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The Canadian carbonizing and briqueting plant now building at Bienfait, Sask., in the heart of the lignite district

American Lignite Coals

Canada Blazes the Way to Put Them on a Par with Anthracite

By Robert G. Skerrett

CANADA'S fuel problem has brought about action on the part of the Dominion Government that is no less important to us than it is prospectively to our northern neighbors. The work of the Lignite Utilization Board of Canada will shortly bear fruit through the carbonizing and briqueting plant now rapidly nearing completion near Bienfait in the Province of Saskatchewan, just across the boundary line of North Dakota. The establishment is designed to have an annual capacity of 30,000 tons of lignite briquets, costing, loaded on cars, about \$7.50 a ton at the works. Each ton of this fuel, as amply demonstrated, will have, when burned in the domestic furnace, substantially the heating value of an equivalent unit of anthracite coal. Two tons of lignite will make a ton of briquets.

While the fuel resources of Canada are both great and varied, their geographical distribution unfortunately leaves a vast region, lying between the bituminous coal deposits in the neighborhood of the Atlantic Coast and the lignite beds of Saskatchewan, destitute of natural fuels save such as peat and wood. The coalless industrial districts of Quebec and Ontario are in this unfavored area, and, accordingly, these provinces, together with Manitoba, must in the main obtain their coal from the United States. This situation has not unreasonably been viewed by the Dominion Government as "an industrial menace and a national problem," hence the steps that have been taken to turn the native lignites into a really efficient fuel.

Up to now, the fuel question in western Canada and particularly in Saskatchewan has bristled with physical and economic difficulties. Into that region there has gone annually in normal times, from the anthracite mines of Pennsylvania, quite 500,000 tons of coal, representing to the consumers an outlay of about \$6,000,000. In addition to this fuel, so it seems, householders have used large quantities of the native coal owing to its cheapness; but the stuff is dirty, breaks up easily, and disintegrates quickly. In short, it is objectionable in use, and relatively low in heating value.

However, underlying the Province of Saskatchewan and reaching southward into Montana, Wyoming, and the Dakotas are immense deposits of poor lignites. These beds cover more than 13,000 square miles, and are estimated to hold 59,812,000,000 tons of the fuel. The lower seam of these lignites is deemed commercially the more important, for it attains a thickness of eight feet, yielding 11,000 tons an acre, or substantially 10,000,000 tons to the square mile. Better lignites and bituminous coals occur in Alberta; but for economic reasons, the Canadian authorities very sensibly set themselves the task of finding a process by which the Saskatchewan lignites could be made nearly comparable with anthracite—realizing that if they achieved this they would incidentally have at hand the

means by which to briquet the higher-grade lignites Alberta.

At the very start, the Lignite Utilization Board availed itself of all information obtainable in the United States and in Europe, and then bent its energies to dealing with the circumstances immediately confronting them, seeking the while to employ to advantage any domestic media that would be likely to keep down the briqueting cost. After the examination of a large number of samples of Saskatchewan lignites, the average composition was found to be as follows:

Moisture	26.13
Volatile hydrocarbons	28.11
Fixed carbon	38.16
Ash	6.86
Sulfur	0.74

The mean of the products of carbonization of a ton of these lignites was:

IN a recent issue, Mr. Skerrett told us something about the brown coals of Germany and the success with which they are being utilized in a manner that puts them right on a par with anthracite. There is something fascinating in this idea of taking deposits that if left to themselves would become hard coal a few million years from now, and in a few hours converting them into the fuel equivalent of hard coal. In a sense the processes of geologic ages are accelerated so that they are brought to their conclusion in hours or even minutes. And now we learn that what has been done in Germany is being done in Canada and may be done in the United States, with the enormous deposits of low-grade coal existing in the great Northwest.—THE EDITOR.

Gas	10,000 cubic feet
Oil or tar, waterfree	15 gallons
Ammoniacal liquor	65 gallons
Carbon residue	955 pounds

Experience has shown that lignite carbonizes much more readily than bituminous coal. This confirms the investigations of our own Bureau of Mines, which discovered that lignite does not coke in the sense that bituminous coal cokes, but crumbles on being carbonized. This action facilitates a continuous and a comparatively inexpensive distilling process, and obviates the laborious and costly charging and drawing of retorts as practised in coal-gas plants. Further, lignite parts with its volatile content more readily than is the case with bituminous coal. The most rapid evolution of gas takes place at the comparatively low temperatures of from 700 to 900 degrees Fahrenheit; and substantially all of the gas is released when 1,000 degrees is reached. The gas has a heating value of

400 to 450 British thermal units to the cubic foot.

