
*Extracts, &c. calculated to assist inquiry as to the probable or actual existence of Coal in any given district.**

Characters of the Coal formation.—Though the appearance of the outward surface gives no certain or infallible rule to judge of the kinds of strata lying beneath, yet it gives a probable one; for it is generally found that a chain of mountains or hills

* A prevailing belief that Coal exists on the South-East coast of the colony, and that accurate examination is alone requisite to discover it, has suggested the propriety of introducing the "Extracts, &c."—(Eds.)

rising to a great height, and very steep on the sides, is commonly composed of strata much harder and of different kinds from those described wherein Coal is found to lie, and therefore unfavourable to the production of Coal; and these mountainous situations are also more subject to dikes and troubles than the lower grounds; so that if the solid strata composing them gave even favourable symptoms of Coal, yet the last circumstance would render the quality bad, and the quantity precarious. And, on the whole, it may be observed, that mountainous situations are found more favourable to the production of metals than of Coal. It is likewise generally found that those districts abounding with valleys, moderately rising hills, and interspersed with plains, sometimes of considerable extent, do more commonly contain Coal, and those kinds of strata favourable to its production, than either the mountainous or champaign countries; and a country so situated as this last described, especially if at some considerable distance from the mountains, ought to be the first part appointed for particular examination. Plains, or level grounds of great extent, generally situated by the sides of rivers, or betwixt such moderate rising grounds as last described, are also very favourable to the production of Coal, if the solid strata, and other circumstances in the higher grounds adjoining, be conformable; for it will scarcely be found, in such a situation, that the strata are favourable in the rising grounds, on both sides of the plain, and not so in the space betwixt them. Though plains be so favourable, in such circumstances, to the production of Coal, yet it is often more difficult to be discovered in such a situation, than in that before described; because the clay, soil, and other lax matter, brought off the higher grounds by rains and other accidents, have generally covered the surfaces of such plains to a considerable depth, which prevents the exploration of the solid strata there, unless they be exposed to view by digging, quarrying, or some such operation.

Modes of examining a formation in which Coal is supposed to exist.—The first step to be taken is to examine all places where the solid strata are exposed to view (which are called the *crops* of the strata), as in precipices, hollows, &c. tracing them as accurately and gradually as the circumstances will allow, from the uppermost stratum or the highest part of the ground to the very undermost: and if they appear to be of the kinds before described, it will be proper to note in a memorandum book their different thicknesses; the order in which they lie upon each other; the point of the horizon to which they dip or incline, the quantity of that inclination, and whether they lie in a regular state. This should be done in every part of the ground where they can be seen, observing at the same

time, that if a stratum can be found in one place, which has a connexion with some other in a second place, and if this other has a connexion with another in the third place, &c.; then, from these separate connexions, the joint correspondence of the whole may be traced, and the strata, which in some places are covered, may be known by their correspondence with those which are exposed to view.

If by this means the crops of all the strata cannot be seen (which is often the case), and if no coal be discovered by its crop appearing at the surface: yet if the strata that have been viewed consist of those kinds before described, and are found lying in a regular order, it is sufficiently probable that Coal may be in that part of the district, although it be concealed from sight by the surface of the earth or other matter. Therefore, at the same time that the crops of the strata are under examination, it will be proper to take notice of all such springs of water as seem to be of a mineral nature, particularly those known by the name of iron water, which bear a mud or sediment of the colour of rust or iron, having a strong astringent taste. Springs of this kind proceed originally from those strata which contain beds or balls of iron-ore; but by reason of the tenacity of the matter of those strata, the water only disengages itself slowly from them, descending into some more porous or open stratum below, where, gathering in a body, it runs out to the surface in small streams or rills. The stratum of Coal is the most general reservoir of this water: for the iron-stone being lodged in different kinds of shiver, and the Coal commonly connected with some of them, it therefore descends into the Coal, where it finds a ready passage through the open backs and cutters. Sometimes, indeed, it finds some other stratum than Coal to collect and transmit it to the surface; but the difference is easily distinguishable; for the ochrey matter in the water, when it comes from a stratum of Coal, is of a darker rusty colour than when it proceeds from any other, and often brings with particles and small pieces of Coal; therefore, wherever these two circumstances concur in a number of these kinds of springs, situated in a direction from each other answerable to the stretch or to the inclination of the strata, it may be certain the water comes off Coal, and that the Coal lies in a somewhat higher situation than the apertures of the springs.

