James Keir and the Geology and Industry of the Black Country: Mineralogy of the South-west part of Staffordshire, 1798

Image: The Wren's Nest from The Black Country - Sixteen Etchings of Scenes in the Coal and Iron District of South Staffordshire by Richard S Chattock

Text: Malcolm Dick

In 1845 most of the papers of James Keir (1735-1820) were destroyed in a house fire. Less is known about him compared to other Lunar men and there is still no major biography of him. Keir was, nevertheless, an important inventor and industrialist, making contributions to an understanding of gases, glass production, the manufacture of chemicals, metallurgy and coal mining.

Keir was interested in geology, a trait he shared with other Lunar figures - John Whitehurst, Matthew Boulton, Erasmus Darwin, William Withering and Josiah Wedgwood. They explored caves, collected fossils, investigated strata and speculated about the origins of minerals and the creation of the earth. Most of Keir’s adult life was spent in the Black Country where he acquired an intimate knowledge of its geography and geological landscape. In 1798 he wrote in the form of a letter to Stebbing Shaw, an account of the region entitled “Mineralogy of the South-west part of Staffordshire”. Shaw published it in his *History of Staffordshire* of 1798 and the text is reproduced here. Keir’s detailed and carefully observed account produced for the Black Country what Whitehurst had created for Derbyshire twenty years beforehand in 1778. Unlike Whitehurst’s An Inquiry into the Original State and Formation of the Earth, Keir did not provide the stratigraphical diagrams which made the earlier publication so original.

Keir outlined his intentions at the beginning by showing the connections between the geology of the area, local industry and wealth. The “valuable mines of coal, iron-stone, lime-stone, and clay” contributed to “the various and extensive trades” of South-west Staffordshire, “the foundation and prosperity” of towns such as Birmingham, Dudley, Wednesbury, Walsall, Bilston, Wolverhampton and Stourbridge and “the comfort and benefit of fuel” in nearby counties.

He described the “remarkable thickness” of the Black Country ten-yard seam of coal which stretched for seven miles with an average breadth of four miles. Keir also focused on the advantages of the iron ore, limestone and clay deposits which led to the building of furnaces, forges and foundries and the manufacture of guns, locks, screws and nails. Iron ore was the essential raw material, but limestone acted as a flux for blast furnaces, combining with impurities and speeding up the smelting process. Clay was turned into firebricks and moulds for metal products. He noted that the growth of canals stimulated demand outside the area and enabled markets to be reached.

Keir’s exploration of the geology of the area was substantially based on his own coal mine at Tividale, in the parish of Rowley Regis. He classified different types of coal, depicted methods of mining, located the extent of limestone deposits and described the ragstone channeled from the Rowley Hills. Towards the end of his article he considered explanations for the formation of coal deposits and the creation of local strata through volcanic action. Like Whitehurst, Keir contributed to the emergence of geology as a scientific subject.

Mineralogy of the South-west part of Staffordshire, by James Keir, esq. F.R.S.

SIR,

IN compliance with your request, I will give you some account of the mineralogy of this Southern part of Staffordshire, and especially of those valuable mines of coal, iron-stone, lime-stone, and clay, to which not only the various and extensive trades and manufactures of this part of the country, and of those of the neighbouring towns, Birmingham, Dudley, Wednesbury, Walsall, Bilstone, Wolverhampton, and Stourbridge, owe their foundation and prosperity, but also the surrounding countries are, by means of the lately extended canals, indebted for the comfort and benefit of fuel. In drawing up this account (which the shortness of the time that your publication can allow prevents from being so accurate as I could wish) I shall endeavour to adapt it to the nature of your work, by confining myself to the great outlines and general principles of the subject, without descending to the minute descriptions of the mineralogist, or the technical distinctions of the miner.

