

ART. XXXII.—*The Albert Coal, or Albertite, of New Brunswick;*  
by CHARLES H. HITCHCOCK.

THE nature of the Albert coal and the mode of its occurrence in the strata have been vexed questions in geology. Its beautiful appearance attracts the eye, while its pecuniary value gave rise to the litigation which occasioned the delivery of the diverse opinions. In this as in so many other difficult subjects time has developed much truth, and shown us that we must not insist too strongly upon seemingly well-established theories.

In this communication I propose to describe briefly the geological features of the Albert coal vein and the accompanying rocks. I shall, whenever necessary, refer to the facts observed by others in this locality, but rely chiefly upon my own observations made in 1861 and 1864, as well as upon hints derived from persons of intelligence living in the vicinity. For a knowledge of many facts relating to the distribution of the different strata, I am indebted to Mr. James Blight, of Hillsborough, N. B. It is necessary to be dependent upon others for some knowledge of the internal structure of the Albert Mine, because the Company will not allow any scientists to examine their property below the surface. I use the word *coal* as a matter of convenience, not necessarily in strict propriety.

There are four different mining properties in Hillsborough, situated upon veins of Albertite:—the Albert, (the only one worked extensively and thoroughly proved), the East Albert, the Prince of Wales, and the Princess Alexandra. The second lies east of the first, and the others north and south of the same. Hillsborough is situated upon the west bank of the Petitcodiac river, near its confluence with the Bay of Fundy.

The rocks are of Lower Carboniferous age, and belong to the Acadian coal series. Several species of *Palæoniscus*, *Lipidodendron*, *Lepidostrobus*, *Spherædra*, and *Stigmæria* occur in the shales and sandstones. Two or three miles southwest from the Albert shaft there appear older crystalline rocks, such as syenite and metamorphic slates; constituting the easternmost point of the extension of these rocks from the vicinity of St. John. The lowest rock in the Carboniferous series is the Albert shale; but I cannot state whether it crops out near the syenite. It probably does not appear anywhere on the edges of the coal basin. Nothing similar to it occurs in the Joggins' section. It should be expected to occur near and below the numerous deposits of gypsum in the eastern provinces.

This shale contains a large amount of hydro-carbonaceous matter. Certain layers of it at the "Caledonia Oil Works," by a rude process, have yielded thirty gallons of refined illuminat-

ing oil to the ton. The greater portion of the shale will sustain a fire without the aid of other fuel. Other layers are more bony, and others still highly ferruginous. It contains immense numbers of fossil fish, almost enough to make one imagine they gave the shale its inflammable character. The surfaces of many layers are glazed. The rock is very weak and abounds in small contortions of the strata. It appears in three localities. The largest has the Albert shaft in its centre; being exposed a mile or so in length, and showing best in the low ground. Small patches of shale may be seen on Peck's and Stinking Creeks, besides an unknown amount farther west at the oil-works. This series cannot be less than one thousand feet thick, as it has not yet been cut through by the shaft, and the general inclination of the bedding is very small.

The second group of strata is a conglomerate, separated from the first by a narrow bed of sandstone. Bits of Albert coal and shale constitute component parts of certain coarse sedimentary strata of this group, and render them oleaginous. The thickness is unknown, probably from 100 to 200 feet. Between the Albert shaft and the Petitcodiac, from three to four miles, this group prevails at the surface, except it be a small area of shale in a deep valley.

The next layers in ascending order are red marl and a bluish gray siliceous limestone. Above these are immense deposits of gypsum, from which most excellent plaster-of-paris is made for exportation. The highest rock in the series in this vicinity is another great mass of reddish conglomerate and sandstone.

There appears to be an anticlinal axis passing through this region, trending nearly ten degrees north of east. I have traced it from the Albert shaft to the Petitcodiac river, and have reason to believe it extends much farther, both west and east. The anticlinal structure is shown in three ways. *First*, the testimony is unanimous that there is an anticlinal in the Albert Mine. *Second*, the conglomerate dips in opposite directions in seven equi-distant localities examined over this area, but the dip is small. *Third*, the rocks succeed one another on both sides of the supposed anticlinal line in the ascending order mentioned above. On the north, we find above the shale, conglomerate, red marl, limestone, gypsum and sandstone. On the south, the order is the same with an opposite dip.

There appears to be a fault along or near this axis, displaying the usual phenomena of anticlinal fissures, and its location may easily be accounted for. The great plicating force acting from the direction of the ocean crowded the Hillsborough rocks north-westerly from the Bay of Fundy, crushing them up into a fold. The shale was not strong enough to sustain the bending; hence its layers were much twisted and fissured along a central line.

