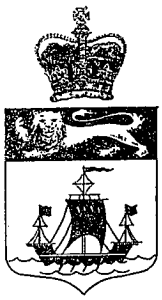

NEW BRUNSWICK

Salt in New Brunswick

J. B. Hamilton
Geological Division

1961

Salt in New Brunswick

Published by authority of HON. H. G. CROCKER,
Minister of Lands and Mines of the Government
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1961

PREFACE

Salt in New Brunswick is the first of a series of publications on the mineral resources of the province. Such publications will be issued from time to time as data is compiled. They will be prepared from information on file at the Mines Branch and from original work done in the field.

Salt was first produced around 1850 and sporadic attempts have been made since that time to develop this industry. This report is a compilation of a large volume of information which has been accumulated over many years.

C. S. CLEMENTS,
Director, Mines Branch.

Fredericton, N. B.
March 27, 1961.

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INTRODUCTION

History

Salt was first produced in New Brunswick between 1850 and 1900, at Salina and Plumweseep by evaporation of brines from local salt springs. Production was limited and sporadic, and while complete figures are not available, it is improbable that a total of more than 500 tons was produced. Ells (1907, p. 128) states that annual production values rarely exceeded 150 to 200 barrels. All salt production appears to have been marketed locally, being used largely for dairy purposes and in the curing of meat and fish.

It was not until 1920 that the presence of rock salt was known in New Brunswick. In that year the D'Arcy well, drilled on Boyd Creek in search of oil, intersected almost 500 feet of rock salt. In the following years, as the number of holes drilled in search of oil and gas increased in the Stoney Creek field near Moncton, the limits of the Weldon-Gautreau salt basin were defined. Since considerable quantities of glauberite are found interbeded with the salt, attention has recently been focused on this basin as a source of glauberite.

As the result of geophysical investigations carried out by Shell Oil Company Ltd., about 10 years ago several other salt occurrences were discovered, and although the Dorchester occurrence is the only one that has been proven to contain salt, geophysical anomalies suggest that the Westmorland sub-basin may also contain accumulations.

Geology

Carboniferous sedimentation in New Brunswick took place in an environment that was almost entirely non-marine. Limited thicknesses of marine deposited rocks occur in the Mississippian system, but the great bulk of Carboniferous rocks are of continental origin. Their distribution is given in Figure 1.

Most of the rocks in the lower part of the Mississippian system are reddish, and show marked lateral and vertical grading. In contrast to the reddish, intermontain, subaerial deposits of the Memramcook, Weldon and Hillsborough formations, the Albert formation is grey and shows all the characteristics of fluviatile and limnic deposition. During deposition of the Albert formation quantities of salt were deposited in the Moncton Basin as the result of marine flooding.

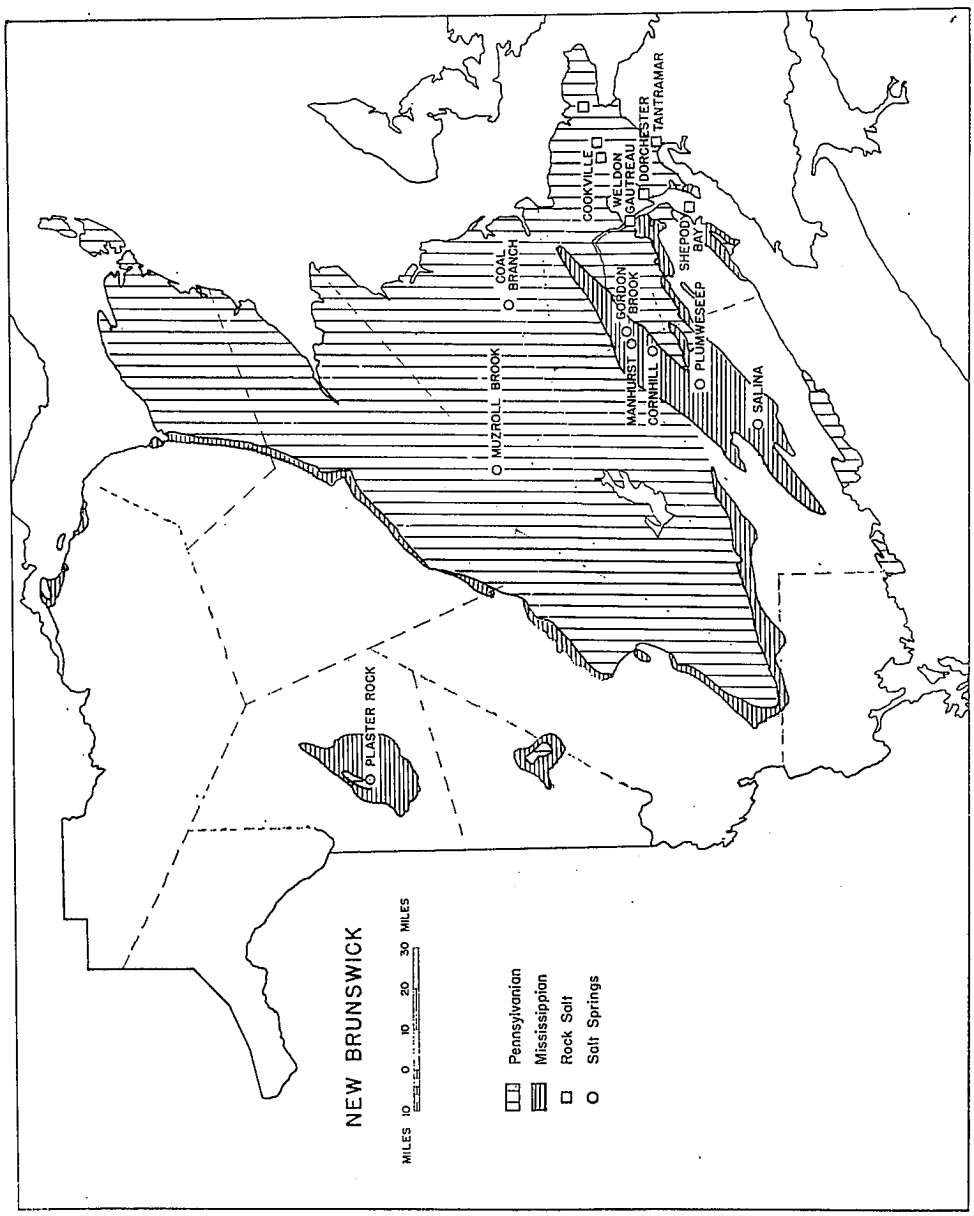

FIGURE 1 Map of New Brunswick, showing distribution of Carboniferous rocks and location of salt occurrences mentioned in text.

In middle Mississippian time shallow marine flooding occurred, during which the Windsor group was deposited and was probably even more extensive than represented in Figure 2. This inundation resulted in the production of the limestone, gypsum, salt and other evaporites which occur in the Windsor group. As a source of salt the Windsor group is of much greater importance than the Albert formation.

Following deposition of the Windsor group Carboniferous sedimentation was characterized by river-channel, floodplain and esturian sheet-sand deposition. These deposits, now restricted to the St. John, Moncton, Central and Plaster Rock basins, probably covered most of New Brunswick at the end of the Palaeozoic era. Mesozoic and Cenozoic erosion was responsible for the present-day patchy distribution of Carboniferous rocks in the province.

Evaporites

The evaporite deposits of New Brunswick have not yet been investigated in detail, although Sund (1958) has described the physical and chemical environments under which the gypsum-anhydrite deposits were probably formed. There remains only a study of the subsequent evaporite phases and their inter-relationships to round out the investigation of New Brunswick's evaporite deposits.

The postulated extent of the evaporite basins which occurred during Mississippian time in New Brunswick is given in Figure 2.

Although the general sequence of limestone at the base, overlain by gypsum and anhydrite, and finally halite, occurs in most of the salt areas of the province, drill-hole data in the Albert basin indicate that variable relationships exist between the various salts. Calcite, dolomite, gypsum, anhydrite, glauberite, halite (and probably many other minerals) occur in varied sequences which sometimes appear to be the opposite of that which would normally be expected. Undoubtedly such anachronisms are due to physiochemical changes in the depositional environments.

The evaporite basins consisted of shallow bodies of marine water that were almost completely cut off from the sea by bars or reef structures. Sea water periodically flowed into the basins, but drainage back into the sea was restricted. Evaporation of the trapped waters resulted in the concentration of salts in the basins and when the water volume was reduced sufficiently, preciptation of the various evaporite minerals occurred. The disparity in the volumes of ingressing and egressing water permitted great thicknesses of evaporites to form.

The basins were surrounded by low-lying land over which sluggish, silt-laden streams flowed, carrying argillaceous matter into the basins, which are preserved as layers of shale and marl interbedded with the salt. The streams also had the effect of freshening the basin waters and altering the salt concentrations, thus disturbing the natural evaporite sequences. In a similar manner, sequences were altered by the periodic influx of marine water.

Environmental conditions within the basins did not differ from those that would normally be expected. However, for short periods of time, stagnancy occurred locally. In the Kingston uplift area argillaceous dolomite, of Albert age, occurs containing laminae of organic matter and pyrite.

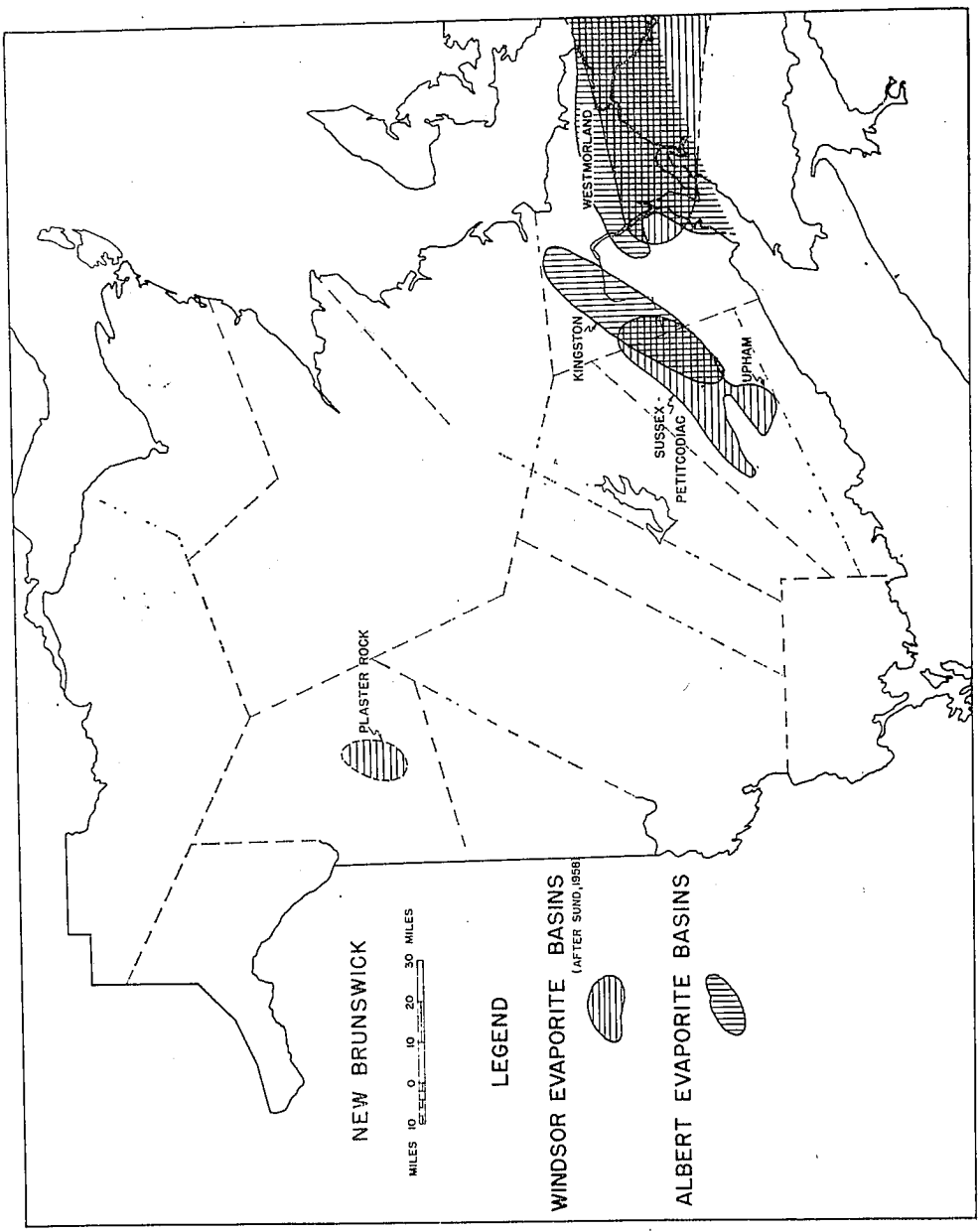

FIGURE 2 Map of New Brunswick showing postulated extents of Windsor and Albert evaporite basins.