The tract of country to which I wish to engage your principal attention is that which is distinguished by a bed of coal of remarkable thickness, generally ten yards, having been found at such depths as are within the reach of human industry and practical advantage. This tract extends from Bilstone, South-wards, to Bretiel-lane, Amblecott, and the Lye in the neighbourhood of Stourbridge, that is, about seven miles in length, and of various breadth, perhaps on an average about four miles. Thus, upon a very gross computation, this country may be estimated to contain about twenty-eight square miles; of which, however, a considerable part is covered by town ranges of mountains called the Dudley and Rowley hills, which pass through the middle of it, and prevent so much space as they occupy from possessing the benefit of coal-mines. This tract of land (through which the Birmingham canal, with its several branches, also the Netherton canal, and the Stourbridge and Dudley canal, pass, and give communication to the several collieries and other works,) comprehends the towns of Bilstone, Darlaston, Wednesbury, Dudley, Rowley, and Oldbury, together with the parishes of these towns, and those of Tipton, Sedgely, Gornal, and Netherton, with a little of the North-west part of the parish of West Bromwich, and also the several collieries about Dudley wood, Brettel-lane, Amblecott, and the Lye.

The abundance of coal, iron-stone, lime-stone, and clay, together with the intercourse opened by means of canals to distant parts of the kingdom, and particularly to the sea-ports of Bristol, Liverpool, and Hull, have, besides promoting the trade of the above-mentioned towns, induced the establishment of iron-furnaces, forges, and foundaries, and other extensive manufactories. The same advantages of coal and carriage give employment to a multitude of smiths and workmen, in forging iron into various goods, as guns, lock, screws, and above all, into nails. Of nails, the quantity manufactured in this district is perhaps greater than in any other equal part of the world; and, as this manufacture requires a very simple apparatus of a small heath, bellows, anvil, and hammer, it is executed at the workman’s own house, to each of which houses a small nailing shop is annexed, where the man with his wife and children can work without going from home: and thus an existence is given to an uncommon multitude of small houses and cottages, scattered all over the country, and to a great degree of population, independently of towns.

Such is the general description of the tract of country of the mineralogy of which I mean to give you some account. But it may be proper previously to observe, that, though I have confined myself within the limits of the bed of coal of ten yards in thickness, there are nevertheless other thinner beds of coal, of eight, six, and four feet in thickness, which extend themselves Northwards over a space at least as large as that which I have described. These thin beds commence at the distance of a few miles from the Northern termination of the ten-yard bed of coat, which ceases and crops out, as the miners say, that is rises abruptly to the surface of the ground, and appears no further in that direction. This cropping out of the thick coal is at Bilstone, Wednesbury, and Darlaston: and at a few miles to the North of these towns, the thin beds of coal begin to be found, and extend along the banks of the Wyrley and Essington canal, the neighbourhood of Walsal, Hayhead quarries, and of Lichfield, and in various parts of Cank wood. I shall hereafter give my reasons for believing that these thin strata rise from under the ten-yard coal.

To return then to the district which it is proposed to describe. In order to obtain a distinct idea of the mineralogy of this country, it will be proper to point out previously certain prominent features on the surface of the ground. Of these, the first that we ought to attend to is that range of lime-stone mountains which begin to rise on the Northern part of this tract of land near Wolverhampton and Bilstone, and extend themselves in a Southern direction to the town of Dudley, which is situated on the slope of the last of this chain of mountains, namely, on that which is rendered conspicuous by the fine ruin of a large antient castle belonging to viscount Dudley and Ward, and commanding by its bold projecting situation a widely-extended view.

The second great remarkable feature of this country is another range of mountains which begin to rise from the side of Dudley opposite to the lime-stone hill, and proceed nearly in the same direction, but a little more turned towards the East. This might be considered as a continuation of the former range, if their very different aspect, and the different nature of the Basaltic rock, of which they are composed, did not produce a striking distinction. This range of mountains proceeds from Dudley through Rowley, whence they are called Rowley hills, and, dividing into two branches, terminates in a valley between Old-bury and Hales-Owen.