There are other springs also which come off Coal, and are not distinguishable from common water, otherwise than by their astringency, and their having a blue scum of an oily glutinous nature swimming upon the surface of the water. These, in common with the others, bring out particles of Coal, more especially in the rainy seasons when the springs flow with

rapidity. When a number of these kinds are situated from each other in the direction of the strata, as above described; or if the water does not run forth as in springs, but only forms a swamp, or an extension of stagnant water beneath the turf; in either case, it may be depended upon that this water proceeds from a stratum of Coal.

If the stratum of Coal is not exposed to view, or cannot be discovered by the first method of searching for the crop, although the appearance of the other strata be very favourable, and afford a strong probability of Coal being there; and if the last-mentioned method of judging of the particular place where the crop of the Coal may lie, by the springs of water issuing from it, should, from the deficiency of those springs or other circumstances, be thought equivocal, and not give a satisfactory indication of the Coal, then a further search may be made in all places where the outward surface, or the stratum of clay or earth, is turned up by ploughing, ditching, or digging, particularly in the lower grounds, in hollows, and by the sides of streams. These places should be strictly examined, to see if any pieces of Coal be intermixed with the substance of the superior last strata; if any such be found, and if they be pretty numerous and in detached pieces, of a firm substance, the angles perfect or not much worn, and the texture of the Coal distinguishable, it may be concluded, that the stratum of Coal to which they originally did belong, is at no great distance, but in a situation higher with respect to the horizon; and if there be also found along with the pieces of Coal other mineral matter, such as pieces of shiver or freestone, this is a concurrent proof that it has come only from a small distance. Though the two fore-mentioned methods should only have produced a strong probability, yet if this last-mentioned place, where the pieces of Coal, &c. are found in the clay, be in a situation lower than the springs; when this circumstance is joined to the other two, it amounts to little less than a moral certainty of the stratum of Coal being a very little above the level of the springs. But if, on the contrary, these pieces of Coal are found more sparingly interspersed in the superior stratum, and if the angles are much fretted or worn off, and very little of other kinds of mineral matter connected with them; it may then be concluded, that they have come from a stratum of Coal situated at a greater distance than in the former case; and by a strict search and an accurate comparison of other circumstances, that particular place may be discovered with as much certainty as the other.

After the place is thus discovered, where the stratum of Coal is expected to lie concealed, the next proper step to be taken, is to begin digging a pit or hole there perpendicularly

down to find the Coal. If the Coal has no solid strata above and beneath it, but be found only embodied in the clay or other lax matter, it will not be there of its full thickness, nor so hard and pure as in its perfect state when enclosed betwixt two solid strata, the uppermost called the *roof*, and the undermost called the *pavement*, of the Coal: in such situation therefore it becomes necessary, either to dig a new pit, or to work a mine forward until the stratum of Coal be found included betwixt a solid roof and pavement, after which it need not be expected to increase much in its thickness: yet as it goes deeper or farther to the dip, it most likely will improve in its quality; for that part of the stratum of Coal which lies near the surface, or only at a small depth, is often debased by a mixture of earth and sundry other impurities washed down from the surface, through the backs and cutters, by the rains; whilst the other part of the stratum which lies at a greater depth is preserved pure, by the other solid strata above it intercepting all the mud washed from the surface.

The above methods of investigation admit of many different cases, according to the greater or less number of favourable circumstances attending each of the modes of inquiry; and the result accordingly admits every degree of probability, from the most distant, even up to absolute certainty. In some situations, the Coal will be discovered by one method alone, in others, by a comparison of certain circumstances attending each method; whilst in some others, all the circumstances that can be collected only lead to a certain degree of probability.

In the last case, where the evidence is only probable, it will be more adviseable to proceed in the search by boring a hole through the solid strata (in the manner hereafter described), than by digging or sinking a pit, it being both cheaper and more expeditious; and in every case, which does not amount to an absolute certainty, this operation is necessary to ascertain the real existence of the Coal in that place.