Theoretically in the warm, shallow salt basins limestones formed first, probably as the result of direct chemical precipitation. The limestones were followed by dolomite when the solubility product of $CaMg(CO_3)_2$ was exceeded. Whenever the salinity reached approximately three times its normal concentration due to evaporation, gypsum formed if the temperature was such as to permit it. The precipitation of gypsum continued until about half the $CaSO_4$ was removed from solution, at which time anhydrite deposition replaced gypsum precipitation. As the water volume further decreased, anhydrite continued to precipitate. When the volume had been reduced to about 90 per cent of its original value, halite began to precipitate. The co-precipitation of halite and anhydrite then occurred until the stability field of polyhalite was reached. Potassium and magnesium salts did not form until the original volume had been reduced to about 98 per cent.

The Stratigraphic Sources of Salt

The significant salt deposits are confined to the Moncton Basin, particularly the Westmorland sub-basin, and to an area south of the Kingston uplift which extends from south of Norton to Anagance.

The Albert is the only formation in New Brunswick that is definitely known to contain rock salt, drill holes having intersected salt in this formation in the

Table I

Stratigraphic Sources of Salt

Basin and occurrence	Mississippian		Pennsylvanian
	Albert formation	Windsor group	
Central Basin			
Muzzroll Brook and Coal Branch			X
Other occurrences			X
Moncton Basin			
Sussex-Petitcodiac sub-basin	X		
Anagance Axis		X	
Cornhill, Manhurst and Gordon Brook	X		
Upham sub-basin			
Salina		X	
Westmorland sub-basin		X	
Weldon-Gautreau Salt Basin*	X		
D'Arcy Well	X		
Gautreau No. 88	X		
Test Well No. 108	X		
Test Well No. 112	X		
Weldon 49-1	X		
Dorchester*		X	
Baie Verte	X?	X?	
Cookville	X		
Shepody Bay (Grand Anse and Maringouin anticlines)		X	
Tantramar Fault		X	
Plaster Rock Basin		X	

*Localities where drill holes have intersected salt.

Weldon-Gautreau basin. The only other drill hole known to have intersected salt is Shell's Dorchester No. 1, where the salt originates in Subzone B of the Windsor group. As indicated in Figure 9 the Albert formation lies almost directly below the Dorchester plug, so an Albert source here cannot be completely discounted.

Gussow (1953, p. 1745) concluded from geological, gravity, and seismic interpretations that the Dorchester, Grand Anse, and Maringouin anticline occurrences are of Windsor age. The Sun Oil Company's Nappan No. 1A well (1947) encountered salt in the Windsor group near Amherst, Nova Scotia. This drill hole is on strike with the Shepody Bay occurrences in New Brunswick on the north side of the Minas Basin.

The Cookville occurrences have been ascribed to the Albert formation on the basis of seismological surveys.

Drilling is the only method that will establish the age of the occurrences, and salt intersections have been limited to the Weldon-Gautreau basin and the Dorchester area. The other occurrences have been dated by geophysical means except those at Cornhill, Manhurst and Gordon Brook where geological evidence indicates that they occur in the Albert formation.

Table 1 shows the stratigraphic sources of the salt for the various known salt occurrences. In the following pages, as in this table, the various occurrences are arbitrarily grouped into basins for convenience in description.

CENTRAL BASIN OCCURRENCES

GEOLOGY

SALT springs and saline overflows have been reported from various parts of the Central Basin of New Brunswick. A triangular-shaped structural basin, the Central Basin, covers about 10,000 square miles with its apices at Bathurst, Oromocto Lake and Cocagne, Kent County. Gently undulating Pennsylvanian rocks, with a regional eastward dip, blanket the basin. These rocks attain their greatest thickness at the east coast where they measure 2,500 and 3,500 feet in the Rogersville and Tracadie sub-basins, respectively.

The Central Basin is outlined by a thin band of red beds the age of which is not known with certainty although they have been dated as Mississippian (Bailey et al., 1871-79). They may be of Pennsylvanian age, correlating with either the Riversdale or Cumberland groups of Nova Scotia.

In assessing the salt possibilities of the Central Basin, consideration must be given to (1) the nature of the Pennsylvanian rocks; (2) the possibility of Mississippian rocks being present; and (3) the nature of any Mississippian rocks that are present.

On the basis of present knowledge the Pennsylvanian system does not appear to be a favorable source of indigenous salt. Sedimentation took place in freshwater fluviatile, lacustrine, paludal and deltaic environments. There is no evidence of widespread aridity having occurred. Frosted sand grains occur locally, but the frosting is believed to have occurred in previous erosion cycles, possibly in the Mississippian period. Any economic quantity of salt that may be present in the Pennsylvanian system would almost certainly have to have migrated there from underlying Mississippian rocks.

It has not been established that Mississippian rocks are present below the Pennsylvanian system in the Central Basin except locally.

Local conglomerates (Newcastle Creek formation) possibly of Mississippian age outcrop near Minto and Fredericton. If these conglomerates are of Mississippian age, then some early Carboniferous sedimentation clearly must have occurred, at least in parts of the Central Basin. The conglomerates appear to have been protected from pre-Pennsylvanian erosion by overlying lavas. It is possible that other areas of Mississippian rocks, not protected from erosion, were removed some time prior to Pennsylvanian deposition.

Several drill holes have penetrated the Pennsylvanian in the eastern part of the basin, but Mississippian rocks were not encountered. The findings are summarized in Table 2.

Table 2

Drill Holes in the Central Basin*

Drill hole	Thickness of Pictou group encountered (feet)	Underlain by
Diamond-drill holes, Minto district	200	Devonian (?) clastics
Canaan well	1,098	Devonian (?) granite
D'Arcy Coal Branch	1,191	Devonian (?) granite
D'Arcy Rogersville	2,270	Devonian (?) clastics
Buctouche well	1,650	Devonian (?) clastics

*Modified after Wright, 1952.

Seismic and gravity surveys carried out by the Shell Oil Company about 10 years ago and by A. H. Miller of the Dominion Observatory, Ottawa, about 15 years ago failed to determine the presence of Mississippian rocks in the Central Basin. Miller's survey was of a reconnaissance nature, not detailed enough to pick up local anomalies that might indicate salt accumulations. Miller reported (1940, p. 200) the presence of elongated gravity troughs extending northeast across the basin. These anomalies were interpreted as indicating variations in the pre-Carboniferous topography. There is now a growing belief that they represent belts of northeast-trending pre-Carboniferous basement rocks of differing densities.

MUZZROLL BROOK AND COAL BRANCH

The origin of the salt which occurs in the overflows from drill holes at the mouth of Muzzroll Brook, Northumberland County, and near Coal Branch, Kent County, is problematic. In both cases the salt appears to have a Pennsylvanian origin, in which case it probably occurs disseminated in sandy or silty beds having originated from evaporation in Pennsylvanian lakes. However, the possibility of a Mississippian source from which salt is carried to the surface by circulating meteoric waters should not be discounted. Detailed gravity surveys in the area of the drill holes would serve to outline possible salt masses if any exist. Analysis of a sample of the Muzzroll Brook drill-hole overflow obtained by the Mines Branch, Fredericton, in 1950 showed the following:

	ppm
Chloride	2,663
Sodium	1,965
Sulphates	1,706
pH	7.1

OTHER OCCURRENCES

Salt has been reported in a hole drilled at the Dominion Experimental Farm, near Fredericton, and at Tracy, Sunbury County, but no information is available on its quantity or quality.

MONCTON BASIN OCCURRENCES

GEOLOGY

THE Moncton Basin includes those rocks of Carboniferous age lying south of the Kingston and Nerepic ridges and north of the Caledonian massif. In outline it has the form of a triangle with its apex near Saint John and its base along Northumberland Strait. Towards the southeast the formations merge with those of the Cumberland Basin in Nova Scotia. The basin deepens towards the east and is blanketed by gently undulating Pennsylvanian rocks which have a regional eastward dip.

Mississippian rocks are exposed along the northern and southern borders of the basin and along the valleys of the Petitcodiac and Memramcook rivers.

Figure 3 gives the sequence of formations in the Moncton Basin.

The widespread similarities of the formations indicate that conditions of deposition were probably uniform in all parts of the basin. The deposits were largely continental; fluviatile, lacustrine and deltaic. Records of shirt-lived marine invasions are present in the upper part of the Albert formation, in the Windsor group and in the Maringouin formation.

Sediments of the Memramcook formation were deposited under oxidizing conditions, the sediments being carried out from the pre-Carboniferous highland masses and deposited rapidly. The early stages of deposition were strongly influenced by a fairly rugged pre-Carboniferous topography.

The Memramcook formation has an extremely variable lithology. The basal beds are a hard, massive red grit or conglomerate. Granite pebbles are common in some places but in others rhyolite boulders are the most important non-matrix component. Conglomerates containing rounded pebbles of granite, argillite, quartzite and volcanic rocks overlie the basal beds. The conglomerates grade upward with interbeds of sandstone and siltstone until finally the upper part of the formation consists of green and red, sometimes mottled, siltstone, and red shale. The Memramcook is graded laterally as well as vertically, becoming finer grained near the centre of the basin.

Memramcook sedimentation also occurred in the Central Basin but has since

SYSTEM	GROUP	FORMATION	LITHOLOGY
PENNSYLVANIAN	Pictou	Tormentine	Siltstone, shale, conglomerate and red sandstone.
		Richibucto	Buff sandstone, green siltstone, basal shale pebble conglomerate.
		Scoudouc	Buff to red sandstone, shale and conglomerate.
		Salisbury	Sandstone, conglomerate, red shale and siltstone.
	Cumberland		
	Riversdale	Boss Point	Top of Tantramar Salt Plug ? Grey sandstone and quartz pebble conglomerate.
		Enrage	Red sandstone, shale, and conglomerate.
MISSISSIPPIAN	Canso	Shepody	Eroded Top of Salt Plugs Grey-green and red sandstone and siltstone.
		Maringouin	Red shale to siltstone (marine to continental)
	Windsor	Subzone C	Limestone and sandstone.
		Subzone B	Limestone, gypsum, anhydrite rock salt, shale and conglomerate.
		Subzone A	Calcareous anhydrite to anhydritic argillaceous limestone.
	Horton Series	Hillsborough	Red sandstone, conglomerate and shale ash bed.
		Weldon	Red siltstone, shale and conglomerate.
		Albert	Rock salt near top of section, grey and grey-green sandstone, shale and siltstone, oil shale, limestone and conglomerate.
		Memramcook	Red sandstone, shale and conglomerate.

Hopewell ? — ? (Riversdale / Canso)

Moncton (Horton Series)

FIGURE 3 Table of formations, Moncton Basin.

been removed by erosion. Remnants remain along the boundary of the basin, and in the Minto area where it has been protected from erosion by a lava flow.

The Memramcook grades into the Albert formation with the contact being placed at the top of the uppermost red bed. Locally, however, the Albert and the Memramcook are disconformable.

The Albert formation outcrops along the Kingston uplift, in the Sussex and Hillsborough areas, and along the north side of the Caledonian highlands. It consists of grey, rudaceous to lutitic sediments, and evaporites locally. The evaporites are quantitatively less important than the resistates and hydrolysates.

The Albert formation, like the Memramcook, is graded laterally. Towards the southwestern end of the basin the rocks are rudaceous with clastic material predominating and the contained organic matter is carbonaceous. The rocks show all the characteristics of continental deposition in this part of the basin.

A fresh-water environment, probably limnic, is postulated for the eastern end of the basin on the basis of the presence of fossil fish, thin laminations, ripple marks, mud cracks, and bituminous matter.

Following the deposition of the bituminous sands and shales, which was contemporary with that of the Albert formation, a shallow marine invasion occurred that gave rise to the limestone, anhydrite, shale, glauberite and rock salt that occur in the upper part of the Albert formation. The extent of this flooding is not known. Records of it are found along the Kingston uplift which probably represents its northern extension. It is probable that the western shores of the ancient Albert Sea did not extend as far west as the Sussex area, because only very small evaporite deposits were intersected in Shell's Urney No. 1 well and these evaporites show characteristics of having been deposited in a playa lake environment (Greiner 1958, p. 25-26).

