

**Please read and send in as full
discussion as possible at earliest date.**

The Canadian Society of Civil Engineers.

INCORPORATED 1887.

ADVANCE PROOF—(Subject to Revision)

N.B.—This Society, as a body, does not hold itself responsible for the statements and opinions advanced in any of its publications.

INITIAL PROCEEDINGS IN OPENING UP A COAL MINE

BY C. M. ODELL, M. Can. Soc. C.E.

To be read at a meeting of the Mining Section, January 8th, 1914.

While but little that is new to members of the society may appear in this paper, the writer's excuse for inflicting it upon the readers of the transactions is that a new generation, which is growing up, may be interested to know of the initial proceedings in opening what is destined to become in the near future one of the largest producing coal centres on the continent.

Before proceeding with the description of the initial work of opening and developing a coal basin it may be well to refer briefly to the field of which the Lingan Basin forms an important part, and to the early operations carried on therein.

The coal fields of Cape Breton, situated on the northeast coast of the island, are largely submarine, and are divided into four basins known locally as the Morien, Glace Bay, Lingan, and Sydney Mines basin, each of these being separated from its neighbor on the land areas by a well-defined anticline. Whether all these basins join into one great one far out at sea, or end as separate individual basins, must be left for future workers to determine, as it is not the purpose of this paper to enter into a discussion on that point. Historical records show that the value of these coal beds was known and some coal exported during the French occupation in the first decades of the eighteenth century.

The earliest mining operations were carried on by driving tunnels into the seams where exposed in the cliffs along the sea coast, or in gullies where the age-long action of streams had cut through the various strata, leaving them exposed on either side. Coal extracted at this time was generally loaded on scows which were towed out to waiting vessels anchored off shore and then transferred to the vessel's hold. In the early sixties of the past century a number of small companies were formed and operations commenced at a number of different points.

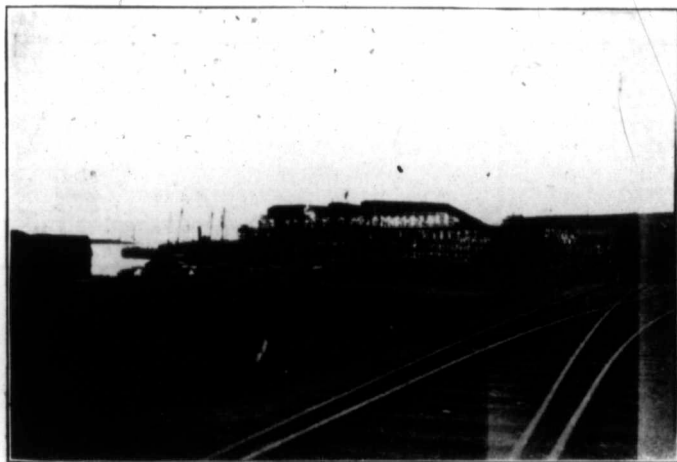
The system pursued by the small individual operators of these mines was to select a point as near the sea coast as practicable. There a mine

was opened either by shaft or slope as the natural conditions best lent themselves thereto, and on account of the proximity of the shipping pier the coal was conveyed to the point of shipment direct in the mine tub or car in which it was loaded in the mine. The distance in most cases being less than a mile the transportation was effected by horses. Gradually the mining was extended and with increased shipments sinkings were made further back from the coast, machinery for handling coal in larger quantities was installed, short lines of steam railway were built, and the coal at the pit mouth was transferred from the mine tub to larger railway cars and thus carried to a point of shipment. It may be of interest to note the gradual expansion in size of cars used in hauling coal from the mines. Up to the early eighties the four-ton car or wagon was almost universal in Cape Breton: During the next few years cars carrying six tons each were introduced. These in turn gave place to ten-ton cars, which were the standard of the larger collieries only, up to the advent of the Dominion Coal Company in 1893, when cars carrying fifteen tons each were substituted. These in turn are gradually giving way to steel cars with a carrying capacity of thirty-five tons dead weight of coal. In the same way, the little ten-ton schooner or "hooker" has by successive stages been supplanted by the great ocean freighter of ten thousand tons carrying capacity.