According to the Report of the Canadian Research Council, there is more gas in a ton of lignite than would be required to carbonize another ton of the raw material. Assuming that it takes 6,000 feet of gas to carbonize a ton of lignite, each ton undergoing treatment would then supply an excess of 4,000 cubic feet which could be used for other purposes, among these the generation of power. Inasmuch as the average gas engine consumes 10,000 B.t.u.'s per hour per horsepower, 4,000 cubic feet of the gas would supply motive energy for 160 horsepower-hours. The ammonia by-product of the carbonizing process can be made available as a fertilizer, for use in refrigeration, or as an ingredient in the manufacture of explosives; while the oils and tars, resulting from the distillation of the lignite, have many fields of application. The Lignite Utilization Board, however, has centered its efforts upon developing a satisfactory briqueted fuel primarily for domestic consumption. The Canadian authorities have watched with

alarm the steady upward trend of the price of coal obtained from this country, and they sensibly are seeking to anticipate the day when the United States will, in all likelihood, place an embargo upon the exporting of anthracite. As they figure it, the cost of lignite briquets will drop with greater production, and the use of that fuel will widen directly in proportion to the volume of output.

The plant at Bienfait is the climax of carbonization experiments which have passed successively through small-scale laboratory tests, large-scale laboratory tests, and semi-commercial tests; and thus the Fuel Utilization Board has reached the conclusions which have warranted the Provincial Governments of Manitoba and Saskatchewan and the Dominion of Canada in appropriating a total of \$400,000, of which fully \$370,000

will be expended in rearing and equipping the works. This is a tidy sum, but the outlay will soon justify itself. With the briquets bringing \$7.50 a ton at the factory, the transportation charge amounting to \$1.50 within a radius of 150 miles, and allowing another \$1.50 for a dealer's profit and cost of delivery, the ultimate consumer would then pay but \$10.50 a ton as against something like \$15 now asked in that region for Pennsylvania anthracite. This represents a potential saving of certainly \$4 a ton; and with a plant output of 30,000 tons yearly, the householders would be the better off each twelvemonth by \$120,000. Further, viewing the matter from its broader economic aspect, the Dominion would keep within its boundaries annually \$450,000, while laying the foundation for a domestic business susceptible of tremendous expansion.

Much like the brown coal of Germany, the lignite of Saskatchewan is so deficient in inherent binding material that a briquet made without the addition of a

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binder will not stand storage and handling. On the other hand, briquetting the untreated lignite with a binder is commercially prohibitive because of the expense involved in view of the low grade of the raw fuel. It was because of this that a system of drying and carbonizing had to be developed which would produce a substance lending itself readily to processes of briquetting.

The carbonized lignite is said to bear somewhat the same relation to the original material that charcoal does to wood, and the resultant coke contains about double the amount of fixed carbon that would be found in a like quantity of raw lignite. Therefore, with its combustion value thus improved the coke justifies the price of a suitable binder.

The practice is to mix the carbonized material with a binder and then to subject it to compression in a briquetting machine. In this condition, however, the briquets are not waterproof, and to make them so they are heated sufficiently to cause the binder to coke. The Canadian investigators have spent a good deal of time in fixing upon a suitable binder, because they recognize that this factor would be an important one in making the whole undertaking industrially practicable.

Coal-tar pitch is an excellent binder, but that substance is by no means cheap in Canada, and the amount available there is rather limited. Sulfite pitch, produced in the manufacture of paper pulp, is at hand in immense quantities. This liquid is generally discharged as waste into the waters near pulp mills, and has been responsible for the poisoning of the fish in the streams. This pitch provides a thoroughly satisfactory binder.