On this basis it would appear that, as a possible source of salt, the Albert formation becomes increasingly more important towards the east. The Albert formation east of the Memramcook river is not well known because it is overlain by younger rocks and few drill holes have been sunk in the area east of the river.

In Shell's Dorchester No. 1 well the Albert formation appears to have been deposited beyond the zone of lagoonal and beach development but within range of offshore currents (Gussow, p. 1809). Probably the marine phase was more extensive towards the east.

The end of Albert deposition was marked by uplift following which rocks of the Moncton group were deposited. In some places the Albert grades gradually into the Moncton with no definite contact. In these instances the boundary of the Moncton group has been placed at the base of the lowest red bed.

The basal Moncton beds comprise red and reddish grey conglomerate, shale, and siltstone. The conglomerates have a varied pebble content which includes schist, quartz, quartzite, and weathered diorites and granites. Certain sections show interbedded conglomerate, sandstone and shale occurring in beds up to a foot thick, and other sections show a coarse grained arkosic facies which resembles crystal tuff.

During formation of the Moncton group a period of deformation and uplift

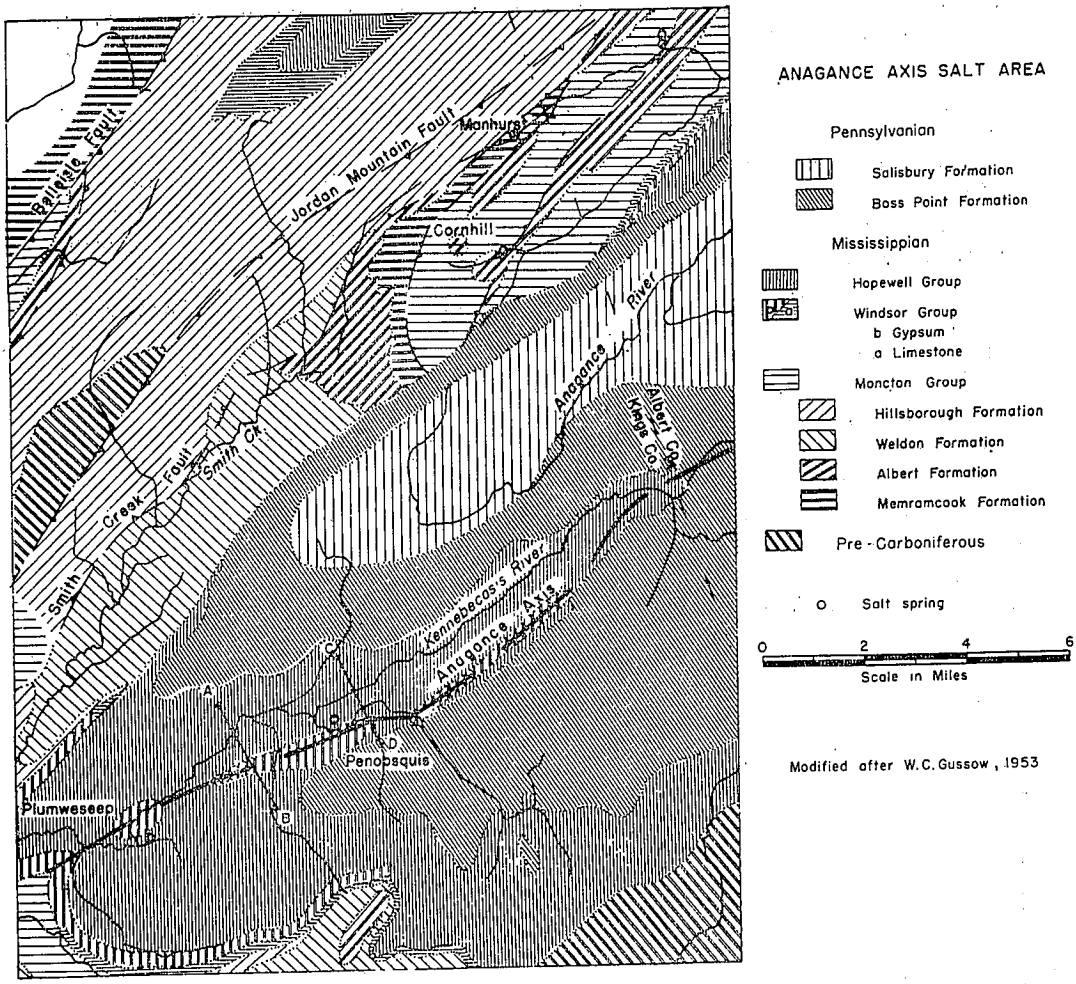

FIGURE 4 Geological map of Anagance Axis area.

occurred. This was accompanied by vulcanism around the edge of the Central Basin and the production of an ash bed in the Moncton Basin. This ash bed serves to divide the Moncton group into the Weldon formation below and the Hillsborough above, the latter comprising mainly coarse clastics. Small angular feldspar fragments, ranging from one-eighth to one-quarter inch, serve to identify the Hillsborough conglomerate, which includes fragments of granite, volcanics, gneiss, diorite, quartz and chert in a matrix of arkosic grit. Red sandstones and silstones occur as lenses and interbeds in the grit and the conglomerate.

The Windsor group is generally conformable with the Moncton, and in most places the contact is gradational. In the Moncton Basin three subzones are recognized in the Windsor group, subzones A, B and C.

Subzone A has a limited distribution and a maximum thickness of about 175 feet. It includes thinly laminated arenaceous, calcareous anhydrite at the base, and massive dolomite to bituminous limestones with chert and shale beds in the upper part.

Subzone B is the thickest of the three. Its maximum thickness is about 1,000 feet and it is divided into four members in the following sequence:

Member 4—red shale, sandstone, conglomerate.

Member 3—massive gypsum (anhydrite), salt.

Member 2—red shale, with or without gypsum stringers, limestone nodules.

Member 1—limestone, generally dense, though in places crystalline, bedding varies from thinly laminated to massive, grey, locally brownish or pink, fossiliferous.

All four members are not universally present and thicknesses vary from area to area.

Subzone C, with a maximum thickness of about 24 feet, is confined to the Shepody Bay region. The rocks of this subzone include fossiliferous grey limestone, sandy limestone, and siltstone, lying discomformably on the beds of Subzone B.

The extent of the Windsor seas are given in Figure 2.

Red beds of the Hopewell group overlie the Windsor group paraconformably, except in the Albert Mines area and northeast of Smith Creek village where structural interpretations indicate sharp angular discordance.

The Hopewell group is characterized by its bright red color. Lithologically the Hopewell conglomerates are difficult to distinguish from those of the Moncton group or Memramcook formation. Differentiation can only be made where stratigraphic relationships are clear. Correlation with the Hopewell group can sometimes be established when limestone fragments containing Windsor fossils are found in the conglomerates of the group.

The Hopewell group comprises conglomerates which commonly show interbeds of sandstone and silstone, and shales and siltstones of local importance. Hopewell sedimentation was interrupted by uplift, deformation, and erosion. This break marks the top of the Mississippian system and serves to divide the Maringouin and Shepody formations from the Enrage.

The Maringouin formation represents a transgression from the marine Windsor to the continental Shepody.

The Shepody formation and the formations in the Pennsylvanian system which overlie it are in most respects similar. They were formed under continental conditions in which grey and red to chocolate sandstones, conglomerates and shales were deposited.

SUSSEX-PETITCODIAC SUB-BASIN

Anagance Axis

The surface trace of the Anagance axis extends from near Sussex to Portage Vale, lying south of the Kennebecasis river and roughly paralleling it.

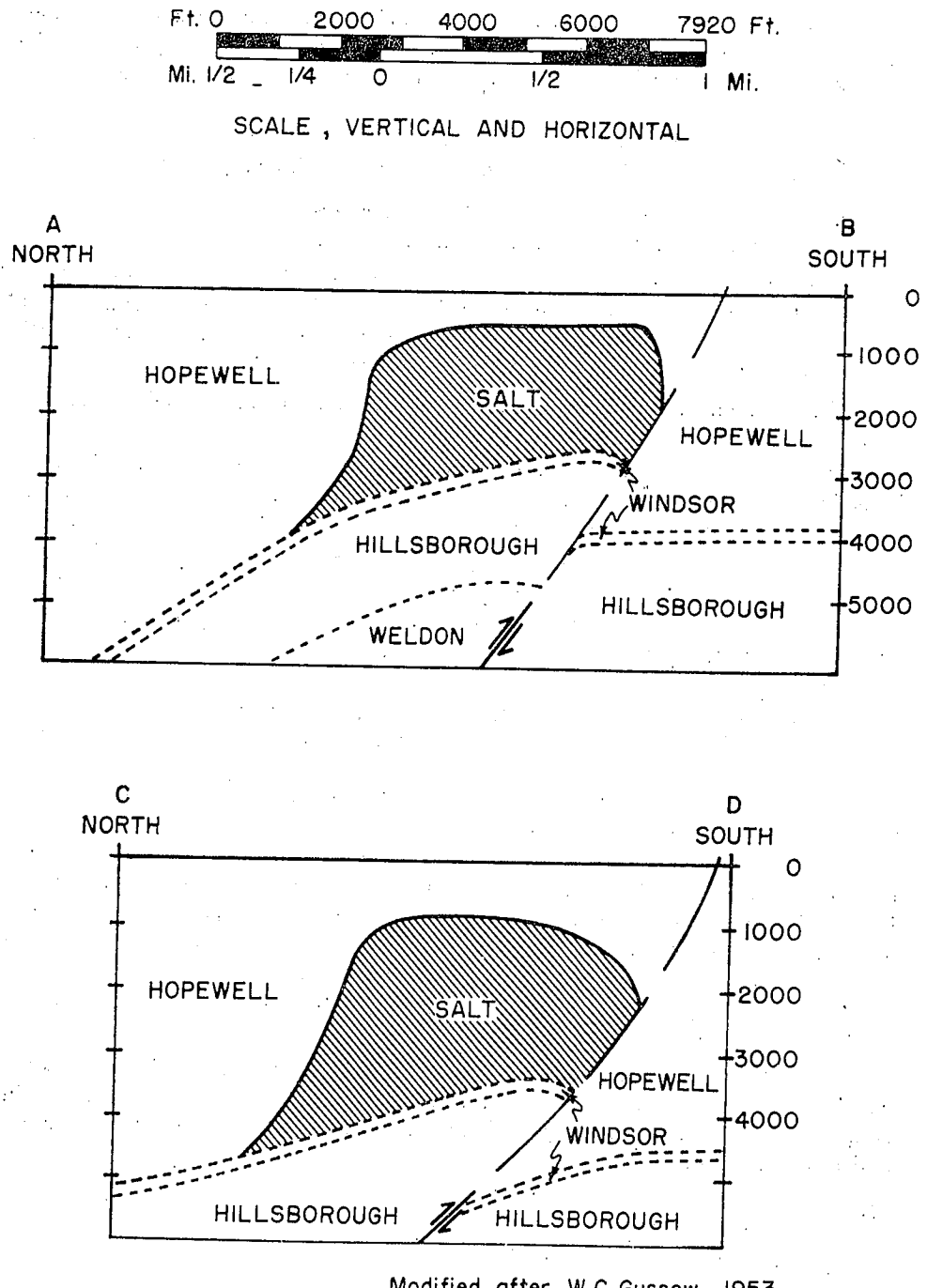

FIGURE 5 Geological cross-section at Plumweseep and Penobsquis.

Salt is believed to be concentrated along this axis, being localized by minor faulting.

Gravity surveys carried out by the Shell Oil Company (Gussow, 1953, p. 1801) show that an elongated trough of gravity minima extends along this axis for about 13 miles. Areas of intense minima are located at Plumweseep, Penobsquis and Portage Vale.

Salt water issues from several springs and a bore hole in the Plumweseep area. The association of the saline waters, sink holes and the gravity minima are believed to indicate the accumulation of rock salt in the area. In any future work on the salt possibilities of this area, the gravity anomalies deserve particular attention.

History

Salt production began in the Plumweseep area more than 100 years ago; it was sporadic and limited, and although the salt was said to be of "superior quality for dairy use," marketing was local. Production ceased entirely about the beginning of the present century.

Production values are available for the period 1887-1897 only, when the average yearly production was about 150 barrels. The cost of producing a barrel of salt was about $2.00 and it was sold for $3.00.