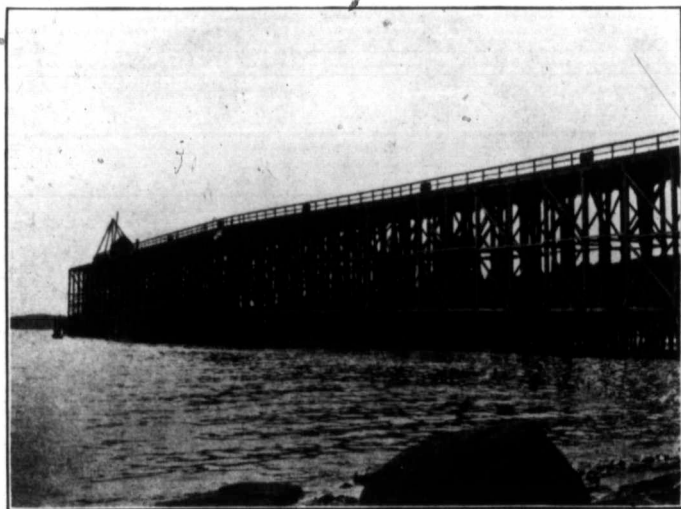
The Dominion Coal Company controls by lease from the Nova Scotia Government all the coal areas worth considering on the southern side of Sydney Harbor, but has for some years confined its operations to the Glace Bay Basin. A royalty of twelve and one-half cents per ton is paid on all coal marketed, and this forms the greater part of the revenue of the province of Nova Scotia. A steadily-increasing market has demanded a larger supply, and the Company has now turned its attention to the immense reserve fields of Lingan and Morien basins. Both of these areas were worked to a certain extent some years ago. The Morien Basin by two companies—the Block House and the Gowrie—while the Lingan Basin was opened at three points by the Low Point, Barrasois and Lingan Mining Co.

The Block House Company, with openings close to the shore, shipped direct from mine tubs to the vessel's hold, over a small shipping pier in Morien Bay, while the Gowrie Company sank a shaft about a mile and a half inland, which was connected with a shipping pier by railway. Coal from the Lingan Basin was shipped partly in Sydney Harbor which was reached by four miles of railway, and partly in Lingan Basin where small piers were erected and connected with the mines by a mile of railway.

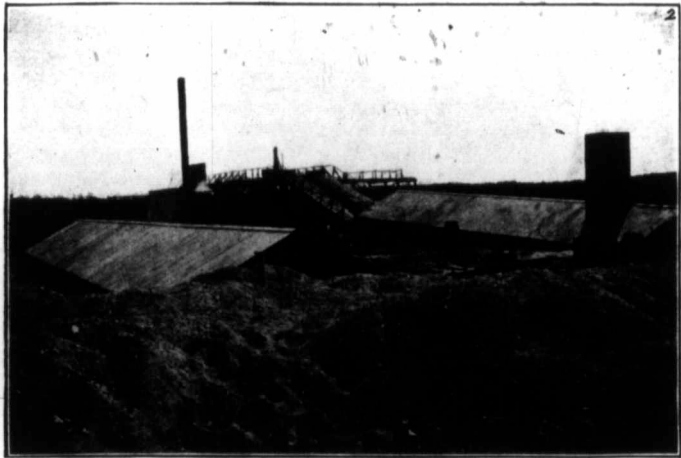
All of these individual operations were absorbed by the Dominion Coal Company at its formation in 1893, many of them having been closed down for years before this date, and their piers allowed to fall into decay. The policy pursued by the present operators has been to concentrate their energies on the Glace Bay Basin for production, and to confine the shipping mainly to two points, viz.: Sydney and Louisburg Harbors, where modern shipping piers capable of handling all the product have been erected. Two points of shipment were necessary for the reason that the magnificent



Coal Shipping Pier in Louisburg Harbor, showing overhead travelling way of belt conveyor, used for carrying coal from storage pocket to point of shipment.



Coal Shipping Pier in Sydney Harbor, in course of construction. Coal from this pier will be delivered direct from railway cars through chutes to ship's hold.



Temporary Bankhead used during development of Colliery No. 14.



Completed Bankhead and slopes of modern Colliery No. 14.

harbor of Sydney, lying within fourteen miles of the mines and offering unsurpassed facilities for shipment, is frozen over during part of the year, while Louisburg Harbor, some twenty-five miles distant in the opposite direction, is open the whole year round and furnishes an outlet when Sydney is closed. Another small shipping pier at Glace Bay Harbor supplies the smaller vessels frequenting this port. This is maintained more as a convenience to such shipping as discharges cargo in Glace Bay and could not at times make Sydney Harbor in safety without taking in ballast.

The bulk of the output is shipped at Sydney where the tonnage during summer months is such that the output is removed as fast as it is sent from the collieries. At Louisburg, which is utilised during winter months, the same regular supply of shipping cannot with certainty be counted on, and consequently a large storage pocket with belt conveyor system is resorted to. Any overplus of coal raised during winter months is stored in coal bank and removed again in summer when the St. Lawrence trade taxes every source of supply to the utmost.