We shall now suppose that, having examined a certain district, situated within a few miles of the sea or some navigable river, that all the circumstances which offer only amount to a probability of the Coal being there, and that boring is necessary to ascertain it. We shall therefore describe the operation of boring to the Coal:

Suppose that a piece of ground, A, B, C, D, has been examined, and from the appearance of the strata where they are visible (as at a precipice and several other places,) they are found to be of those kinds usually connected with Coal, and that the point to which they rise is directly west towards A, but the ground being flat and covered to a considerable depth with earth, &c. the strata cannot be viewed in the low grounds;

therefore, in this and all similar situations, the first hole that is bored for a trial for Coal should be on the west side of the ground, or to the full rise of the strata as at A, where boring down through the strata 1, 2, 3, suppose 10 fathoms, and not finding Coal, it will be better to bore a new hole than to proceed to a greater depth in that; therefore, proceeding so far to the eastward as B, where the stratum 1, of the first hole is computed to be 10 or 12 fathoms deep, a second hole may be bored, where boring down the strata 4, 5, 6, 7, 8, the stratum 1 is met with, but no Coal; it would be of no use to bore farther in this hole, as the same strata would be found which were in the hole A: therefore, proceeding again so far to the eastward, as it may be computed the stratum 4 of the second hole will be met at the depth of 10 or 12 fathoms, a new hole may be bored C, where, boring through the strata 9, 10, 11, 12, the Coal is met with at 12, before the hole proceed so deep as the stratum 4 of the former. It is evident, that, by this method of procedure, neither the Coal nor any other of the strata can be passed over, as the last hole is always bored down to that stratum which was nearest the surface in the former hole.

Rocky or mineral strata met with in what is usually understood by the Coal formation.

1. *Whin-stone*.—The strata of what is denominated whin-stone are the hardest of all others; the angular pieces of it will cut glass; it is of a very coarse texture, and when broken across the grain, exhibits the appearance of large grains of sand half vitrified; it can scarcely be wrought, or broken in pieces, by common tools, without the assistance of gunpowder; each stratum is commonly homogeneous in substance and colour, and cracked in the rock to a great depth. The most common colours of these strata are black or dark blue, yet there are others of it ash coloured and light brown. Their thickness in all the Coal countries is but inconsiderable, from six or five feet down to a few inches, and it is only in a few places they are met with of these thicknesses. In the air it decays a little, leaving a brown powder; and in the fire it cracks, and turns reddish brown. Limestone, and what is called *bastard limestone*, is sometimes, though rarely, met with in coaleries. It is a well known stone; but from its resemblance in hardness and colour is often mistaken for a kind of whin. Sometimes, particularly in hilly countries, the solid matter next the surface is found to be a kind of soft or rotten whin;—but it may be noted, that this is only a mass of heterogeneous matter disposed upon the regular strata; and that beneath that, all the strata are generally found in as regular a order, as where this heterogeneous matter does not occur.

2. *Post-stone*.—This is a freestone of the hardest kind, and next to the limestone with respect to hardness and solidity. It is of a very fine texture; and when broken appears as if composed of the finest sand. It is commonly found in a homogeneous mass; though variegated in colour; and, from its hardness, is not liable to injury from being exposed to the weather. Of this kind of stone there are four varieties, which may be distinguished by their colour. The most common is white post, which in appearance is like Portland stone, but considerably harder; it is sometimes variegated with streaks or spots of brown, red, or black.

Gray post is also very common; it appears like a mixture of fine black and white sand: it is often variegated with brown and black streaks; the last mentioned appear like small clouds composed of particles of Coal.

Brown or yellow post is often met with of different degrees of colour; most commonly of the colour of light ochre or yellow sand. It is as hard as the rest, and sometimes variegated with white and black streaks.

Red post is generally of a dull red colour: this is but rarely met with; it is often streaked with white or black.

All these lie in strata of different thicknesses; but commonly thicker than any other strata whatever: they are separated from each other, and from other kinds of strata, by partings of coal, sand, or soft matter of different colours which are very distinguishable.