L. W. Bailey (1898, p. 121-122) describes the Plumweseep salt works as follows: "The salt is made by evaporation, two furnaces being employed side by side, and having over them one pan made of boiler plate, holding 2,000 gallons and one holding 400 gallons. There are also two kettles holding 200 gallons each, and four holding 150 gallons each. These latter kettles, weighing 1,000 lb. and costing $50 each, are found to be very liable to crack, and sometimes last only a single season, thus increasing materially the cost of production, as well as giving uncertainty to the amount of product. Wood in four-foot lengths, is burnt in one end of each furnace, and the fire is continued from Monday morning until Saturday night. Only two men are employed, one for the day and the other for the night, and great care is taken to secure a product which is pure and clean. Work is carried out in warm weather only. During the time the works were running in 1897, they turned out a little over twenty-one barrels per week; but there is plenty of brine to run a much larger plant, while if, by boring, a brine of greater strength were reached and more economical methods of concentration were employed, the yield could, no doubt, be very largely increased. There would be no difficulty in selling a larger quantity. The strength of the brine at present is twenty per cent. Salt made at this place is held in high repute for the curing of meat."

Several holes have been drilled in the vicinity of the Plumweseep springs in the hope of encountering the source of the salt which occurs in the spring waters. The deepest hole recorded is approximately 500 feet, (drilled by the provincial government in 1945), but salt was not intersected in any of the drill holes. Bailey (1898, p. 122) mentions a hole drilled about 1887 to a depth of 125 feet and

remarks that water taken from the bottom of the hole "showed an increase in strength of about four degrees in the salinometer."

Shortly before World War I an English concern gained control of about an acre of ground containing the salt springs. They drilled 425 feet without intersecting salt, and sank a shaft to 40 feet before abandoning the project because of the outbreak of war. This was the last serious attempt to produce salt in the Plumweseep area.

In 1945 three holes were drilled in search of salt by the provincial government (Mines Branch). The first two were abandoned owing to caving before bedrock was reached. The third was drilled to 488 feet in spite of drilling difficulties, but the core recovery was poor. Wright (1946, p. 99) reports the core to have been "interbedded mottled red and green angular gravelstone and soft shale, the latter with round greenish spots, 'bulls eyes', and some cavities which probably once contained a soluble mineral substance."

Analysis

A sample taken from the overflow from the hole drilled about 1913 by Hayes (1920, p. 20) was analyzed by the Mines Branch at Ottawa as follows:

1. Colorless, odorless.
2. Taste—saline (salty).
3. Reaction—as received, neutral; upon evaporation to small volume, very faintly alkaline.
4. Specific gravity at 15.5°C—1.04.
5. Suspended matter—a very small quantity, light and flocculent in character.

1,000 parts by weight of filtered water contained:

		Hypothetical combination	
Na	16.00 parts	NaCl	42.3 parts
Ca	1.32 parts	$CaSO_4$	4.31 parts
Mg	0.80 parts	$MgSO_4$	0.39 parts
SO_4	3.36 parts	$CaCO_3$, CO_2	0.20 parts
CO_3	0.17 parts		47.20
Cl	25.60 parts	CO_2 free	0.05 parts
	47.25		47.25

Total dissolved saline matter by direct experiment dried at 180°C—47.0 parts.

The sample was later tested for potash, but none was found. Faint traces of lithium were detected.

Cole (1930, p. 20) collected a sample from the same overflow in 1928 and the analysis is given below in Table 3.

Table 3

Analysis of Solids from Plumweseep Brine

Analysis of solids	%	Conventional combination	%
Na	33.62		
K	1.24		
Ca	2.73		
Mg	0.11	$CaSO_4$	8.67
SO_4	6.12	$CaCl_2$	0.50
Cl	53.60	$MgCl_2$	0.43
Br	—	KCl	2.36
I	—	NaCl	85.46
Total	97.42	Total	97.42

Discussion and Conclusions

In the Anagance axis area the Windsor evaporites lie unconformably on the red and grey clastics of the Moncton group.

The Windsor group in this part of the Moncton Basin is estimated to average 1,000 feet in thickness (Gussow, p. 1745; Stewart, p. 1939) comprising dark grey, very poor, fine grained, largely crystalline, limestone overlain by approximately 800 feet of pale grey, mottled, microcrystalline gypsum. The limestone is massive, while the gypsum is almost completely devoid of bedding. The gypsum rarely outcrops, so that its distribution is only approximately known, being inferred largely on the basis of the presence of sink holes. Rock salt has been encountered in neither outcrop nor drill hole in the area. The presence and distribution of halite in the Anagance axis area is probably determined by several factors, which include environment, erosion, migration, and faulting:—

(1) Environmental conditions favored halite accumulation in Windsor times. Halite could be normally expected to occur in evaporation sequence following the precipitation of limestone and gypsum. (2) Erosion occurred between the deposition of the Windsor evaporites and the Hopewell clastics. It is not known how much rock salt was taken into solution and removed during this period of erosion. It is known however, that gypsum was removed in large quantities because sink holes were extensively developed in the pre-Hopewell evaporite terrane. (3) The distribution of salt would be affected by flowage of the underlying gypsum which may have occurred some time since deposition. Gussow (1953, p. 1745) postulates that gypsum flowage has occurred because of the variable thickness of the gypsum unit. Sund (1958, p. 65) considers that mottling of the gypsum is further evidence of flowage. Both flowage and erosion probably account for the highly irregular subsurface gypsum topography encountered by the Barrett Company Limited drilling program in 1956, which disclosed that gypsum surface elevations varied as much as 85 feet within horizontal distances of less than 200 feet. (4) Faulting has probably been the most effective factor in concentrating rock salt in the area. The association of a gravity trough and the Petitcodiac fault is of particular significance in this regard. The faulting probably initiated salt migration which continued on to form an elongated dome pushing the Hopewell rocks upward

to form an anticline. This is the most logical explanation for the Anagance anticline since the anticlinical structure is absent below the main reflecting horizon at depth. (Gussow, 1953, p. 1801).

• Cornhill, Manhurst and Gordon Brook

The Cornhill salt springs are found over an area of several acres about half a mile south of the Cornhill East school on Salt Springs Brook.

The presence of salt springs at Cornhill is not mentioned in the early geological reports referring to New Brunswick salt occurrences. W. J. Wright, (1944, p. 8) states that these springs were first brought to his attention in 1930 and that he knows of no attempt having been made to recover salt from the brines.

In 1945 the salt springs areas were surveyed by the provincial government (Mines Branch) and in 1947 two vertical cable tool holes were drilled by the Branch in the hope of intersecting salt at depth. Both holes were drilled through vertical beds of Albert siltstone. Hole No. 1 reached a depth of 400 feet, but No. 2 had to be abandoned at 300 feet owing to difficulties encountered in drilling. While both holes showed brackish water overflows, neither encountered rock salt.

The Cornhill brine analysis is given as follows:

Table 4

Analysis of Brine from Cornhill

Filtered sample	ppm	Hypothetical combination	ppm
Total solids on evaporation	39,480.0		
Ca	1,105.0		
Mg	70.0	$Ca(HCO_3)_2$	181.0
Na (calc.)	13,759.0	$CaSO_4$	3,604.4
K	N.D.	$MgSO_4$	350.0
Cl	19,800.0	Na_2SO_4	2,803.0
SO_4	4,718.0	NaCl	32,650.0
CO_3	—		
(HCO_3)	136.0	Suspended matter	994.0

The Manhurst salt springs are on the south side of Bennett's Brook, between the brook and the Manhurst schoolhouse.

There is no available information regarding the composition of the Manhurst brine, nor any record of drilling in the area.

Gordon Brook is a small stream flowing into Bennett's Brook from the north. The junction is close to the Petitcodiac-Havelock highway, about one and a half miles west of the Intervale station on the Canadian National Railway line.

Brine springs occur in the valley of Gordon Brook, scattered over a distance of about 1,700 feet upstream from its junction with Bennett's Brook.

Wright (1944, p. 8) reports that the water of one of the springs is bitter tasting and that the grass about the spring is covered with a white precipitate in dry weather. He believes the source of this material to be a magnesium salt or glauberite which occurs in the Albert formation below, since the spring issues

from a sedimentary horizon that dips approximately 60 degrees to the southeast.

In 1947 the Mines Branch sunk a diamond-drill hole in search of salt in the area of the springs. The hole reached a depth of 230 feet but salt was not encountered. The drill intersected grey, non-bituminous shale, and thin interbeds of chocolate-red shale.

Great difficulty was encountered in drilling in all the holes sunk in search of salt in the Sussex-Petitcodiac basin. Drillers' logs repeatedly indicated delays in drilling owing to caving. It would appear that drill holes should be cased or cemented, or both, in order to achieve success.

The Cornhill, Manhurst and Gordon Brook brine occurrences all probably represent salt solutions derived from the Albert formation (*see* Figure 4). It may be noted that all the springs are located near faults. It is not known if there have been salt accumulations in the form of plugs or domes as the result of faulting, or if the faults serve only as planes along which circulating waters migrate, carrying salts to the surface from bedded salt deposits below.

Shell Oil Company's gravity survey (Gussow, 1953, p. 1800) did not completely cover this area; but the gravity values, incomplete as they are, suggest that the Cornhill and Gordon Brook springs at least, lie in gravity depressions. In the Cornhill area gravity values drop below 29 milligals and in the Gordon Brook area, below 27 milligals.

It is probable that salt in this area is interbedded with glauberite and clastics in the same manner as it is in the Albert formation at Weldon.

UPHAM SUB-BASIN

● Salina

The Salina springs are 7 miles due south of Norton on Salt Spring Brook, a tributary of the Hammond River. The springs lie about a mile east of the Salina post office. Several attempts are reported to have been made to recover salt from these brine springs but production has been, in each case, limited and short-lived. The date when production first began is not known. It was, however, some time prior to 1868, according to Dawson (1868, p. 284). He reported that the salt was produced by evaporating brine from the spring and that it was of excellent quality.

Chalmers was the first to make detailed statements about the Salina occurrence. He stated (1890, p. 91N): "At Salina there are likewise a number of surface springs, but the brine in any of them does not contain more than about three per cent of salt. The manufacture of salt was commenced here a few years ago but was discontinued. The owners of these springs are desirous of having them more fully tested by borings, and possibly this might result in improving the quality of the brine."

Chalmers visited Salina and examined the area again in July, 1895. At that time a drill hole was being put down, and he gives the following account of the core (1896, p. 97-98A).

	Thickness of intersection (feet)
Superficial deposits	64
Gypsum	21
Sandstone	15
Gypsum	220
Sandstone	10

Chalmers noted that the beds were nearly vertical so that the width of intersections did not represent true thicknesses.

He also collected water samples from the drill hole and from a nearby spring. The samples were analyzed by the Geological Survey of Canada, and the following results are given by Hoffmann (1896, p. 54-55):

"It was found to contain a small quantity of brown, flocculent, organic matter in suspension. This was removed by filtration, leaving the water clear and colorless. Specific gravity, at 15.5°C., 1.0185. It contained in 1,000 parts, by weight:

		Hypothetical combination	
Potassa	0.177		
Soda	9.614		
Lime	1.549	Chloride of potassium	0.280
Magnesia	0.185	Chloride of sodium	18.145
Sulphuric acid	2.319	Chloride of magnesium	0.313
Chlorine	11.379	Sulphate of lime	3.762
	25.223	Sulphate of magnesia	0.159
Less O, equiv. to Cl	2.564		
	22.659		22.659

Total dissolved solid matter, by direct experiment, dried at 180°C., 22.605. An Imperial gallon of the water, at 15.5°C., would contain:

	Grains
Chloride of potassium	19.963
Chloride of sodium	1,293.648
Chloride of magnesium	22.315
Sulphate of lime	268.212
Sulphate of magnesia	11.336
	1615.474

R. W. Ells (1907, p. 128-129) gave the following analysis of the Salina brine:

	Per million
Potassium chloride	19.936
Sodium chloride	1,293.648
Magnesium chloride	22.315
Sulphate of lime	268.212
Sulphate of magnesia	11.336

He gave the strength of the brine as 20 per cent and made the following general remarks: "In New Brunswick but little drilling has been attempted, though a couple of holes were sunk some years ago, but these were merely shallow wells, the deepest recorded being only 330 feet. In view of the fact that gypsum is abundant in some parts of this area, it would seem advisable to test the district thoroughly with several holes sunk to a considerable depth to ascertain whether underlying bodies of salt exist in this part of the province."