This involves amongst other expenditures the construction of a branch line of railway, connecting each new colliery with the main line, and a colliery railway yard near the pit mouth for the handling and sorting of the various grades of coal. The expenditure necessary to place in full operation a colliery in virgin territory is in round numbers about \$750,000 per unit, and may be generally divided as follows:—

Purchase of site.....	2%	\$15,000
Prospecting and temporary work.....	2%	15,000
Railway construction.....	12%	90,000
Permanent bankhead, colliery buildings, and operating machinery.....	33%	247,500
Lighting.....	2%	15,000
Water supply.....	5%	37,500
Drainage and grading.....	2%	15,000
Housing employees.....	22%	165,000
Fire and life saving stations.....	2%	15,000
Shipping facilities.....	7%	52,500
Underground development including tracks, mine tubs, piping and mine machinery.....	11%	82,500
	100%	\$750,000

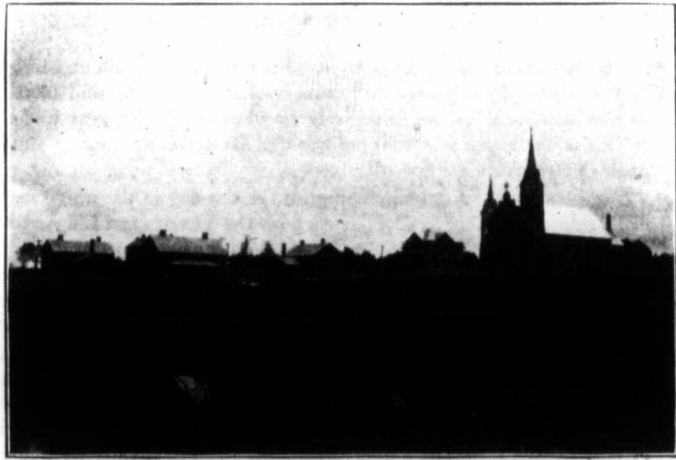
Reference to the map will show that the known coal seams of the Lingan Basin extend from Sydney Harbor on the north to Lingan Bay on the south, a distance of about five miles, and extending some two miles inland, embracing an area of ten square miles of land area and about ten square miles of submarine.

The general dip is northeasterly and the angle of dip about 14 degrees in the centre of the basin, decreasing towards the south and increasing as the seams are followed northerly to where they disappear under the waters of Sydney Harbor, where the dip has increased sharply until an angle of 40 degrees has been attained.

The plans of the Company comprise the opening in the near future of eight collieries in this basin, four each on the Victoria and Lingan seams. Four of these, numbered 12, 14, 15 and 16, are now practically complete and producing to their estimated full capacity of 1200 tons per day, while a fifth is in process of development. Plans are maturing for the opening of two more at the extreme southern limit, and a similar one on the extreme northern limit. This will exhaust the operations on the Victoria and Lingan seams, and leave future enlargement of production to the Barra-sois seam, which is the uppermost of the series, and the Mullins seam, which is the lowest of this group and consequently the largest in superficial extent. When these last seams are opened up to their capacity five more mines will have been added to the operations in the Lingan Basin, making thirteen mines in all in an area of ten square miles.

The system of working is to locate the various openings along the outcrop of the seams at intervals of about a mile and a quarter apart. The deep or main slope is then driven on the dip of the seam and from this the levels are broken off at intervals of 500 to 600 feet. These levels will extend half a mile on either side of the slope, at which point a solid barrier of coal extending parallel to the slope will be left. The barriers will extend from the surface to the extreme working length of the collieries, and are designed to separate each mine from the neighboring workings, so that in case of flood or fire each mine can be treated as an independent unit of production, and a stoppage of one mine need not affect the adjoining operations. Only a basin of such marked regularity in slope and position of the various seams comprising it would lend itself to such a system of working, and in this basin nature has left nothing to be desired. The coal collected from the various levels is drawn to the main slope, whence it is carried by a rope haulage system to the bankhead, there to be run over screens and picking belts into the railway cars for transportation to either of the railway terminals.

Records show an average of about 2.4 tons of coal raised per man employed, and the house record shows about 2.4 working men housed per tenement. Hence a colliery of 1200 tons daily production requires five hundred men, and they in turn require two hundred tenements. The old time "miners' rows" have been long since tabooed and to-day the Company erects neat cottages which are let to the men at reasonable rates. The most suitable style of tenement seems to be a good class of double house, set on a large lot of land, and the grounds around many of the miners' houses to-day present a neat and attractive appearance. These houses are erected and owned by the Company. Their cost at present date averages about \$1,500 to \$2,000 per double block, exclusive of land. As



Double Tenement Houses in course of construction. Lingan District,
Dominion Coal Company's Collieries.



