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IS THERE COAL UNDER PRINCE EDWARD ISLAND?—BY HENRY S.
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The great activity of late in the coal trade of Nova Scotia and a continuing demand have enhanced the value of coal prospects, and have stimulated inquiry and search in every direction in which rock structure may suggest, not only to the geological student and the miner, but to the promoter and speculator, a possible deposit of coal.

Among the regions in which it is supposed hidden extensions of the productive measure may exist, the Gulf of St. Lawrence is included. For a long time it has been looked on as overlying the major portion of an original coal field of which remnants are found fringing its waters to the south and east, containing, perhaps, in isolated sections, workable seams of coal.

Prince Edward Island lying in the southern part of the Gulf, offers a means of access to any underlying deposits, although the superficial strata of the Island, of later age than the coal measures of Nova Scotia, show of themselves no indication of what is beneath, and are regarded as a cloak covering hidden treasures.

In Prince Edward Island the expectation in this direction can only be met by actual search in depth, and this may best be done by bore-holes in places carefully selected. Matters have gone so far as to receive attention from the Canadian Geological Survey Department, and an experienced officer* has revisited the Island with that object in view. With this feature of the question it is not proposed to deal in this paper, which has for its object only a review of such suggestions as the structure of the several geological formations developed in the neighbouring regions seem to present.

It is no part of this paper to consider the correlation of the several series of deposits both above and below the productive coal measures of Nova Scotia. The terms used are those which appear most convenient, and are the same as those employed, in the Reports of the Geological Survey of Canada, by Mr. Hugh Fletcher in his papers on the surrounding districts. Although disputes have arisen over these terms, and the propriety of their selection has been questioned, they have this advantage,—they leave no doubt as to the sequence of the several groups of strata to which they relate. Whether they be correlatively correct or not, is of no moment in this connection. The terms used are taken to mean as follows:—

Permian.—Strata chiefly reddish sandstones with a base of conglomerate showing at New Glasgow and elsewhere; a few small seams of coal and bituminous shales. The upper members more friable and more easily eroded.

Coal Measures.—Strata containing workable beds of coal with shales and fireclays chiefly black and grey, and sandstones generally grey in colour.

Millstone Grit.—Strata conformably underlying the productive measures, including coal seams, and grit often coarse and reddish in colour.

*Dr. Ells, Summary Rept. Geol. Surv. Canada, for 1902.

Carboniferous Limestone.—Limestone associated with gypsum, sandstones, marls, and local conglomerate; fossil shells, common; coal seams, thin, few, and irregular.

Carboniferous Conglomerate.—Bathal beds often indicating induration.

Devonian.—Including the plant beds of Riversdale, N. S., and Little River, N. B. The Albert shales containing the characteristic Psilophyton.

In this inquiry, the material that is available and from which, on consideration, a conclusion may be derived, consists of:—

(a) The rock formations surrounding the Gulf of St. Lawrence;

(b) The character of the deposits containing workable beds of coal in the measures bordering the area;

(c) And the evidence of soundings in the Gulf which are recorded on the shipping charts.

It is assumed that in Pre-Cambrian days the outline of eastern North America took shape much as it is now, and at the same time the salient features as seen to-day of that part of the continent were established. The edge of the continental shelf was determined and gave limit to the movements which since then have, in large measure, been epirogenic in character.

Synchronous with the alternations to which the region has been subjected along the eastern edge of the shelf, a line of marked weakness branched westward from the margin, where it is sharply deflected eastward to the south of Newfoundland and the Grand Banks. The latter are essentially a part of the continent, though at present under water and in touch only at the Virgin Rocks, which are, it is believed, of Pre-Silurian age.*

If we view the several formations involved in this region as units, it will appear that the amount of local disturbance each has undergone is somewhat proportionate to the respective age: the Permian least, the Millstone Grit moderately, while older

*It is not questioned that the Grand Banks have been largely added to by moraine matter of the Glacial epoch, and have had accretions deposited from icebergs, but on a shallow rock base, an integral part of the continent.

series have suffered much more. The disturbances that did occur, being in proportion to the continental movements, and local, were principally due to settlements under the weight of an increasing mass on an imperfectly denuded and uneven floor of deposition of a previous cycle.

The principal physical features seem to have been retained during the several epochs in the area of the Gulf and its surroundings. Ever since Silurian time the Gulf was an area of depression in its relation to more ancient rocks, although at some periods occupied by more recent and more easily eroded deposits, elevated for a time above the general level of the ocean. During the recurring cycles since Pre-Cambrian erosion gave it shape, depression, deposition, elevation and erosion, regional in action, have been each in turn at work, not always fully replacing and not always fully undoing, the results attained by the opposing force. We see this in the marginal remains and in the islands of the Gulf.

In very early stages of the earth's history direction seems to have been given to the subaerial erosion by the line of fracture that branched westward from the continental edge during periods of elevation which then established a system of drainage for a large area. The same fracture affected the foldings consequent on settlement of the deposits and the oscillations of the plateau.

The geological history of the region it is assumed may be thus summarized:—It was fashioned by deep erosion while Cambrian depositions were proceeding, and folded by lateral pressure which produced parallel ranges along the edge of the continent, the continuity of which was disturbed by the branch fracture to which reference has already been made. Of the lines of partial relief to the lateral pressure, one was established on the south side of the coastal range in New Brunswick, thence it was diverted by the fault spoken of to a course nearly due east and west, leaving on the north the highlands of Dalhousie Mt. in Pictou Co., and those near Cape George in Antigonish. It thus formed the southern rim to the Gulf region. Thence renewing their original direction the oro-

genic movements proceeded through the highlands of Inverness to join the great fault of the St. Lawrence Valley and the Gulf, and give an easterly margin to the area in question.