Cole (1930, p. 20) reported the existence of another salt spring at Salina. The location is given as about a quarter of a mile west of the Salina post office on the south side of the road near a creek. The following information, and analysis in Table 7, is taken from his report:

Field notes

Temperature of air	74°F
Temperature of brine	52°F
Baume reading	2
Equivalent specific gravity	1.0140
Measured flow	6 gpm

Laboratory notes

Specific gravity at 60°F	1.0157
Total solids at 110°C	1.96
Reaction	N

Table 5

Analysis of Solids from Salina Brine

Analysis of solids	%	Conventional combination	%
Na	30.47		
K	0.63		
Ca	5.46		
Mg	0.39		
SO_4	13.12	$CaSO_4$	18.56
Cl	48.30	MgCl	1.14
Br	—	KCl	1.20
I	—	NaCl	77.45
Total	98.37	Total	98.35

The analysis of the two springs is approximately the same.

Discussion

The location of the most important salt spring at Salina is given in Figure 6. The theory suggested by this geological map is that the salt originates in or below the Moncton group northwest of the Clover Hill fault, and is carried up the fault plane to the surface by circulating meteoric waters. If this is the case, the source of the salt solution is probably in the Albert formation, since conditions at the time of deposition of the Moncton group or Memramcook formation are not believed to have been favorable for salt accumulation.

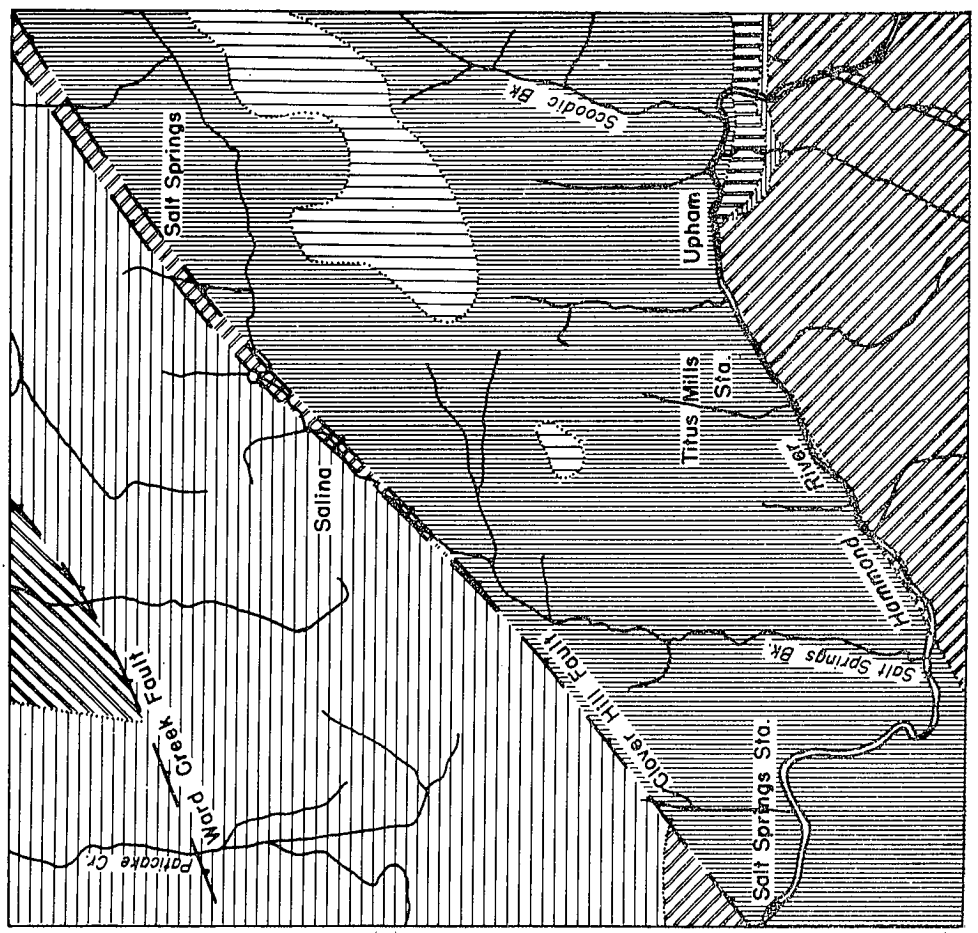

FIGURE 6 Geological map of the Salina area

However, two factors argue against this proposition of the Albert formation. Firstly, the Albert formation in this end of the Moncton basin comprises coarse clastic sedimentary rocks such as conglomerates, arkoses and sandstones. Secondly, the organic matter in the Albert formation in the western part of Kings County is carbonaceous rather than bituminous. These facts indicate that deposition was largely carried out in a continental setting, in swift-flowing, shallow waters. While shallow continental waters, do not, in themselves, preclude salt accumulation it is difficult to envisage it occurring in association with coarse clastics that show no evidence of desert environments.

In addition, a comparison made of the brine from the Salina spring with that of a spring in the Weldon-Gautreau basin—known to originate in the Albert formation—shows that important values of glauberite occur in the Weldon-Gautreau spring but none appear in the Salina spring.

The writer favors the view that the salt water source occurs in the Windsor group and lies south of the Clover Hill fault, because thicknesses of evaporites of the Windsor group occur at Upham less than five miles away. It is not unreasonable to assume that they extend beneath the Hopewell group from Upham to Salina.

The exact location or the details of the drill hole put down at the salt springs in 1895 (Chalmers, 1896, p. 97-98A) are not known, but it is postulated that the gypsum intersected is of the same age as that at Upham. The "interbedded sandstone" units that are recorded in this hole are evidently not present in the Upham gypsum, since neither Manzer (1947) nor Sund (1958) mention them. These "sandstone beds" may, in fact, be sandstone dykes because before Hopewell deposition, the gypsum was subjected to extensive erosion with the production of sink holes and solution joints into which the Hopewell sediments were deposited.

In Figure 6 the locations of the faults in relation to the salt spring are inferred from outcrops along strike at considerable distances from the spring itself. However, even if the distribution of the faults with respect to the spring is as designated on the map, a salt body could exist in the Windsor group south of the faults. The Clover Hill fault is interpreted as being a high angle thrust fault with the fault dipping to the northwest. A salt mass in the Windsor group at depth could therefore occur directly beneath the spring, and circulating ground waters could migrate through the shattered pre-Carboniferous rocks to the surface. Before drilling for salt on such assumptions however, it would be advisable to undertake gravity and seismic surveys in the area to determine if salt is present in quantity, and to determine the relationship between the salt and the faults.

Conclusions

It is possible that salt has accumulated on the south side of the Clover Hill fault in much the same way as it did at Plumweseep. That is, the salt may occur in the form of a diapiric mass localized by faulting. The quantity and quality of any salt that exists in the area can only be determined by drilling.

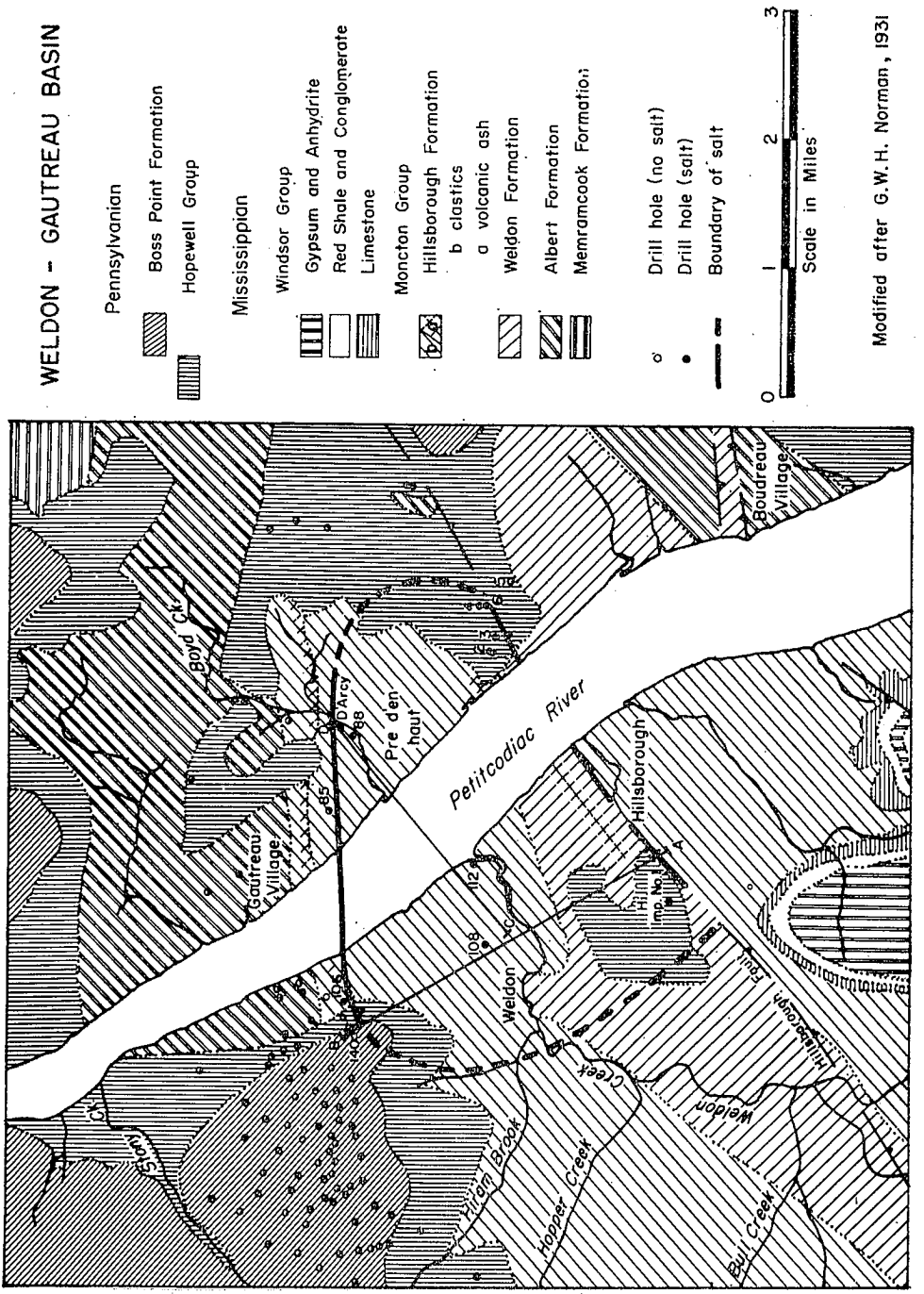

FIGURE 7 Geological map of the Weldon-Gautreau basin

WESTMORLAND SUB-BASIN

The gravity anomalies which outline the Weldon-Gautreau basin and the Dorchester salt plug demonstrate the relationship that exists between gravity values and salt bodies. The sensitivity of gravity methods is not only limited to the detection of large masses of subsurface salt; but knowledge can also be gained about the depth at which salt occurs. For example, gravity studies in the Weldon-Gautreau basin indicated that salt occurred about 1,700 feet below the surface. This has been substantiated by drilling. On this basis, it is assumed that the other gravity anomalies in the Moncton Basin deserve particular attention inasmuch as they represent areas of probable salt accumulation. These areas include the Grand Anse anticline, the Maringouin anticline, the Tantramar fault, the Cookville district, and Baie Verte.

● The Weldon-Gautrea (Albert) Salt Basin

Salt occurs over an area of 7½ square miles immediately north of Hillsborough, in a structural basin known as the Weldon-Gautreau or Albert salt basin. The basin underlies the Petitcodiac river and extends about 2 miles west and 1½ miles east of the river.

The basin has not been subjected to severe deforming stresses although faulting has cut off its southern extremity. The rocks have been gently warped with the production of anticlines and synclines that strike slightly north of east. It has been suggested that some of the folding is due, in part, to salt migration.

Rocks belonging to the Boss Point, Enrage, Hillsborough, Weldon and Albert formations have been recognized in the basin.

The upper part of the Albert formation is the locus of salt accumulation, where rock salt, glauberite, anhydrite and shale occur intimately associated and interbedded with one another.

Evaporites do not outcrop in the Weldon-Gautreau district; but upper Albert formation beds, containing "salt hoppers", are exposed on Boyd Creek. It is believed that the trace of the salt horizon is represented by a zone of crumpled shales which outcrop along the creek. The shales have been deformed by slumping which has accompanied the removal of salt by solution.

Salt springs were long known to occur in the Weldon-Gautreau area, but it was not until 1920 when the D'Arcy Exploration Company encountered salt in a hole drilled in search for natural gas and oil that quantitative information about the deposit became available. In the following thirty years New Brunswick Gas & Oilfields Limited and the New Brunswick government drilled a total of six holes in which salt was intersected. As a result of drilling, and geophysical work carried out by A. H. Miller of the Dominion Observatory and by the Shell Oil Company, the salt boundaries have now been approximately defined. (*see* Figures 7 and 8).