It is not likely that any of the shale rose above the surface at the time of flexure; and now that a portion of it has been laid bare by the removal of the upper rocks, the fissure and contortions show more plainly than in the overlying tough conglomerate to the east, which being narrower will naturally contain less of any foreign matter that has subsequently been injected into it.<sup>1</sup>

Some relics of this great force are now perceptible at the Albert mine, showing that the pressure is still exerted, perhaps as strongly as at any time of its manifestation. This phenomenon is much more noticeable than the "swellings of the walls," so common in deep mines. As soon as the coal is removed, strong timbers are put in to keep open the drifts, but in a short time these cross-pieces are split and crushed by the powerful force pushing the walls together. And when the timber is destroyed, the walls shut in, closing with a great noise as loud as thunder for hours, but not so near the workmen as to interfere with their progress. Not merely do the walls close, but frequently large fissures are produced behind the vein, so that the miners can clamber up and down new crevices. Large masses of rock are sometimes detached from either wall, in consequence, filling up the drift. We might explain the falling of fragments by gravity, but not so easily the crushing of the timbers.

The coal shows the effects of the crushing process no less plainly. It is much broken, even to grains, and needs no pick for its removal from the vein. It will flow as easily as heaps of corn, and therefore pains are taken to tap the vein in the right place, and at the proper time. If by oversight the main shaft is not walled up very tight, the coal will stream through the crevices between the beams, to the great inconvenience of the workmen.

The first outcrop of Albert coal was discovered by John Duffy, fifteen or sixteen years ago, in a deep ravine on Frederick's brook. The vein was about four feet wide, but by working upwards twenty-five feet into the bank, it thinned out to two or three inches. Duffy drifted about 300 feet on the course of the vein above the water-level, and sunk a shaft sixty feet, where the coal is said to have attained a width of ten feet. He then disposed of the property to Cairns, Allison & Co., who held it at the time of the litigation, but have now mostly transferred their shares to other parties, holding them under the same charter.

To describe the numerous variations in the course, thickness and shifts in the Albert workings, so far as known, would be unnecessarily tedious. Percival describes them for the first 200

<sup>1</sup> The fact of the existence of the coal in a vein occupying an anticlinal dislocation was maintained by Messrs. Robb and R. O. Taylor in their Joint Report upon the Albert Mine in 1851. See *Proc. Am. Phil. Soc.*, vol. v, p. 242. Their report was accompanied by chemical analyses by Dr. O. M. Wetherill, who made the material a variety of asphaltum and named it *melan-asphalt*.

or 300 feet of the descent, occupying more than three pages of the size of this Journal in a little more than catalogue style of enumeration. I am assured by the manager, Capt. Byers, that, from that depth to the bottom of the shaft, 950 feet, the character of the irregularities has not changed. In brief, the peculiarities of the mine are the following.

The general course of the vein is N. 65° E., but the coal is repeatedly heaved southward by small faults. Its inclination is northwestward from 75° to 80°, often vertical. The body of the vein is extremely irregular, constantly expanding and contracting, both laterally and vertically. What is too narrow to be worked in one level enlarges to six and twelve feet, a hundred feet lower, or the reverse; but in general the width increases in following down the vein. At the time of Percival's examination, the vein was not considered workable 170 feet west from the old shaft. At lower levels the yield is renumerative 700 feet west and 2300 feet east of the new shaft, which lies several rods west of the first. In consequence of the uncertainties in the character of the vein, it is found necessary to accumulate a large supply of the coal during the suspension of navigation, so that there will always be enough stock on hand in the warmer months to load the vessels without delay. Whenever a displacement is met with the vein is not lost, because a film of the coal remains in the slip to indicate the location of the heaved portion. The widest part of the vein is said to be twenty-eight feet.

The narrow portions of the coal are invariably contained in a harder rock; where the rock is softer the vein is larger. "Horses" are common. In such cases the cavity above, out of which the horse fell, is found to be filled with coal; so that the width of the coal at that level is equal to the usual width *plus* the width of the horse. Numerous small branches run off into the shales from the main vein. These are short and might be described as irregular and branching spines from a main stem. Many of the fragments of rock taken from the mine show these small injections. The most striking proof of the proper character of the mass is afforded by the edges of the strata in contact with the coal; they are coated with Albertite, while the surfaces are covered only when enclosing one of the small lateral branches, a few inches long.

With the facts now presenting themselves to the explorer, I think no one would call the Albertite mass a bed. It occupies an irregular fissure along an anticlinal line, and the deep workings have failed to develop the lower anticlinal branching of the coal anticipated by the advocates of the bed theory. The numerous branches are unlike any phenomena connected with beds. There is no fire-clay to form the floor of a bed; and, in addition, the common adherence of the coal to the edges of the strata, rather than slickensides—I do not mean those in the hori-

zontal slips—seems to complete the evidence that the coal does not occur between stratified planes. To disclaim a bedded character casts no reflections upon the observations of the distinguished geologists who have decided otherwise; because they started with erroneous premises. To them the idea of coal in a vein was preposterous. It appeared as great an anomaly as it would be now to find Niagara fossils in the Potsdam group.