With the geological cycles that occurred prior to the Carboniferous era, we are not particularly concerned, beyond noting the more and more marked persistence, as time rolled on, of the dominant features, and the establishment then of systems of drainage which have continued to the present day, e. g., that through the Cabot Strait and between St Paul's Island and Cape North, which must have been long continued for the erosion to cut down rocks as hard as these Pre-Cambrian, to such profound depths, 2000 feet or more below the level of the sea, itself some 1400 feet below the eroded top of the mountain plateau. Then, too, the Pre-Carboniferous erosion cut through the Pre-Cambrian rim to the Gulf area, where the ancient break had occurred at the deflection between Cape George and Cape Mabou. In the waters between these capes, soundings show a submerged ridge, a remnant of the mountain range. A similar old time denudation, doubtless, gave direction to the rivers of Pictou. Yet again we have another opportunity to measure the work of Pre-Carboniferous erosive agents in these time-defying rocks. The eastern end of the coastal range bordering the Bay of Fundy has its present termination in Caledonia Mountain, but when the land stood at a higher level, the range extended further to the eastward and beyond the passage across it of the existing rivers, the Petitcodiac and Memramcook. Of the extension beyond these rivers, remnants of former peaks project through later formations at Lutz Mountain, Colhoun's and McManus's Mills. These modern rivers have their beds cut in rocks of Millstone Grit, Carboniferous Limestone and Albert Shales, deposits here occupying a broad valley previously eroded across the range of old rocks by Pre-Devonian streams, the predecessors draining the extensive country lying to the north of the range.

To what depth this great Pre-Devonian valley was eroded is not known, but bore-holes in search of oil in the Albert Shales

have proved it to be over 1000 feet below the tide, and thus presumably comparable in character to the broad valley in Cabot Strait that drained the St. Lawrence region when the continent was elevated far above its present level. That the continent has stood vastly higher than it now does, there can be no doubt, and to convert the present estuary of the great river and the Gulf into a valley with a flowing stream capable of eroding its bed, would require a general elevation of not less than 2,500 feet, and possibly still more.

The Pre-Carboniferous erosion, which was of excession magnitude, left for subsequent depositions a platform that, through all after changes, has retained much of its original horizontality. Nor has it been broken, except locally, by fractures of secondary importance, and then only to a very limited extent. The cycles preceding the Carboniferous, supplied the erosion that gave shape to Nova Scotia as a peninsula and formed the great bays of the coast, of which some still show above the present shoreline remains of the Lower Carboniferous deposits that evidently encircled and covered much of this and neighbouring lands. Remains of these deposits are to be found in the bays of St. Margaret, Chedabucto, Fourchu, Gabarus, Lorraine, Mira, the Bras d'Or, St. Ann, Aspy, St. Lawrence, etc.

Circumstances changing, and a new cycles entered on, there must have followed a depression of corresponding magnitude and conditions favorable for the deposition of the bay and other deposits, the massive limestones and gypsums beds which are spread over an extent of country some four hundred miles in length.

After an epeycyclical period and lessened disturbances which left large districts of these later deposits still exposed to denudation, a series of sedimentations set in, which in time culminated in strata associated with the productive coal measures.

We have now reached the crux of the matter, and have to consider how wide-spread were the conditions favorable to the deposition of coal seams, and in what districts did those con-

ditions exist. Was the Gulf in any part an upland region during the coal measures period?

We do know from a study of the Pictou coal field that there were limits and parts where no workable coals were laid down.* In Cumberland County, also, the Geological Survey has demonstrated the gradual and final substitution of non-bituminous for bituminous deposits. A close study on the western coast of Cape Breton, it is believed, will show like conditions there,—basin-shaped districts which never were parts of one coal sheet continuous over the Gulf area. The districts of coal measures now found isolated above the shore line, were in some cases probably not separated by faults, but further exploration is necessary to prove this. An examination of the admiralty charts suggests that a surmise may fairly be made of the rock structure which underlies part of the Gulf. The islands tell us something, and we know that a well defined anticline, bringing to the surface Carboniferous Limestone strata, extends from Skepody Mt., at the head of the Bay of Fundy, towards Wallace, parallel with the Cobequid range and the series of great folds in the gold-bearing rocks of the Cambrian. This Wallace anticline is not seen to the eastward, but its continuation, hidden under Permian strata, is suggested by the presence of an elevated ridge shown by soundings to range east of Pictou Island and southeast of Cape Bear of Prince Edward Island. I venture to go still further a-field and to regard that the basal rocks of the Magdalen Island, also of Carboniferous Limestone age, and which, in comparatively recent times, were much more extensive than they now are, extended, as indicated by the soundings, parallel to the Cape Breton coast near to Prince Edward Island, owing their origin to a folding contemporary with the Wallace anticline. Within the shelter of these ridges possibly were the conditions alone favorable for the accumulation of coal in seams of workable thickness.

Prince Edward Island and the major part of the Gulf area lie outside the fold.

*The Pictou Coal Field, Trans. N. S. Inst. Sc., vol. 8, 1893.