Besides these two ranges of mountains, there are two detached hills, which, because they have an influence on the inclination or position of the coal, deserve notice. These are the hills on which Wednesbury church stands, and that which is near the village of Netherton.

It is an important fact, the knowledge of which tends greatly to the understanding of the inclination of the coal and other strata, that generally this inclination corresponds with that of the nearest lime-stone hill; that is, these strata rise in the same direction, though not in the same degree, as the hill or be of lime-stone rises. Now the range of mountains from Dudley towards Wolverhampton is formed of rocks or beds of lime-stone elevated to a high pitch on each side, and inclining so to each other, that by their approach they form an oblong ridge near their tops, not unlike the roof of a house. In the same manner the coal and its accompanying strata, lying to the East and West of these mountains, rise or crop up on both sides in directions corresponding with those of the neighbouring lime-stone elevation; so that, generally, the nearer a pit is sunk to a lime-stone hill, the coal is found at a less depth. I say generally, for, besides the irregularity of the surface of the ground from the greater or less thickness of the measures superincumbent on the coal, and which do not shew the same uniformity and correspondence as the coal and its adjacent strata, I shall afterwards shew that the coal itself is subject to very singular irregularities of position and inclination.

This general correspondence of the inclination of the coal with that of the lime-rocks is further confirmed by the two following circumstances:

1. The West side of the range of lime-stone hills is steeper than the East side; and , accordingly, the coal on the West side dips also more rapidly, and is sooner out of the reach of miners than the coal on the East side; which latter side, therefore, furnishes the principal collieries.

2. The lime-stone hill, that is at the Northern extremity of the range, does not appear to be elevated on both sides in the manner in which have described the general formation of those hills; but on the East side only. And, accordingly, the coal also is found on that side only; as if the elevation of the rock on the Western side had not been sufficiently great to make it appear above ground, or to raise the coal to such a height as to bring it within the reach of miners.

I have mentioned that the bed of coal does not extend over the lime-stone hills; but it seems to have broken off near their base; and it skirts their Eastern and Western sides, in some places its termination appearing above ground, but generally covered with earth. As this termination is not by gradual diminution, but abrupt and at once, like a fracture, we cannot from this circumstance, and from the corresponding inclination of the coal and lime-stone strata, avoid inferring, that the same convulsion which broke through and raised the strata of lime-stone into the form of mountains, must have also broken and raised the superincumbent strata, of which coal is one; and that these strata, being softer than the rock, were thrown off, or, having been shattered, have long since been washed away by the flood; so that now no vestige remains of the convulsion upon these hills but the solid ribs of lime-stone which form the mountains, and which have been able to resist the action of air and water.

Upon a first view of the subject, it may perhaps surprise that I have mentioned the coal as being superincumbent on the stratum of limestone; whereas the high mountains are formed from this stratum, and the coal is only found at greater or less depths in the lower grounds. But whoever would form just notions of the strata of any varied country must keep in mind that valuable observation of Mr. Mitchell, in his paper upon Earthquakes, Philosophical Transaction for the Year 1760; namely that those mountains which have been formed by the disruption and elevation of their component rock, as all mountains composed of lime-stone strata are, (which disruption and elevation he attributes to some violent explosion or earthquake) do actually consist of those strata which in the plains are covered with many other incumbent strata, and consequently are originally the lowest of all that we know. As I have not an opportunity of illustrating this observation by a section of the strata, I will endeavour to exemplify it, and to shew how the strata, originally inferior, are now in some parts so elevated as to form mountains, in the following manner: take half a dozen or a dozen common cards, and place them lengthwise on the rise of an inclined plane so that the upper cards shall slide by their gravity, or be drawn downwards a little over the lower cards; thus the card originally lowest will now be the highest upon the plane, and its upper end will represent that part of the stratum of lime-stone which forms the mountains, whilst its lower end will appear to immerge under the other cards towards the lower part of the inclined plan representing the valley. The next highest cards upon the plane will represent the strata of earth and iron-stone intervening between the lime-stone and coal. The succeeding card will represent the coal itself; and the remaining cards will represent the several beds of earth and rock that lye between the coal and the surface of the ground.