In the past few years interest has centred on this occurrence because substantial quantities of glauberite, as well as rock salt, are present. In all, over one billion tons of rock salt are present in the Weldon-Gautreau basin.

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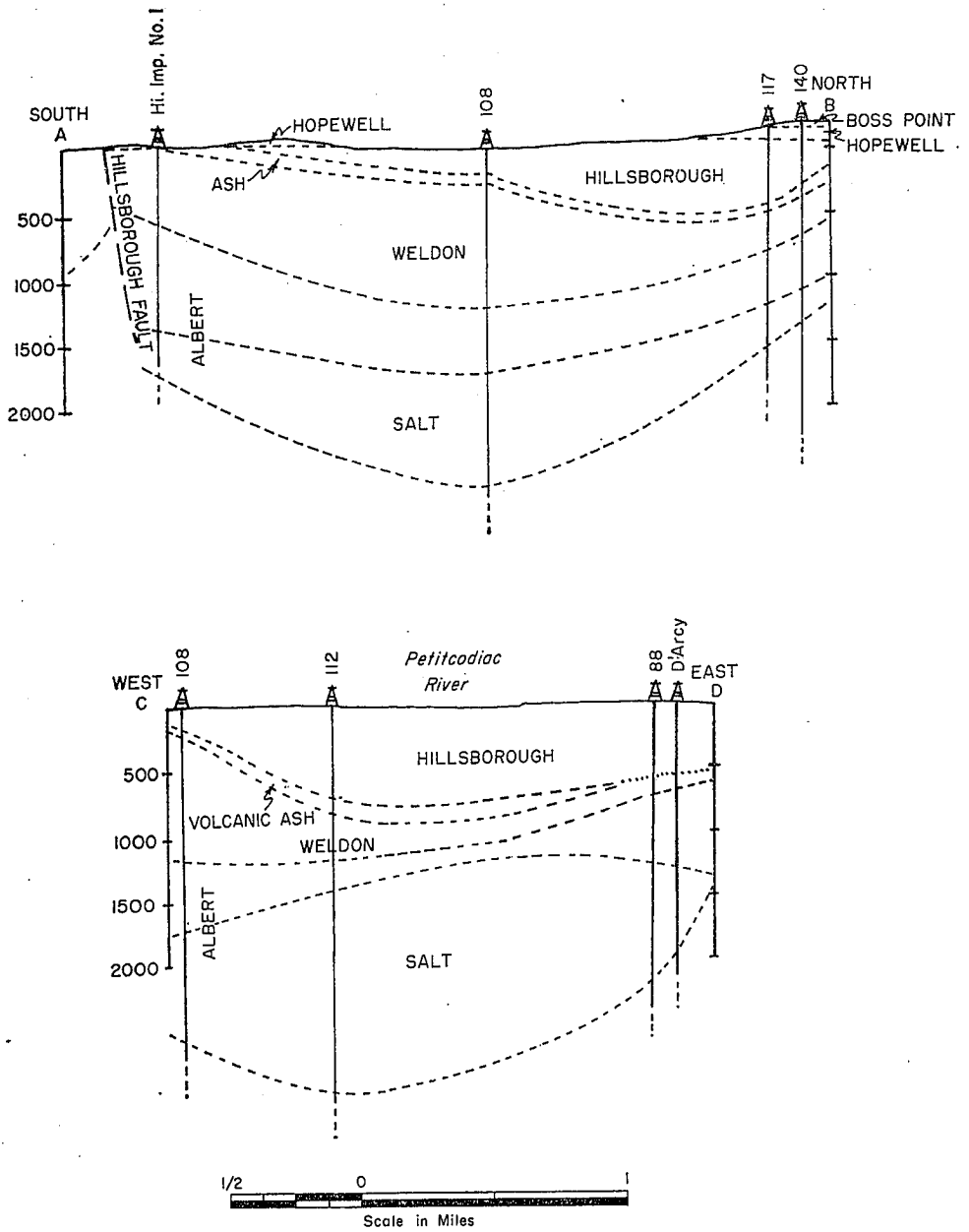


FIGURE 8 Geological cross-section across the Weldon-Gautreau basin

stantial quantities of glauberite, as well as rock salt, are present. In all, over one billion tons of rock salt are present in the Weldon-Gautreau basin.

The following table gives the depth to the salt and the thicknesses of salt encountered in the various holes drilled in the basin.

Table 6

Salt Intersections in the Weldon-Gautreau Basin

Name of hole	Depth to top of salt (feet)	Thickness of salt (feet)
D'Arcy well	[redacted] 1295	489
Gautreau No. 88	1,222	915
Weldon No. 108	1,740	900
Weldon No. 112	1,446	1,539
Weldon No. 117	1,208	235
Gautreau No. 6	700	?
Weldon No. 49-1	1,573	?

D'Arcy Well (Gautreau No. 1)

The D'Arcy well, drilled in 1920 with a percussion rig, interesected almost 500 feet of salt. A detailed log is given in the Appendix.

The first report on the analysis of the D'Arcy hole was made by J. T. Donald and Company and reported by McMullen (1923, p. 51-52). The following facts were given:

(1) A sample representing 455 feet of the salt gave an analysis of 83.65 per cent sodium chloride.

(2) The dried salt contained minute traces of magnesium chloride and 1.95 per cent of calcium sulphate.

Cole (1930, p. 24) gave the next report on the analysis of the D'Arcy hole. The analysis of 5-foot composite chip samples from the hole, taken from his report, are given below in Table 7.

Table 7

Analysis of Salt from D'Arcy Well

Conventional combination	Depth in feet			
	1,330-1,350	1,475-1,495	1,615-1,635	1,760-1,780
	(%)	(%)	(%)	(%)
NaCl	91.16	79.88	82.13	82.10
$CaCl_2$	—	—	0.36	—
$MgCl_2$	—	—	0.20	—
Na_2SO_4	0.36	—	—	0.39
$CaSO_4$	2.50	6.08	6.70	7.58
$MgSO_4$	0.36	0.30	—	0.39
Insol.	5.35	11.70	8.66	7.20
Bromine	Trace	Trace	Trace	Trace
Iodine	—	—	—	—

Gautreau No. 88

In 1929 New Brunswick Gas & Oilfields Limited drilled hole No. 88, in which 915 feet of salt were intersected between depths of 1,222 feet and 2,137 feet.

Cole (1930, p. 25) reports the analysis of the settled clear brine reduced to a dry basis, from samples taken between 1,380 and 2,022 feet as follows:

Table 8

Analysis of Brine from Samples Taken between 1,380 and 2,022 Feet in Gautreau No. 88 Well

Analysis of solids	%	Conventional combination	%
$(HCO_3)_2$	0.051		
CaO	0.616		
MgO	0.017	$Ca(HCO_3)_2$	0.069
SO_3	2.051	R_2O_3	0.043
Cl_2	58.489	$CaSO_4$	1.443
R_2O_3	0.004	$MgSO_4$	0.051
Na_2O	0.904	Na_2SO_4	2.071
Na_2	37.868	NaCl	96.323
Br	N.D.		
K	N.D.		
Total	100.000	Total	100.000

Weldon No. 108, No. 112 and No. 117

New Brunswick Gas & Oilfields Limited drilled test wells Nos. 108, 112 and 117 over the period 1937-1938. Wells Nos. 112 and 117 were cored throughout the salt sequence but in No. 108 cores were taken only at 100-foot intervals.

Substantial amounts of glauberite occur both in the upper and lower reaches of the evaporite sequences of each of these holes.

For Weldon No. 108 the following table, taken from H. W. Hole (1944, p. 3), gives the average analysis of drill samples taken from 1,739 feet to 2,373 feet. The percentage values quoted represent the average salt concentration taken between the corresponding depths listed at the left.

Table 9

Analysis of Salt (and Glauberite in part) Between 1,739 and 2,373 Feet in Weldon No. 108 Well

Depth feet	NaCl %	Depth feet	NaCl %
1,739-1,749	.928	2,040-2,050	51.30
1,749-1,764	.581	2,042-2,056	37.76
1,754-1,760	.626	2,052-2,062	26.00
1,769-1,777	.975	2,062-2,074	21.62
1,777-1,783	1.510	2,074-2,086	20.90
1,789-1,795	1.695	2,081-2,100	45.10
1,795-1,811	3.25	2,100-2,110	48.70
1,811-1,835	1.045	2,110-2,120	54.80
1,818-1,840	1.74	2,120-2,130	65.40
1,840-1,851	1.74	2,130-2-140	62.40
1,851-1,863	2.275	2,167-2,179	41.70
1,863-1,874	1.700	2,185-2,197	44.20
1,874-1,885	1.915	2,197-2,203	46.40
1,885-1,895	3.60	2,202-2,215	47.50
1,895-1,906	1.217	2,215-2,226	58.90
1,906-1,915	1.279	2,226-2,236	76.50
1,915-1,926	2.046	2,236-2,251	70.80
1,931-1,942	2.470	2,241-2,261	71.20
1,942-1,950	1.685	2,264-2,273	41.70
1,950-1,966	33.22	2,273-2,279	45.10
1,966-1,978	33.22	2,285-2,297	46.00
1,978-1,984	3.25	2,297-2,319	46.80
1,984-1,996	2.275	2,317-2,327	62.70
1,996-2,008	61.80	2,327-2,337	55.70
2,008-2,020	38.10	2,337-2,349	61.30
2,020-2,030	51.10	2,349-2,356	45.10
2,030-2,042	51.10	2,362-2,373	27.40

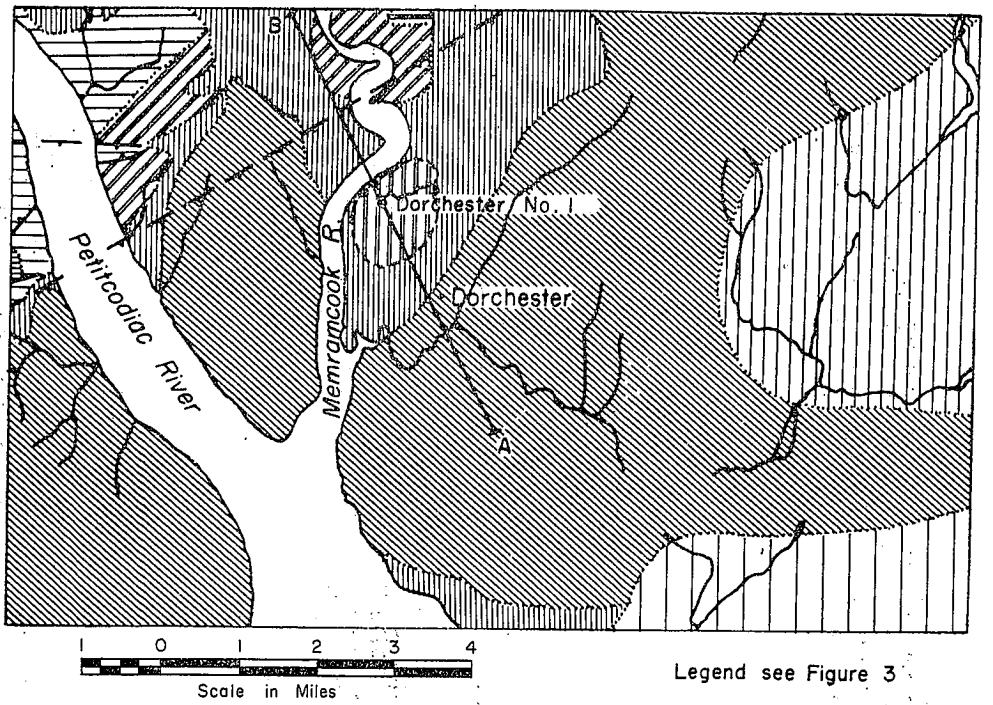
Depth feet	Na_2SO_4 %	NaCl %
1,996-2,050	11.82	47.3
2,050-2,110	11.70	32.4
2,110-2,197	2.567	53.7
2,197-2,251	.....	60.0
2,251-2,319	.....	51.1
2,319-2,373	.....	50.4

Cole (1958) gave the following analysis of a crushed and screened sample taken from between 1,710 and 1,718 feet in Weldon No. 108:

