the least doubt that the sandstone in the pit, No. 1, Fig. 1089, is the same sandstone as that proved in the borings; all the appearances on the surface, as well as the general rise and dip of the strata, prove this. Extending the line of section across the valley, it is clear there is a general rise of strata along the line of section. No doubt the strata in the drift dip towards the west, but that is no doubt influenced by the slip-dyke which crosses it. I would observe that, taking the line of section along the face of the valley in Fig. 1087, in the direction of the dotted line *a b*, and applying the inclination of the top bed of ironstone, shown Fig. 1097, to that line, and not to the curved or projecting line along the face of the hill, the position of the bed would be rising from *a* towards *b*, and it would require a slip-dyke, shown Fig. 1087, to throw the bed into its proper position along the face of the valley to the west of the magnetic quarry. On examining Fig. 1087 it will be seen that the magnetic quarry and the top bed of ironstone, as shown in Fig. 1097, project considerably to the east of the general line of the side of the valley, which, being towards the dip of the strata, shows the top bed at a lower level than if the section had been continued in a more direct line, or in the direction *a b*. Whatever conclusion, therefore, may be arrived at after all the explanations given, we have the fact of an almost horizontal bed of ironstone, and of nearly a uniform thickness, distinct in character from the ordinary beds of the district, extending over a length of 568 yds. and a width of 200 yds., which clearly proves that it is not a vein. How much greater distance it extends, must be left to future explorations to prove; but it would certainly be an extraordinary anomaly in geology for such a thickness of strata to disappear altogether in a short distance. If it extends across the valley, as shown in *Bewick's* plan, Fig. 1096, then there is no reason to suppose that it may not extend to the same distance to the north; and if, according to Bewick, the borings have not yet reached to the top bed of ironstone, then the deposit of ironstone, in the valley of Rosedale, is richer in ore than either Professor Phillips or myself has set forth. The correct extent must, however, be left to future explorers to discover. Enough has been proved to show a most extraordinary deposit of a very peculiar and rich ironstone, and well worth further investigation.

*Bewick.*—There is a section of the cross drift, shown in Fig. 1089, driven at right angles from the main drift to prove the breadth of the dyke, and which, at the distance of 16 yds., cuts the shale, and apparently touches the top seam at the same time. At the distance of 6 yds. the stone in this drift ceases to be magnetic. It is, therefore, incomprehensible to me how it can again become so at the distance of 200 yds. from this point. Of course, you have a right to infer from the information that reached you that such is the case. Still I would strongly recommend that the borings should be continued to prove whether the sandstone be below you or not, to ascertain which could not fail to give great satisfaction to all concerned; the cost would not be great, as the bottom of your borings must be near the top of that rock.

*Wood.*—The cross drift was not sufficiently extended to the west to prove the dyke, but, as there was a considerable rise of the strata in that direction, no doubt such an inclination has been occasioned by the proximity of the dyke, shown on the plans, Figs. 1087, 1088. All the facts show that the slip-dyke has been a dislocation subsequent to the formation and consolidation of the various beds affected by it; and consequently such dyke could not, we can scarcely conceive, have any influence on the character of the ironstone bed itself, especially as it is not contended, I believe, that such dykes are either of a basaltic or mineral character, there being no appearance, in my judgment, to justify such a conclusion.