In the same manner as the coal rises, or crops, up to the sides of the great range of lime-stone mountains, so it also follows the direction of the detached hill above mentioned; namely, that on which the church at Wednesbury stands, and that near the village of Netherton. In some intermediate place between the lime-stone range and Wednesbury, on the East side, and between that range and Netherton hill, on the West side, the coal lies nearly level, and from thence rises on both sides towards the respective hills. This position of the coals is called by the colliers a Trough. It is proper to observe, that though the coal follows the direction of all the known lime-stone hills, and of the two detached hills above mentioned (which I suspect are lime-stone elevations*), it must not be supposed that the coal follows the direction of inclination of the surface of the ground in general, the ordinary risings of fallings of which it seems to have no correspondence with. How the coal is affected with relation to the range of the Rowley or Basaltic hills, has not been fully ascertained, excepting that it certainly does not crop out along the skirts of these hills, as it does along the lime-stone range; whence the colliers have formed their opinion that it passes under and through these hills. It is certainly to be found at the foot of them on both sides, at moderate depths, and does not there crop out. Therefore we may suppose that it passes a certain way further under them; but whether it completely passes through from side to side without interruption is a question that cannot be with certainty ascertained, but which I shall consider more fully, after I have related the facts that are known respecting the coal and other strata.

OF THE STRATA OR MEASURES BETWEEN THE SURFACE OF THE GROUND AND THE COAL.

Having given a general survey of the coal country, I shall now proceed to a more detailed account of the strata and substances under ground, their relative situation, their irregularities of position, fractures or fissures, and whatever circumstances may seem to deserve most notice in a mineralogical or commercial view.

The number and thickness of the measures above the coal are so various and different in different places, that they scarcely deserve to be considered a regular strata, and have nothing of that uniformity which the beds of coal have, which are similar, at least in a very considerable degree, in thickness, quality, and

* I suspect, from this correspondence of inclination of the coal and of Wednesbury and Netherton hills, that these hills are lime-stone elevations, although this stone does not appear on the surface relative position, over the whole

extent of the country. The irregularity in the thickness and number of the measures above the coal, occasions a great difference in the depth of the pits in different places. In some places the coal has been got at the surface of the ground in open quarries, and in other fields the pits are 140 yards deep. The strata containing iron ore (called iron-stone), and those which consist of a finer kind of clay, called fire-clay, pipe-clay, and pot-clay, from its power of resisting heat, and its fitness for making tobacco pipes and glass-house pots, are the next in order with regard to uniformity of thickness and position. As to the other intervening masses of rock, bind, clunch, and especially those upper earths which consist of red and yellow particles, they vary so much and so irregularly, that they frequently differ not only in the same field, but even at the distance of a few yards, and therefore no general account can be given of their order, number, or thickness. The kinds, however, of the measures are generally the same throughout the coal country, and of these a notion may be formed from the following list of measures found in digging a coal-pit in Tividale colliery, in the parish of Rowley, in 1797.

OF THE MAIN-COAL

The main coal consists of divisions, and indeed may be considered as a number of beds differing regularly in quality and thickness, and separated from each other by very thin partitions, which in some places are wanting, so that it has been generally mentioned as a single bed of coal of extraordinary thickness. These divisions or beds are distinguished by peculiar names, which, together with their thickness, are given below.

* Roach is a coarse ferruginous earth or clay, differently coloured and veined, red and yellow. It seems to me to consist of the decomposed particles of the basaltic rock, called here Rowley Rag, of which the Rowley hills are formed, with other alluvial matter.

