CAUSES OF WANTS OR AREAS OF BARREN GROUND IN THE COAL BEDS OF THE STATE.

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There are several faults met with in coal mines which are known by appropriate names such as slip-dikes, dislocations of the strata, horsebacks, clay veins, wants, etc. Slip-dikes are evidently the result of violent mechanical convulsions which changed the level of coal beds from a few inches to hundreds of feet. Dislocations of the strata are trap-dikes into which intrusive matter in the form of lava has been enjected. These faults are rarely met in Ohio. Horsebacks, clay veins and wants in the coal are, however, numerous. A horseback is a roll in the roof or floor of the mine, generally coming from the roof by which part or the whole of a coal seam is cut away for a few feet, or for many hundred feet. A horseback in the roof is evidently the remains of an ancient water channel which ran over the coal marsh in the early stages of the subsidence of the land, and which cut down through the carboniferous accumulation from which the coal is derived, leaving a deposit of mud or sand, usually sand, in the place of the dinuted vegetable ditritus. A clay vein, a thin fault of fire-clay mixed through a seam of coal, comes from the floor of the mine, the underlying clay having been pressed up into a crevice or rent in the coal marsh while the vegetable ditritus was undergoing mineralization after becoming covered by the sediments of the ocean. A want in the coal will in this paper refer to those great areas of barren ground where a coal seam is due but does not exist, and never did exist; and I propose in this paper to present a few thoughts as to the causes of such barren areas in the coal measures of Ohio.

The Ohio coal field, which occupies nearly one-third the area of the State and which lies along the Ohio River from Bellaire to Pomeroy, attains a thickness of sixteen hundred feet, has been so recently opened and so limited have been the subterranean excavations, that it is largely a matter of conjecture as to the causes as well as the extent of many of the wants or intervals of barren ground. But that great areas of barren ground extend through many if not every one of the twenty or more different beds of coal of workable height known to exist in the State is now generally acknowledged alike by geologists, mining engineers and practical men. A vast and invaluable amount of information in

regard to the existence of wants in coal seams was brought to light by the late geological survey, particularly in the later volumes of the survey, for the first published reports were more hopeful than the later ones as to the amount of coal enclosed in the mineral strata of the State.

The steadiest of all the coal beds is No. 8 of the geological nomenclature—the Pittsburgh vein; next to this in steadiness, so far as developments would indicate, is the "great vein" of the Hocking Valley—No. 6 of the geological reports. The least reliable coal, though one of the most valuable as regards quality and adaptability to various uses, is the lower coal of the State series—No. 1, or the "block coal" of the Mahoning Valley. This coal is mined extensively near Youngstown, Massillon and Akron, and is also opened and worked to a considerable extent around the village of Jackson, in Jackson county. It is everywhere found disposed in a wavy and uneven floor, being thickest in the low places or swamps of the mine, and growing gradually thinner as it extends up the sides of the swamps or troughs until it is either suddenly cut away by a fault, formed in my judgment by the shore waves of the ancient sea lashing the sides of the coal marsh in the first stage of the subsidence of the land; or it bravely continues the ascent of the trough sides till it thins down to a feather edge.

The troughs or basins in which this coal seam is found deposited were unquestionably scooped out of an originally level plain by water agencies anterior to the deposition of the coal vegetation. Any one who goes into a mine in the Mahoning Valley (or any other district of the State) where the lower coal of the State series is being mined, may observe, where the hills have been cut down by the miners, the coal floor pitching at an angle of twenty or even thirty degrees, while the underlying beds of Cuyahoga shale which exist in the form of thin, alternating sheets of shale and sandstone, lie stretched out in an extended and level plain, This circumstance explains not only the cause of the wavy character of the coal-bed, but accounts for the limited area in which the coal was deposited. Upon the highlands, which constituted the greater portion of the plain, the coal vegetation never grew.