The vein-character of the deposit is seen more distinctly in the smaller openings. On the East Albert property two shafts have been commenced near the anticlinal line in the conglomerate over the shale. These reveal, at the depth of thirty feet, nearly six inches width of a richer and more beautiful coal than the Albert, gradually thinning out to the width of coarse paper at the surface, and most unequivocally cutting vertically across nearly horizontal layers of sandstone. As before, we have here the phenomena of shifts constantly working the vein southward, and a slight leaning in the same direction. Following the line to the Petitcodiac, there are seen other openings upon the vein of less extent.

The two veins crossing the anticlinal are very interesting. Upon parallel lines about a mile apart, their course is N.E. and S.W. One appears to intersect the principal vein very near the Albert shaft. The intersection of the other is concealed by a great depth of alluvium. It cannot be said that the coal is likely to prove more abundant at these intersections, as is the case at the union of metallic lodes, yet the similarity of the two classes of veins is such as to warrant the exploration.

These two side veins cut the strata nearly at right angles to the dip. The following is in general their nature, as observed in half a dozen openings. The conglomerate with a gentle dip is traversed by vertical joints, two of which parallel to each other, and from two to seven feet apart, are filled with threads of Albertite, occasionally enlarging to bunches an inch thick. Between them are branching threads of the same material, joining the lateral seams at various angles. I think there are no branches upon the outside walls. The whole field reminds one of an area of tin veins. Like the others, this vein-field leans slightly southward. It will be interesting to watch the development of these veins to see whether they will develop like the Albert. Their persistency and ability to cut through the strata render them worthy of attention. But no one ought to expect to discover a large vein till the threads have been followed down to the subjacent shale. The surface at the Albert mine is more than a hundred feet lower geologically than the bottom of the East Albert shaft where the coal is nearly six inches wide.

I think the following conclusions may be drawn legitimately from the foregoing and kindred facts.

1. *The Albert coal occurs in true cutting veins, not in sedimentary beds like ordinary coal.*

2. *The Albert coal was originally in a liquid state, was injected into vertical fissures, and subsequently hardened into a substance resembling jet.* The liquid may have been derived from vegetable accumulations, or possibly in part from the abundant ichthyic remains in the shales. Whether the shales were originally oily, as now, and the fissures subsequently filled with a viscid fluid derived from them, or whether the charging of the fissures imparted an inflammable character to the rock, I will not conjecture, though it is easy to satisfy one's own mind. The cavities of the Albert coal occasionally hold liquid petroleum, and those in the adjacent shales more often. A few quarts of petroleum have been brought up from borings along the line of both the Albertite veins on the east side of the Petitcodiac. With the hardening, the hydro-carbonaceous liquid received oxygen into its composition.

3. *The Albert coal must be compared with the asphaltic and bituminous veins found in the Quebec group in Canada.* It there "fills veins and fissures in the limestones, shales, sandstones, and even in the trap rocks which traverse these." "In other cases, it fills fissures several inches in diameter, so that it has been mistaken for coal, and attempts have been made to work it at Quebec and elsewhere. The mineral is never, however, in true beds like coal, but is always confined to veins and fissures which cut the strata." "The matter is of a shining black color, very brittle, breaking into irregular fragments with a conchoidal fracture." (*Geol. Canada.*) The Quebec coal is like the Albert in the small amount of the ashes, but contains more carbon.

4. *These carbonaceous veins are analogous to veins of petroleum.* The borings for petroleum in Ohio and Western Virginia are most successful along lines of fracture, particularly an anticlinal axis. The description of the chasm filled with oil would undoubtedly be given in words similar to those used respecting the Albert vein, if we could sink shafts and drive on the course. The views of Prof. Andrews in this Journal, ([2] xxxii, 85,) respecting the location of petroleum, are very just, and show that it often occurs along anticlinal faults. The immense yield of many oil-wells certainly suggests the presence of more than the "horse-cavities" filled with the liquid.<sup>2</sup>

5. *The carbonaceous veins, such as the Albert coal, Canadian asphalt and liquid petroleum, while possessing many characteristics of metallic lodes, will be found to differ from them in some*

<sup>2</sup> A valuable paper, by T. S. Hunt, in this Journal, [2] xxxv, 157, 1863, upon Bitumens, etc., presents the general conclusions stated above. His data were derived both from analysis of mineral combustibles and explorations in petroleum districts.

Sir William Logan mentions the occurrence of petroleum springs for twenty miles along a fold in the stratification in Gaspé in 1844. J. P. Lesley has described a vertical vein of asphaltic coal, precisely like the Albert, in Ritchie Co., W. Va.

respects. These particulars will be ascertained fully by the immense enterprise now manifested in sinking for petroleum. We can anticipate differences in respect to the limited depth, little variations of thickness at intersections, irregular yield, and origin of the carbonaceous veins. A proper knowledge of them may lead to some modification of terms in our definitions.

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