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Economic investigation of the lignites of the Dickinson, N.D. area

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TITLE

Economic Investigation of the Lignites of the Dickinson, N. D., Area.

AN ECONOMIC INVESTIGATION OF THE LIGNITES OF THE DICKINSON, NORTH DAKOTA AREA.

Area embraces Townships 139 and 140, Ranges 95, 96, 97 and 98, West of the Fifth Principal Meridian, and is situated near the center of Stark County, North Dakota.

Since the economic features only are of value in this discussion, it will be necessary to dwell but briefly on the geological age, etc. The strata of this district undoubtedly belong to the Fort Union Formation (Early Eocene) in common with those farther west in North Dakota and Montana, and not to the Laramie (Upper Cretaceous), as has been stated in various geological reports. The authority for this statement is Mr. F. H. Knowlton in his report in Bulletin No. 341, published in 1907, by the U. S. Geological Survey.

The topography of this country does not lend itself readily to the study of the strata. The region is characterized chiefly by its rolling plains, which gradually rise toward the north and south from the flood plains of the Heart and Green Rivers, with here and there a solitary Butte, which, owing to an exceptionally hard, sandstone capping, has withstood the ravages of erosion. Another important feature, whereby most of the outcrops were examined, is the large number of cut banks, ranging from 10 to 50 feet high, made by the streams meandering back and forth across their flood plains. No workable coal was

found in any of the buttes, nor did any wells sunk on the high prairies show good beds within fifty or sixty feet of the surface, which is the maximum depth of the homestead wells.

The formation is made up of alternating beds of clay, sand ar sandstone, and lignite. These beds have no definite character, the clays ranging from almost pure fire clay to very sandy and feruginous, "bastard clays," while the sands are equally uncertain, both in color, chemical character and physical properties. This is an important item to note in connection with the coal beds; The fact that the quality of the covering of the vein often decided its availability. For instance, a seven foot vein, with a good, hard clay roof, could probably be mined when the same vein covered with soft sand would be worthless. It was noticed that in most of the cases the immediate covering of the veins was a blue or gray, shaly clay, but that occasionally the clay was displaced by soft, yellow or gray sand-stone. It was also noticed that the horizon of the pure fire clays is about 75 to 100 feet higher than the lignite zone; and there is no indication of bituminous deposits in them.

The following are a few cross-sections of coal banks taken at various places, showing nature of covering, etc:

Section at Dickinson Pressed Brick Company plant, southwest of Dickinson, in NE¼ of Sec. 9, T. 139, N. of Range 96 West.

Dirt and loam -	3 feet
Burned lignite and brown shale -	6 feet
Shaly, gray clay -	4 to 5 feet
Sandy, yellow clay -	10 feet
Clay mixed with lignite -	1 to 2 feet
Fine-grained hard, blue clay -	3 to 4 feet
Rotton lignite with shale -	1 to 2 feet
Medium grade lignite -	2 to 3 feet
Good " " (resinous)	4 feet
Clay unexposed -	7 feet

This bank was worked by the stripping method, but the company now finds it more economical to buy coal from the mines. The vein here dips about three degrees to the northeast, away from the river. This vein pinches about 800 feet west of this point, and a lower vein from five to seven feet thick appears in the river bed, mostly under water, which is not exposed at this time of the year. Toward the east this vein is persistent for about one quarter of a mile and then deteriorates. It appears again in NE¼ Sec. 10, T. 139, N. R. 96 W., and is known as the Linneville Bank.

Section of the Linneville Bank.

Dirt and gravel -	2 to 3 feet
Yellow, sandy clay -	6 to 8 feet
Blue, finely laminated clay -	6 to 8 feet
Good quality lignite (resinous)	9 feet

This bank was mined by the pit method, which consists of excavating the coal, allowing the cover to fall in the pit, is then removed from the face of the coal, by shovel or scraper. The pit is not operated at the present time. This bed is a fine illustration of the wavy character of the veins in this district. The face of the cut bank has a direction of southeast and northwest 70 degrees, and is opened for about three hundred feet. The coal and overlying strata dip from both ends of the cut toward the center, forming a swag, the east and west wings of the same showing a tendency to thin out and disappear toward the surface.

Section at the Lehigh Mine, in the SE¼ Sec. 8, T. 139 N. R. 95 W.