Some of the workable beds of coal lying between Nos. 1 and 6, are opened and worked to a considerable extent, and like the lower coal, these beds are often wanting where they are due—they

thin down and disappear altogether in the hillsides of the mine, exactly as the lower coal disappears. No. 6, the great vein of the Hocking Valley, the Steubenville shaft and the Salineville coal, is as I have said, a remarkably steady coal, and by reason of its superior quality and extra height is more extensively mined than any other seam in Ohio. There are, however, extended intervals of barren ground in this coal seam, upon which the coal vegetation never grew. These wants or barren areas are always met in what must have constituted the highlands of the old coal plain. The same conditions met in the long, narrow and serpentine swamps of the lower or Mahoning Valley coal are repeated, though on a greatly larger scale in the great vein regions of the State.

The mines of Salineville offer the best field for studying this subject, for there the basins are sometimes as narrow as in the Mahoning Valley. The coal at Salineville, as in the Mahoning Valley, begins to lose height on the sides of a steep hill, and finally thins out and disappears altogether, reappearing in another trough, miles distant.

In the great vein region of the Hocking Valley the coal is stretched over a vast area of unbroken ground. It has, however, some wants; in one of the mines at Corning, a hill has been encountered—the coal thinned down and disappeared, and beyond the basin the coal driller could find no coal by boring for a mile or more.

At Coshocton the hills in the mines sometimes rise to a height of 20 feet, the coal gradually thinning down in its ascent, losing height from the bottom of the bed, though it nowhere, so far as I have observed, disappears altogether in any of the mines of this district, but dips over into adjoining basins and recovers its lost height. As the hills are not often cut down, the opportunity for judging as to whether the strata immediately underlying the coal conform to the pitch of the coal is not as good as in the Mahoning Valley mines. But the fact that the coal gradually thins down in ascending the hills, and mainly loses height from the bottom of the seams, is conclusive proof that these undulations existed before the coal was deposited, and are not due to an upheaving and folding of the strata, after the coal field was built up. In one of the mines of the Glasgow—Port Washington Co., in Tuscarawas county, the floor is blasted up to a depth of 8 or 10 feet, in one part of the main gangway. Here the coal was found dipping at an angle of 15

degrees, while the strata below ran level—a repetition of the conditions met in every mine in the Mahoning Valley.

Other wants in coal beds are frequently met where the coal vegetation, after having been deposited, was subsequently removed by denuding forces—by currents of water in rapid motion sweeping over the coal marsh, and cutting away part or the whole of the coal vegetation, and leaving a deposition of sand over the denuded area. These wants, as I have stated in the opening paragraph of this paper, are called horsebacks, and they are readily distinguished from the wants or intervals of barren ground which I have described.

It is my opinion, formed from observation, that a number, if not all of the coals of the lower coal measures of the State, will be found resting in swamps, or troughs, or basins, which were once river beds, or lakes, or arms of the sea, and that great stretches of barren ground will be encountered in mining.

The Pittsburgh coal, the lowest bed of the upper measures, is very extensively mined around Bellaire and Pomeroy, and is remarkable for its continuity, and its freedom from faults of all kinds. A few clay veins are occasionally met, but seldom any horsebacks, except occasional saddle-like rolls in the floor of the mines, which rise up into the coal for a foot or eighteen inches, resembling the shape of a horse back. No barren areas, or elevated plains where the coal vegetation never flourished are met. The coal is found, wherever it is due, stretched out in an unbroken sheet. It is highly probable that all the coal beds of the upper measures will be found occupying more extended areas and be less subject to wants than those of the lower series.

The subject of this paper is by no means exhausted, and I shall refer to it again at some future meeting of the Institute. The views which I have set forth are, as I am aware, peculiar, but I am satisfied they will be found, in the main, correct, so far as the coal beds of Ohio, at present opened and worked, are concerned.

The paper by Mr. Roy on the Causes of Wants or Areas of barren ground in the coal beds of the State was the last of the series, and brought out quite a lengthy discussion by a number of the engineers, Mr. Akley, Mr. Head, Mr. Mitchell and Mr. Hazeltine, taking part in the discussion.