	%
$CaSO_4$	9.23
NaCl	0.10
Na_2SO_4	33.01
Insol.	57.06
Total	99.40

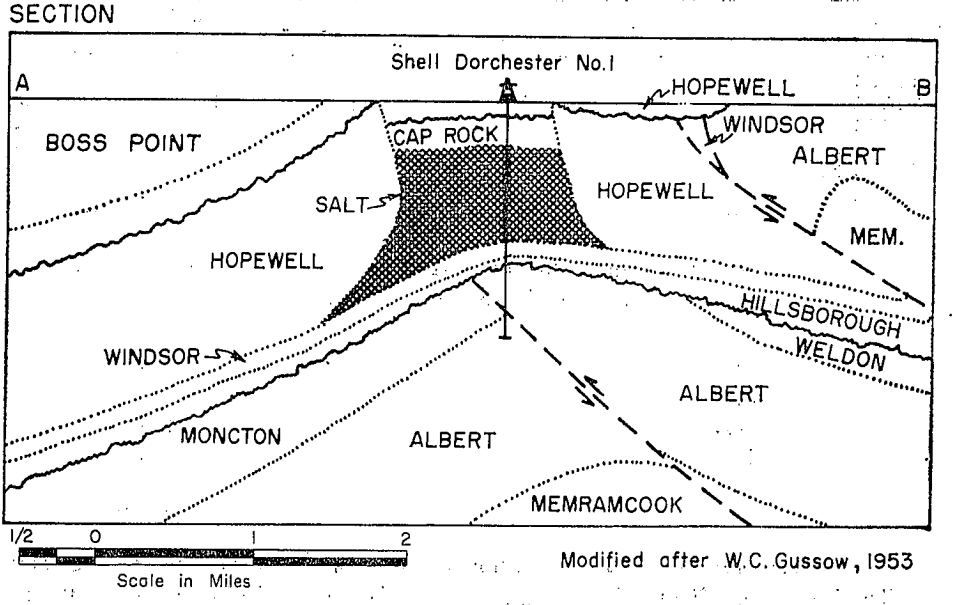
For Weldon No. 112 the following analysis is given for depths between 1,384-1,911 feet (Cole, 1958) and 2,203-2,968 feet (H. W. Hole, 1944, p. 2):

PLAN



Legend see Figure 3

SECTION



Modified after W.C. Gussow, 1953

FIGURE 9 Geological plan and section across the Dorchester salt plug

Table 10

Partial Analysis of Weldon No. 112 Well

Depth feet	Insol. %	$CaSO_4$ %	Na_2SO_4 %	NaCl %
1,384-1,387	93.40	—	—	—
1,387-1,389	93.30	—	—	—
1,416-1,421	89.33	3.88	4.355	0.995
1,412.5-1,416	91.42	—	—	—
1,421-1,424	91.10	3.260	1.457	0.702
1,424-1,428	87.78	2.360	0.838	0.936
1,428-1,430	90.40	5.030	2.06	0.936
1,430-1,434	85.40	7.350	11.80	0.820
1,435-1,440	61.33	9.025	26.70	0.906
1,440-1,443	54.73	11.440	30.60	0.838
1,443-1,446	74.31	8.360	14.95	0.936
1,446-1,453	54.05	9.133	37.02	0.789
,453-1,455.25	62.33	7.613	25.53	0.935
,455.8-1,456.7	83.15(?)	3.622	10.23	0.995
1,456.7-1,471.7	60.82	7.980	27.25	0.935
1,471.7-1,473.20	75.85	6.045	5.194	10.060
1,473.2-1,475.8	34.08	9.895	23.32	33.46
1,905-1,911	36.58	11.22	33.30	22.010
2,203-2,293	19.10	2.339	14.541	66.47
2,293-2,400	17.50	2.090	16.813	77.14
2,400-2,502	6.25	3.960	2.933	88.16
2,502-2,605	13.90	4.100	0.052	79.57
2,605-2,700	14.10	2.330	14.153	68.09
2,700-2,803	6.50	2.490	11.961	86.30
2,803-2,898	6.60	2.230	15.223	77.25
2,898-2,968	17.01	2.640	12.742	71.92

H. W. Hole stated (1944, p. 3) that the saturated solutions from the group samples between 2,203 to 2,968 feet contain about 2.62 pounds of sodium chloride per U.S. gallon.

Cole (1958) reports the following analysis made by Canadian Industries Limited, on a sample from 1,908 feet:

	%
$MgSiO_3$	4.044
$MgCO_3$	1,450
$CaCO_3$	6.000
$CaSO_4$	33.483
Na_2SO_4	39.481
NaCl	13.357
Fe_2O_3	0.614
Al_2O_3	0.623
Total	99.052

For Weldon No. 117 the analysis of salt intersections is not in the Mines Branch files. Interested persons may be able to obtain this data from the office of New Brunswick Gas & Oilfields Limited in Moncton.

Weldon No. 49-1

This hole was drilled 50 feet north of Well No. 112 and encountered salt at 1,573 feet, continuing in the salt formation to 2,051 feet. The base of the salt formation was not reached, the hole being discontinued because it was believed, at the time, (1949), that the mixture of salt and grey shale encountered was of too low a grade for mining.

Table 11

Partial Analysis of Weldon No. 49-1 Hole

Depth feet	Thickness feet	Na_2SO_4 %	$CaSO_4$ %	NaCl %	Insol. %
1,434¼-1,436	1.75	16.46	44.99	Trace	21.70
1,436¾-1,439½	2.75	23.63	38.72	0.06	22.78
1,439½-1,441¼	1.75	25.57	45.82	Trace	17.18
1,441¼-1,442¾	1.50	1.58	24.28	0.32	45.50
1,442¾-1,445	2.25	25.85	50.36	Trace	17.06
1,445-1,448½	3.50	32.00	41.47	0.06	16.56
1,448½-1,450¾	2.25	30.36	44.43	0.06	13.60
1,453-1,455½	2.50	16.95	41.28	Trace	22.68
1,455¾-1,460	4.25	14.44	40.30	0.21	26.56
1,460-1,462¾	2.75	5.27	42.49	0.17	24.42
1,462¾-1,465	2.25	35.09	45.16	Trace	9.84
1,465-1,466¾	1.70	21.38	46.13	0.06	16.60
1,656½-1,663	6.50	19.07	24.52	43.00	7.98
1,696-1,702	6.00	14.51	22.41	51.05	5.68
1,753-1,758	5.00	2.29	4.56	85.70	3.14
1,931-1,933	2.00	2.86	2.62	93.00	0.62
1,938½-1,941	2.50	3.05	9.71	82.19	2.08
2,092-2,094	2.00	None	19.92	71.95	4.30
2,170-2,174	4.00	21.17	27.68	39.04	6.48

Analysis of the most promising sections of core from the hole is given below in Table 12.

Table 12

Analysis of Salt from Most Favorable Sections of Weldon No. 49-1 Hole

Depth feet	Thickness feet	NaCl %
1,735-1,758	5	85.7
1,931-1,933	5	93.0
1,938½-1,941	2½	82.2

The Dorchester Salt Occurrence

The Dorchester salt plug was discovered in 1949 by the Shell Oil Company. It was outlined by a gravity survey in which it appeared as an elliptically shaped gravity anomaly with minimum values over the plug in the order of five milligals. Miller's (1940) gravity surveyca rried out a few [illegible] previously along

Highway No. 2 did not detect the plug, despite the fact that the highway is less than a mile east of the centre of the diapiric mass.

The presence of salt beneath the anomalous area was definitely established when salt was intersected in Shell's Dorchester No. 1.

The salt plug has roughly the shape of an ellipse, with its long axis striking approximately N25°E. The major axis is over 9,000 feet long and the minor nearly 6,000 feet. The plug was intersected between 395 and 4,810 feet in the Dorchester hole, giving a total thickness of 4,415 feet, of which 3,660 feet was rock salt. The salt reserves in the plug are calculated to be in the order of three billion tons.

Table 13

Abbreviated Log of Shell's Dorchester No. 1 Hole

Footage	Thickness feet	Abbeviated description
0- 395	395	Unconsolidated silt and gravel.
395-1,150	755	(Cap rock) gypsum and anhydrite.
1,150-4,810	3,660	Salt plug (and impurities).
4,810-5,180	370	Calcareous anhydrite, some gypsum.
5,180-5,231	51	Impure gypsiferous limestone.
5,231-8,229	2,998	Moncton and Albert formations.

The salt plug lies at the western end of the Dorchester anticline. This anticline plunges gently to the east and a mass of salt, decreasing in thickness towards the east, is believed to have accumulated along its crest. The salt is believed to extend eastward at least as far as the Tantramar River. Baillie's interpretations, reported by Gussow (1953, Figures 10-11) of seismological data indicate that 2,000 feet of salt has accumulated on the crest of the anticline 3½ miles east of Dorchester at a depth of 3,200 feet. Immediately north of Morice Lake 1,200 feet of salt is believed to occur at a depth of 6,500 feet.

At Dorchester, salt migration is probably the result of post-Mississippian movement, although it may have been only slight, on an unnamed fault which underlies the main Dorchester fault. This movement served to weaken the overlying rocks enabling the intrusion of the Dorchester plug. Since the Pennsylvanian Hopewell and the Boss Point formations are distorted at the edge of the plug, at least the final stages of salt intrusion occurred after Boss Point deposition.

The following analysis has been given by Wright (1952, p. 9) for the Dorchester well:

Table 14

Analysis of Salt from Shell's Dorchester No. 1 Hole

Depth feet	Thickness feet	Insol. %	CaO %	Na %	K %	Cl %	SO_4 %
1,895-1,900	5	1.24	2.40	25.55	—	54.83	4.78
2,115-2,120	5	2.04	3.97	34.63	—	53.41	4.70
2,120-2,200	80	0.91	2.56	35.33	—	54.47	3.82

The theoretical combinations of these elements have not been given by the analyst, but it is evident that halite is present in the zones in quantity and that small values of anhydrite and glauberite are also present. When the theoretical combinations are calculated, the weighted average of NaCl in the 90-foot sample is approximately 89 per cent.

Baie Verte

Several factors favor the presence of salt at Baie Verte, among which are the following: Baie Verte lies on the strike of: (1) the Albert salt basin and the Cookville seismic reversal; (2) the Dorchester anticline, and; (3) the Tantramar fault. Since the salt associated with these structures is of both Albert and Windsor age, the salt at Baie Verte may originate either in the Albert formation or Windsor group.

Intense gravity anomalies, such as are associated with the other salt deposits in the Westmorland basin, have not been found at Baie Verte. Table 15, modified after Wright (1952, p. 12) compares anomalies over known salt deposits with those at Baie Verte.

Table 15

Comparison of Gravity Anomalies

Locality	Thickness of overburden (feet)	Thickness of salt (feet)	Gravity contours
Weldon-Gautreau	1,500	900	25 to 23
Dorchester	1,150	3,600	15 to 00
Cookville	2,500 (?)	?	19 to 18
Tantramar fault	1,150 (?)	?	-1 to -2
Baie Verte	1,500 (?)	?	20 to 12

Wright points out (1952) that the gravity values in the Baie Verte district conform to a regional pattern which is related to the pre-Carboniferous surface.

The Dorchester anticline appears to be the most promising structure for accumulation of salt at Baie Verte. Salt is known to occur on the crest of the anticline at Dorchester and is suspected to extend eastward for at least 10 miles. When the plunge of the anticline is calculated, based on a regional dip of approximately 200 feet per mile as given for the Scoudouc formation, the crest lies about 9,180 feet below the surface at Baie Verte. The validity of such a calculation as Wright (1952) points out is strengthened by the fact that if the anticlinal plunge is projected eastward the crest should lie about 20,000 feet below the surface at Hillsborough Bay in Prince Edward Island. Salt is known to occur at this locality at a depth of approximately 20,000 feet.

The presence of salt at Baie Verte can only be ascertained by drilling, but a detailed gravity survey in the area might outline favorable drilling sites.

Cookville

There is a gravity minimum about a mile in diameter at Cookville, roughly elliptical in outline and with a closure of one milligal. A seismic reversal at 4,000 feet coincides with the anomaly. Similar reversals occurred at the same depth 3 and 14 miles to the east, in two other north-south profiles that were run by the Shell Oil Company.

These gravity and seismic results are believed to indicate the presence of salt. The trace of the reversals is given in Figure 10. It is also believed that the salt may extend to the shore of Baie Verte along the same strike.

According to Gussow's interpretations (1953, Figure 11, p. 1793), this salt occurrence would be in the Albert formation, differing from the Shepody Bay and Tantramar occurrences which are of Windsor age. If this is the case the deposit could be expected to be similar, in some respects at least, to the Albert basin deposit.

Shepody Bay

Two gravity troughs underlie Shepody Bay, coinciding with the Grand Anse and Maringouin anticlines. It is postulated that the anomalies indicate the presence of salt along the crests of the folds. Indeed, the folds themselves are believed to be the result of salt tectonics (Gussow, 1953, p. 1779).