Bettington Boilers of Waterford Lake power-house,
in course of construction.

they occupy extra large lots and are built on wide streets, they average but four to an acre, hence about twenty-five acres of land per colliery is required for housing alone. Adding 125 acres for colliery buildings, railways, roads, pole lines, pipe lines, and drainage ditches, we find an average of about 150 acres per colliery required for surface rights, or about 2000 acres for a layout such as is undertaken here.

The lands surrounding the houses are for the most part owned by the Company, and are all laid out and the streets graded by the Company's engineers. In quite a few cases the miners buy lands and build their own houses, and this custom will no doubt increase as the whole section becomes more settled. The Company encourages the men to become their own landlords, and assists them pecuniarily in many cases.

About two-and-one-half miles of standard gauge track is required for colliery yard at each bankhead, with an additional amount of branch line to reach the main railway, making an average of about five miles of track to be laid for each colliery opened. This track is all laid with 60 lb. rails, while the main line, which is subjected to heavier traffic, is laid with 80 lb. rails. All tracks are built in a most thorough and up-to-date manner, as nothing less would suffice for the enormous and ever-increasing traffic.

As development proceeds and output increases, larger expenditures become necessary for increased screening appliances and picking belts by which the various grades of coal are sorted and impurities removed. More recently a washplant or coal washery was demanded through which the lower grades of coal are passed to more effectually remove sulphur and other objectionable materials. To this end the Company has erected a large coal washer of the Baum type, claimed to be the best in the world, and capable of washing one hundred and twenty tons of coal per hour.

As a matter of economy the refuse from the picking belts and the slack coal from the screens is used under boilers for power raising. A great change has been effected in recent years by the introduction of electric power in place of steam, and the tendency now is to eliminate all steam around the collieries of the Lingan Basin, except for heating purposes. Up to this year these collieries have been supplied with electric power from a generating station located in the centre of the Glace Bay Basin some eight miles distant, but as a part of the equipment a larger generating station situated in the heart of the Lingan district is now nearing completion. This station is to be operated by turbine-driven generators of from 2000 to 4000 kilowatt capacity. The boiler plant consists of three Bettington boilers, a description of which was published in the Special Nova Scotia edition of the Canadian Mining Journal, published in September last. When completed the entire equipment of this district, including air compressors, coal hoists, ventilating fans, bankhead machinery, screening plant and underground pumps will all be electrically operated.

In the matter of protection both for men and property underground, the Draeger life saving apparatus has been adopted, and the erection of

a life saving station at each mining centre is deemed a necessary portion of the general equipment.

Water supply is always one of the very first requisites, and at present a temporary pumping plant at Waterford Lake supplies the needs of the community through a main and distributing system. Plans are however about perfected for a full and ample supply to the whole community at an estimated cost of \$250,000.00.

Surface workings of all collieries are electrically lighted from the Company's plant, and some street lighting is also done. At present the townsite known as New Waterford, is unincorporated and practically all street work, drainage and sewerage is undertaken by the Company. Mine drainage is effected by pumping plants located near the seashore, water being forced through vertical boreholes by electrically-driven underground pumps, and carried by surface ditches direct to the sea.

Shipping piers with all modern appliances are located in Louisburg and Sydney Harbors, the average haul from pit mouth to shipping pier being about twenty miles. Locomotives of 120 tons weight, with coal hoppers of two different types are used on all lines. The two types being wooden hoppers of 15 tons carrying capacity, and steel hoppers of 35 tons capacity. In addition a small percentage of coal which is shipped by rail is carried in box cars. To accommodate these, special box car loaders are installed at some of the collieries, as the loading appliances for hopper cars would not answer for the side doors of the box cars. Present pier loading capacity is about 1600 tons per hour, but the new pier shown in photo, which is nearing completion, will greatly increase this.

Coal-carrying steamers have been gradually increased in capacity from the 3000-ton ship which was looked upon as a leviathan some twenty years ago, to vessels of 10,000 tons capacity in use to-day. These will again be displaced by ships of still greater burden as years go by.

Even with the colliery fully equipped and producing to its full capacity, expenditure on capital account cannot be said to have ceased entirely, as with the working extending farther and farther to the deep, increased pumping and ventilating capacity becomes necessary, the increased length of mine tracks and air piping add their quota, and additional mine cars and mining machines are required to gather a given quantity of coal over a greater area.