Coarse, sandy clay -	10 to 20 feet
Coaly shale -	3 to 5 feet
White fine-grained sand -	20 feet
Blue, tough bastard clay -	4 feet
Lignite -	12 to 14 feet

This mine is operated by the butt entry system. The rooms are 26 feet wide and 6 to 8 feet are left for pillars. From 5 to 6 feet of coal is left in the roof to insure safety, a part of which is recovered at the time the rooms are allowed to cave. The pillars are not robbed. Two rows of timber props are used in each room, are recovered. The coal is mined by electric driven undercutting machines, the only mechanical system as yet introduced in this district. The management claims that it is impossible to mine less than a seven foot vein at a profit. In the Lehigh mine with good ventilation, no dead-work extremely light pressure on the roof and pillars, thereby giving the minimum waste in pillars, coal and props, no water to contend with, labor but a few cents per ton higher than eastern labor, they find it impossible to compete with eastern bituminous coal, outside of the home market. Lignite being much lower in spec. gravity the bulk per ton to be mined and handled is much greater than in bituminous coal. According to borings made by the Consolidated Coal Company, this vein diminishes to seven feet and five feet a mile north and east to five feet a half mile west and to seven feet a half mile south.

One half mile northeast from the Lehigh Mine in a cut bank of the Heart River, in the NE¼ Sec. 8, is located the Riley mine, operated by the hand and wagon method.

The coal is exposed for about 200 yards, and dips about 3 degrees to the northeast. The north end of the vein is partially under water. The bed is 9 feet thick and has a soft, sandy, clay cover. About 6 feet is mined, 3 feet remaining in the roof. The entries are narrow and extend into the bank only about 200 feet.

Section of the Cooper Bank, NW¼ Sec. 6, T. 140 N., R. 96 W.

Loam and dirt -	1 to 2 feet
Laminated, yellow, sandy clay with iron streaks -	8 to 10 feet
Lumpy, blue clay -	5 feet
Brownish, gray clay, with iron nodules -	6 to 8 feet
Fine-grained, soft, gray sandstone -	4 feet

This bank contains only about eight feet of good coal and is a good example of a thick vein that could not be mined by entries, on account of the soft, sand roof.

Next to the Lehigh mine, the Zenith mines are the most important in this territory. They are situated in the NW¼ and SW¼ Sec. 6, T. 139, N. R. 98 W. No. 1 Mine in the NW¼ is about worked out, the surrounding country having been burned, leaving only a knob of coal land about twenty acres in extent. Considering the amount of scoria and the

wide, gumbo flats, the lignite fires covered considerable territory in this locality. The Zenith coal vein is about 17 feet thick and contains from 5 to 12 feet good, workable coal. Within 300 feet of the fire zone, on each side of the mine, the coal is slacked and of no value. About 5 to 7 feet of coal was left in the roof and there is from 20 to 40 feet of covering, mostly clay. No. 2 Mine, which has just been opened, has a vein about 20 feet thick, and the coal is of very good quality, the roof being hard, blue clay. Mining is done by the hand under-cutting method, with the use of augers and dynamite.

All the cases examined, where it was possible to study the structure of the strata underlying the coal, indicate that the wavy character is due to the topography of the surface, preceding deposition, and not to folding. The evidence also indicates that there are probably two causes for the non-persistence of the strong lignite beds. One is, that certain parts of the deposit were eroded before being covered by subsequent deposition. This would explain the abrupt termination of certain veins. Another theory, and one which explains the lense formation of certain deposits, is based on the filling in of the low places during deposition. More weight is given to the first explanation, because of the fact that the veins are fairly

continuous, and can be traced for considerable distances. even when they are degraded to mere seams. Another important feature in the structure of this area, and one which bears strongly on the value of the lands, is the dip of the strata away from the rivers. Aside from the local dips or waves in the coal beds, the borings made at Lehigh, Dickinson and other points along the Heart River, show that the coal bearing strata havea slight dip toward the north, while toward the south they tend to pinch down to seams. The railroad well at Dickinson shows a five foot vein at fifty feet depth. One half mile north the Dickinson city well shows a small vein of coal at 71 feet; and a total depth of 95 feet shows no other beds. Having no means of determining elevations, the dip of the strata from the river was approximated about 3 degrees. If, as thus indicated, there is such a general dip, it naturally follows that it is a part of a great fold or syncline, which appears again along the Green River. The natural inference then is that the high lands between the flood plains of the rivers are from 100 to 200 feet above any valuable coal measures. Toward the northwest of Dickinson, about 8 miles, there is a strip of country between the two rivers where numerous outcrops are found, indicating an upward fold in that direction also.