† The rock, so called from its hardness, is white, and consists of a mixture of siliceous and argillaceous earths; which earths are mixed in different proportions. The rock has the largest proportion of siliceous earth. Next to this, are the rock-binds, which have more argillaceous earth, and consequently are softer than the rock. Then the clunch-binds have still less siliceous earth; and, lastly, clunch has the least of this latter earth, and is the softest. The clunch and clunch-binds shiver into flakes when exposed to the weather. The rock-binds, and still better the rock, retain their texture. The rock is subject to crack or fissures, through which the water flows; and it is chiefly from these fissures in rock that the water of mines issues. Thin lamin_ of coal are often laid horizontally in the rock, and frequently there is thin coal in the form of large broad leaves of aquatic plants, running in all directions through the rock.

‡ Clunch is a smooth soft earthy matter, which, on exposure to the weather, falls into shivers or flakes. It evidently consists chiefly of argillaceous earth, and contains more or less of the siliceous earth. I have not analysed it, and therefore do not know more of its contents. Sometimes it has a reddish or yellowish colour, and is then called by the colliers wild; but when it is of proper bluish or greyish colour, it is said to be kind; by which epithets the colliers express their observation that coal is generally found accompanied with clunch and other measures that are of white, black, bluish, and grey, colours, but very seldom with such as are red or yellow. The former colours are therefore said to be kind; and the latter are called wild, as being irregular and accidental.

Clunch generally contains balls of iron-stone.

_ Smutt is a mixture of coal and clunch.

_ This thin coal (called the Two foot Coal, though it is seldom thicker than eighteen inches) is the first regular bed of coal. It is too thin to be of any use.

** Fire-clay, called in some places Pipe-clay, from its having been made into tobacco-pipes, for which purposes it is not now used, not being white enough.

†† A parting is a small quantity, generally of clunch or soft earth, that separates the more considerable beds from each other. From these interstices between the strata or divisions of the coals itself generally proceeds the inflammable gas or air that incommodes the miners.

‡‡ Broach-coal is a coal of very good quality, which sometimes is got, but generally neglected, not being thought sufficiently thick to furnish a large enough quantity of big coals to render the working of it profitable.

__ The measure called Penny-earth is a clunch which contains a considerable quantity of balls, or nodules of iron-stone; for the sake of which pits are sunk in the neighbourhood of Wednesbury.

|||| Chance-coal is a name given to accidental masses of coal, which are not regular strata.

*** A smooth schistus, rendered black probably from its vicinity to the coal.

THE NAMES OF THE BEDS OF THE MAIN-COAL

The coal, including the partings, which are more various in their thickness than the coal, generally exceeds ten yards. But even the coal varies in the thickness of its several beds in some degree, though it every where preserves the distinction of different beds. A very extraordinary variation occurs in one instance. The two upper beds of the main coal, namely, the roof-coal and top-slipper, separate from the rest of the coal at Bloomfield colliery, and the separation grows wider and wider in a Northern direction, till at length these two beds, which when thus separated acquire the name of the Flying Reed, crop out to day and are lost, which the lower part of the coal proceeds on to Bilstone, where consequently it has only the thickness of about eight yards.

The interval between the two upper measure, or flying reed, and the lower part of the main coal, is filled up with soft clunch at the place of separation, which clunch assumes a harder texture, and at last is changed to rock that strikes fire with steel.

OF THE MEASURE BELOW THE MAIN-COAL

The measures which generally known under the main-coal, which in some place are dug for the sake of the iron-stone and glass-house pot-clay, and sometimes for the vein of the coal, called heathing-coal, are as follows.

	Yards	feet	inch
1. Dark clunch, generally about	0	1	6
2. Light-coloured clay, with small round iron-stone, called White Grains	0	2	6
3. Main iron-stone mine, that is, iron-stone balls or nodules, involved in clunch. Of this mine there are three distinct measures,	1	0	0
4. Table-batt, a smooth, level-faced, schistus. Sometime thicker,	1	0	0
5. White clay, containing white iron-stone,	1	0	6
6. Heathing-coal, in three	2	0	0

distinct layers. Good coal,