3. *Sand-stone*.—This is a freestone of a coarser texture than post, and not so hard; is so lax as to be easily pervious to water; when broken, is apparently of a coarse sandy substance; is friable and moulders to sand when exposed to the wind and rain; has frequently white shining spangles in it, and pebbles or other small stones inclosed in its mass. Of this, there are two kinds commonly met with, distinguished by their colours, gray and brown, which are of different shades, lighter or darker in proportion to the mixture of white in them. It is most generally found in strata of considerable thickness, without many secondary partings; and sometimes, though rarely, it is subdivided into layers as thin as the common gray slate. It has generally sandy or soft partings.

4. *Metal-stone*.—This is a tolerably hard stratum, being in point of hardness next to sand-stone; generally solid, compact, of considerable weight, and of an argillaceous substance, containing many nodules or balls of iron ore, and yellow or white pyrites; its partings, or the surfaces of its strata, are hard, polished, and smooth as glass. When broken, it has a dull dusky appearance (though of a fine texture), like hard dried clay mixed with particles of coal. Though hard in the

mine or quarry, when exposed to the fresh air it falls into very small pieces. The most usual colour of this stone is black; but there are several other lighter colours, down to a light brown or gray. It is easily distinguished from freestone by its texture and colour, as well as by its other characteristics. It lies in strata of various thicknesses, though seldom so thick as the two last-mentioned kinds of stone.

5. *Shiver*.—This stratum is more frequently met with in coaleries than any other. There are many varieties of it, both in hardness and colour; but they all agree in one general characteristic. The black colour is most common; it is called by the miners *black shiver*, *black metal*, or *bleas*. It is softer than metal-stone, and in the mine is rather a tough than a hard substance, is not of a solid or compact matter, being easily separable by the multitude of its partings, &c. into very small parts, and readily absorbing water. The substance of this stratum is an indurated bole, commonly divided into thin laminæ of unequal thicknesses, which break into long small pieces when struck with force; and, on examination, they appear to be small irregular rhomboids: each of these small pieces has a polished glassy surface; and, when broken cross the grain, appears of a dry, leafy, or laminated texture, like exceeding fine clay: it is very friable; feels to the touch like an unctuous substance; and dissolves in air or water to a fine pinguid black clay. There are almost constantly found in its inclosed strata lumps or modules of iron ore, often real beds of the same.

There are other colours of this stratum besides black. The brown or dun shiver is very frequently met with; it agrees with the above description in every thing but colour. Gray shiver is also very common: it seems to be only a mixture of the black and dun; and by the different degrees of mixture of these colours others are produced. It lies in strata sometimes of considerable thickness, at other times not exceeding a few feet: they are commonly parted from each other by laminæ of spar, coal, or soft matter.

6. *Coal*.——

To illustrate how the various strata lie in some places, and how often the same stratum may occur betwixt the surface and the Coal, we shall give the following example. The numbers in the left-hand column refer to the classes of strata before described, to which each belongs. The second column contains the names of the strata; and the four numeral columns, to the right hand, express the thickness of each stratum, in fathoms, yards, feet, and inches.

EXAMPLE.

No.		Fas.	Yds	Ft.	Ins.
	Soil and gravel	0	1	1	0
	Clay mixed with loose stones	1	1	0	0
3	Coarse brown sand-stone, with soft partings	3	0	2	6
2	White post, with shivery partings	1	1	0	5
5	Black shiver or bleas, with iron-stone balls	2	0	2	0
6	Coarse splinty coal	0	0	2	6
5	Soft gray shiver	0	1	0	7
2	Brown and gray post, streaked with black	1	0	2	0
5	Black shiver, with beds and balls of iron-stone	0	1	2	6
4	Gray and black metal-stone	0	1	1	9
2	White and brown post	1	1	0	0
5	Black and gray shiver, streaked with white	0	1	0	6
3	Soft gray sand-stone, with shivery partings	0	1	1	0
2	Yellow and white post, with sandy partings	1	0	2	0
5	Black and dun shiver, with iron-stone balls	0	1	2	6
2	White post streaked with black, and black partings	1	0	0	6
5	Gray shiver, with iron-stone balls	0	1	0	9
4	Brown and black metal-stone	1	1	2	6
5	Hard slaty black shiver	1	1	0	0
6	Coal, hard and fine splint	0	0	3	6
5	Soft black shiver	0	0	0	3
6	Coal, fine and clear	0	0	3	3
5	Hard black shiver	0	0	1	0
Total Fathoms		25	0	0	0

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