In the question of the availability of the lignite of this area, there are two important considerations. First, whether or not the vein is of sufficient thickness and quality to warrant mining by the entry system. If the first condition does not hold, whether or not the amount of surface stripping necessary is too great to allow mining by that method. There are only two large mines operating in this district, and the experience of the operators is that it is impossible and impracticable to mine less than 6 or 7 feet of coal, and that it is necessary to have from 3 to 5 feet of coal in the roof. Since there is only about 30 to 40 feet of covering above these mines, it follows that in deeper mines, which might be opened in the future, it would be necessary to use heavier pillars and more timbering, thus increasing the cost of operation. Again, since these mines are entered by openings driven in from the hillsides, directly on the coal, it is clearly seen that deep shafts or long inclines would also increase the cost of operation. These facts are presented to show that deep mining or mining of shallow veins are questions to be decided in the indefinite future. Here it is well to state that there is a vein of lignite 22 to 25 feet in thickness, about 300 feet below the surface at Dickinson. It was penetrated by a deep well, driven by the Northern Pacific Railway Company, who also

drilled one at Medora, fifty miles west. At Medora this vein is found at a depth of only 130 feet. There is no information available concerning the extent of this deposit, but it is safe to assume that it underlies a considerable territory. It will be many years before any further prospecting will be done on this deposit.

By the stripping method of mining it is possible to mine the coal from 2 feet and 3 feet veins, providing the depth of stripping does not exceed one and a half times the thickness of the coal. Thus it is seen that even 10 feet veins cannot be mined, if the stripping exceeds 15 feet or, at the most, twenty feet. Consequently, most of the lands are valuable for coal only in the immediate vicinity of the outcrops or banks, because invariably these outcrops are found on the drainage, with the ground surface rising on each side of them. Investigation also shows that in the majority of cases the veins tend to diminish away from the cropping. This disproves the popular fallacy that they are certain to thicken as the mines go back into the hill. The soil in this locality is fertile and often yields from $10 to $15 per acre per year. Practically all the arid and semi-arid lands are far above the coal horizon in the Butte areas. Thus it is conclusive that the land may contain coal in workable quantities near the surface and immediately available, not fifty years hence, in order to make it more

valuable for mineral than agriculture. So far as the writer was able to ascertain all such lands are in the possession of private persons or corporations, having been obtained, either by purchase or by proving up, in accordance with the homestead laws. Whether or not there was fraud connected with any of the latter operations, it is impossible to say without special investigation. A thorough knowledge of the extent and value of the coal beds would require a series of deep borings throughout the area, which would entail a cost probably as great as the value of the lands.

The economic value of the lignites of this district as compared with eastern bituminous coals is found by exhaustive steam tests to be 63 per cent. of the latter. This precludes the use of lignites under the locomotive boilers and limits the market to the local trade. On the other hand the home market is greatly restricted because of the numerous small outcrops which supply the ranchers and farmers. What the future has in store for the lignite, it is impossible to say, but there are two means by which it may be made of great economic value to the country. If the lignite can be successfully and cheaply briquetted there is no doubt of its value as a steaming proposition. Such tests are now being made by the Technologic Branch of the United States Geological Survey at Pittsburg, Pennsylvalia, samples having been taken from Lehigh, North Dakota. On the other hand, lignite has great gas producing qualities. Tests

show that 2.29 pounds of dry North Dakota lignite in a gas producer plant has the same power value as 3.39 pounds of the best West Virginia coal in a steam plant. Taking an optomistic view then, it would seem that the lignites contain great possibilities for future power

In view of the foregoing facts, this writer made appropriate recommendations to the General Land Office of the United States in regard to lands hereinbefore mentioned, which have been classed as valuable coal lands, and had been withdrawn from entry by homesteaders, such recommendations being in accordance with and along the line of action indicated by the act of Congress approved March 3, 1909, entitled "An Act For the Protection of the Surface Rights of Entrymen."

Respectfully submitted,

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Fargo N. D.