The Canadian Research Council sapiently pointed out three years ago, before the Lignite Utilization Board became active, that the road to success in the briquetting problem is strewn with the wrecks of ill-conceived attempts to do this apparently simple thing—failure resulting from either ignorance of what had been done, lack of technical experience, or shortage of money. Therefore, the Lignite Utilization Board obtained the generous appropriations already mentioned, and with this fund in hand, and with a wealth of expert assistance, it was relatively easy to settle upon a proper line of procedure and then to start the erection of a plant of ample capacity to operate on a commercial basis. The Board intends to distribute its output through the ordinary channels of trade even though working as a governmental institution. As explained officially, "In its relation toward business interests, the Board has the power of an incorporated company to buy, sell, make contracts, hold property, etc. In its relation to the Government, it is a trust, holding and expending funds provided by the Government, and having power to hold property in trust."

The factory at Bienfait would have been in full swing months back had not delays been encountered in connection with the delivery of machinery and building materials. Even so, the chairman of the Board, Mr. R. A. Ross, reports that the works will be producing briquets by the beginning of the coming summer. This example on the part of our neighbors to the north should prove heartening to us, and no doubt will serve to strengthen the hand of the U. S. Bureau of Mines in its ceaseless endeavors to open up new sources of fuels within our continental limits. Two years ago the Bureau stated that the nation's coal resources of all ranks totaled 3,553,637,000,000 mineable tons of 2,000 pounds, of which 1,051,290,000,000 tons, or nearly one-third, consisted of lignite. Of this lignite 964,424,000,000 tons lie in North and South Dakota and

northeastern Montana, while approximately 23,000,000,000 tons are in Texas, 7,404,000,000 tons are in Alaska, and relatively smaller quantities are in several of the other western and southern states. Plainly, if these so-called low-grade fuel deposits can be transformed into briquets substantially the equal of a corresponding weight of anthracite coal, surely this metamorphosis should be encouraged in every possible way.

The fact that should be held continually in mind is that our lignite deposits are commonly found in those parts of the country where no other solid fuel exists. The average analyses of some of our lignites give the following values:

		North	Arkansas	Texas	Dakota
Moisture . . . per cent		29.73	28.63	27.13	
Volatile hydrocarbons " " "		37.87	32.53	29.11	
Fixed carbon " " "		23.95	30.43	36.16	
Ash " " "		8.45	8.41	7.60	

The Alaska lignite closely resembles that of Texas and North Dakota, and the sulfur content of the lignite in these fields rarely exceeds 1 per cent. The average heating value is about 7,500 British thermal units per pound. The Arkansas lignite is distinguished from the others principally by a higher percentage of volatile matter, which yields large quantities of oils and tars.

Fuel conditions in so-called western Canada are not radically dissimilar from those prevailing throughout our own lignite-bearing States, into which we ship yearly millions of tons of bituminous and anthracite coals. As the Bureau of Mines expresses it, the procedure is "literally an example of 'carrying coals to Newcastle.'" The results are high prices for both industrial and domestic fuel, the imposition of a great handicap on the industrial development of these regions, the tying up of much transportation equipment needed for other service, and other economic lost motion. The problem therefore involved in the utilization of lignite is not a local but a national one."

Finally, by way of emphasis, the Bureau shows what is happening in the territory naturally tributary to the Dakota lignite deposits. Into this region something like 2,000,000 tons of bituminous coal is shipped annually from Illinois, Indiana, West Virginia, Kentucky, and Pennsylvania. The average haul is about 1,000 miles.

If the lignite in the Dakotas and Minnesota were put into stable and serviceable condition, by means of carbonizing and briquetting, the fuel demand could be supplied with an average haul of less than 400 miles. Two years ago the freight rate was about four mills per ton-mile. On the face of it, if the fuel and power requirements of the area in question were supplied from the local lignite mines there would be a yearly saving on freight alone of quite \$4,800,000! And if this near-by fuel were used in place of the anthracite and bituminous coals brought from other States, the movement of 1,200 engines and 50,000 cars would be avoided. The rail-tonnage referred to does not, of course, include the carriage of 1,500,000 tons of anthracite which makes a goodly part of the trip to this region by way of the Great Lakes.

The Bureau of Mines has at its disposal an appropriation of \$100,000 for the investigation of lignite utilization, and New Salem, North Dakota, has been selected for the site of a Government plant for large-scale carbonizing and briquetting tests. This allowance seems inadequate in view of what Canada has done to provide for the needs of a far-less densely populated section. Here in the United States the transportation of coal and its widespread distribution invite reflexes of a grave economic character concerning probably twelve times as many people as in the case of the Dominion.

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