Two main factors — other than the gravity lows — favor the view that salt has accumulated here. Firstly, evaporites in the form of gypsum outcrop along the axes of the folds, with the gypsum possibly representing the cap rock of a diapiric salt mass. Secondly, over 6,000 feet of salt and gypsum were intersected in a hole drilled by Sun Oil Company several miles to the east in Nova Scotia. This drill hole lies on the strike of the two folds.

Tantramar Fault

There are gravity minima on the north side of the Tantramar fault at the east end of the Cumberland Basin. A broader minimum also lies immediately north of the southwest end of the fault. It is possible that this latter area of minimum gravity represents an evaporite basin from which salt may have migrated into the Tantramar fault zone (Gussow, 1953, p. 1797). This would explain the presence of sink holes and the intense gravity lows which coincide with the fault.

PLASTER ROCK BASIN OCCURRENCE

SALT has been reported on Salt Brook, a small tributary entering the south side of the Tobique River about half a mile north of Plaster Rock, Victoria County.

This occurrence has been mentioned in various publications on the geology of New Brunswick as far back as 1865. Hind (1865), Bailey and McInnes (1887, p. 7), and Hayes (1920, p. 22), refer to this occurrence. It was not until 1936 however, when Rose's report on the Plaster Rock area was published by the Geological Survey of Canada, that the economic possibilities of the occurrence on Salt Brook were discussed.

GEOLOGY

The Plaster Rock Basin is a typical, undisturbed, structural basin. It covers an area of about 30 square miles and contains rocks of both Pennsylvanian and Mississippian age.

The most recent breakdown of rocks in the area has been given by Wright, and is reported by Sund (1958), as follows:

TABLE OF FORMATIONS

SYSTEM	GROUP	LITHOLOGY
PENNSYLVANIAN	Petitcodiac	Red conglomerate
MISSISSIPPIAN and/or PENNSYLVANIAN	Hopewell	Red shale with sandstone
MISSISSIPPIAN	Windsor	Gypsiferous shales, limestone
	Moncton	Red sandstone, shale conglomerate
PRE-CARBONIFEROUS		Metasediments (mainly shale), volcanics

FIGURE 11 Table of formations, Plaster Rock area.

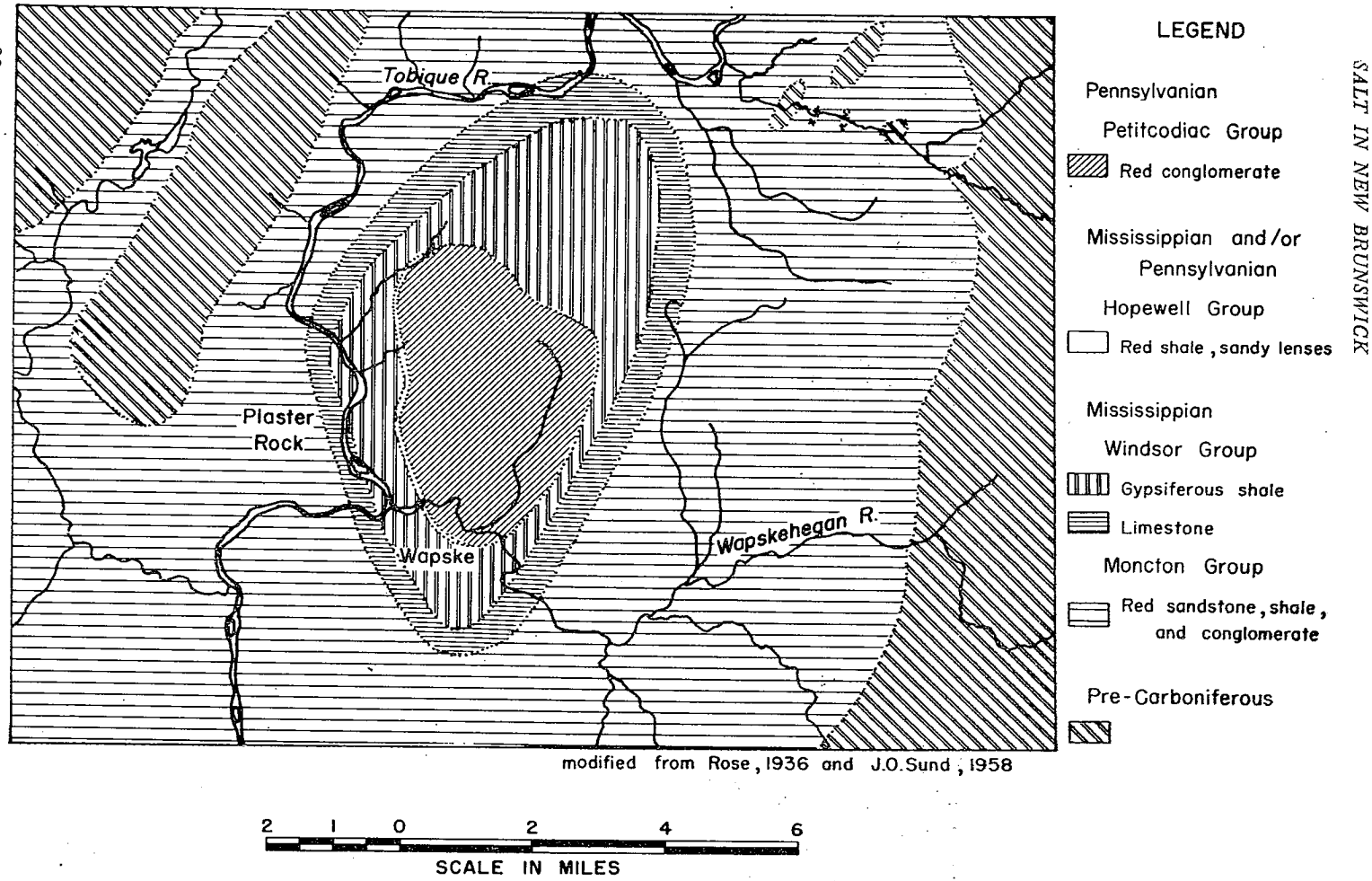


FIGURE 12 Geological Map of the Plaster Rock area.

The lowermost Carboniferous rocks in the Plaster Rock Basin, the Moncton group, lie unconformably on a basement complex of deformed and altered lavas, pyroclastics and clastic sedimentary rocks. The Moncton group consists of red conglomerate, sandstone, and shale and was deposited on an undulating pre-Carboniferous terrain. The deposits are largely the products of deltaic and fluviatile environments.

The red clastics of the Moncton group are paraconformably overlain by a unit which is predominantly limestone. The unit is about 130 feet thick consisting of thin beds of red shale, interbedded with fossiliferous, grey to mottled grey-green, and reddish limestones. The limestone beds range generally from 1 to 5 feet in thickness, but a thickness of up to 20 feet sometimes occurs.

The limestone grades into a gypsum-shale sequence with the limestone layers gradually being replaced by layers of gypsum. The gypsiferous shales have been estimated to be about 100 feet thick. The gypsum, as in the case of the underlying limestone, occurs as interbeds with red and green shale. Bedding is in the order of 1 to 2 feet, but in rare instances beds up to 20 feet in thickness occur. The gypsum tends to be impure and occurs, as well, disseminated throughout the shale beds.

Halite is probably disseminated throughout this unit also.

The gypsum beds are comformably overlain by a red shale unit that is approximately 800 feet thick. These red shales are believed to be of the Hopewell group.

The uppermost rocks in the Plaster Rock Basin comprise red conglomerates. The unit is thin and has been correlated with the basal Petitcodiac group of the Moncton Basin.

ANALYSES

No detailed analysis has been made of the Salt Brook brine. However, a rough qualitative analysis was reported by Hind in 1865. He stated, according to Hayes (1920, p. 22), "Salt Brook, which flows into the Tobique a short distance above the plaster cliffs, has a brackish taste and medicinal properties; on examination it was found to contain a small quantity of sulphuretted hydrogen, a considerable percentage of sulphate of magnesia (epsom salts), to which probably its aperient effects are due, and some common salt."

W. J. Wright (1944), reviewing the salt possibilities of the province, made the following statement about the composition of Salt Brook brine (p. 9): "The water in Salt Brook does not taste salty but the presence of a chloride presumably sodium, was detected by silver nitrate."

DISCUSSION

The Plaster Rock Basin was probably the first evaporite basin to develop during Windsor time. The evaporites were formed by the evaporation of marine waters which were trapped in the basin as the ancient Windsor Sea withdrew to the south and east. The marine phase was short-lived, and the flooding occurred only once.

Gypsum was precipitated in the basin when the water volume was reduced to the point where the solubility of $CaSO_4$ was exceeded. During the precipitation of the gypsum, mud, in varying quantities, was being carried by streams into the basin from the surrounding highlands.

Halite was precipitated when the concentration of sodium and chlorine reached sufficiently high levels. The ideal evaporite sequence did not occur however, because the incoming stream waters effectively reduced the salt concentrations. This probably resulted in periodic deposition and solution of the salts and tended to distribute them throughout the section.

At present there is no direct evidence of the presence of an economic quantity of salt in the Plaster Rock Basin. Several holes have been drilled along the Tobique River; but none have been drilled in the centre of the basin, the most favorable area for salt accumulation.

A gravity survey would indicate if salt is present in quantity, and also at what depth it occurs.

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APPENDIX

The descriptive logs of 5 wells and 7 diamond-drill holes are given on the following pages for easy reference. These logs have been taken from reports on file in the Mines Branch office at Fredericton. *See* Figure 8 for locations.

D'Arcy Well (Gautreau No. 1).

Gautreau No. 88.

Test Well No. 112.

Weldon No. 117 (incomplete).

Weldon No. 108.

Gautreau Salt, Diamond-drill Hole No. 1.
Diamond-drill Hole No. 2.
Diamond-drill Hole No. 3.
Diamond-drill Hole No. 4.
Diamond-drill Hole No. 5.
Diamond-drill Hole No. 6.

Part of Weldon No. 49-1 Drill Hole.

D'ARCY WELL (GAUTREAU No. 1)

Weldon Formation

Depth feet—inches	Thickness feet—inches	Description
0-20	20	No sample.
20-70	50	Surface gravel, red to green.
70-85	15	Conglomerate, sandy, red.
85-97	12	Sandstone and grit, quartz and pink feldspar.
97-113	16	Grit, reddish brown.
113-191	78	Sandstone and grit, red to brown.
191-221	30	Grit and sandstone, brown-red; quartz and feldspar.
221-243	22	Conglomerate, grey.

D'ARCY WELL (Gautreau No. 1)—*Continued*

Depth feet—inches	Thickness feet—inches	Description
243-249	6	Sandstone and grit, grey.
249-255	6	Conglomerate, grey to brown.
255-264	9	Sandstone and grit, brown.
264-285	21	Conglomerate, red; and grey sandstone, fine-grained cemented hard.
285-317	32	Sandstone and grit, reddish brown; with dark red sandstone, fine-grained, cemented hard, calcareous.
317-363	46	Sandstone, dark red, fine-grained, cemented hard, calcareous; and conglomerate, brown-red bands; and marl, red, thin.
363-385	22	Conglomerate, grey; with dark fine-grained red sandstone.
385-405	20	Conglomerate, grey; and grit.
405-435	30	Sandstone, red, marly, fine-grained, cemented hard, calcareous; and brown-grey limestone; and conglomerate bands.
435-447	12	Sandstone and grit, red.
447-470	23	Conglomerate and grit, red to grey.
470-490	20	Sandstone, dark red marly, fine-grained, cemented, calcareous.
490-520	30	Conglomerate and grit, brown-red; and thin dark red sandstone bands.
520-570	50	Conglomerate and grit; and dark red, fine-grained, cemented, marly, sandstone.
570-605	35	Sandstone and grit, brown red; with sandy marl or marly sandstone, dark red.
605-625	20	Limestone, grey to brown, sandy, hard, micaceous.
625-678	53	Marl, brown-red, sandy.
		Albert Formation
678-744	66	Shale, blue-grey, non-bituminous, calcareous; and thin bands of light grey, sandy limestone.
744-774	30	Shale, blue-grey to light grey, calcareous, non-bituminous.
774-825	51	Limestone, brown to grey, sandy; hard; with little shale.
825-900	75	Shale, blue-grey to light grey, non-bituminous, calcareous; with thin bands grey limestone.
900-987	87	Limestone, brown, sandy; and thin shale, blue-grey, non-bituminous, calcareous.
987-1,027	40	Shale, blue-grey to light grey, non-bituminous, calcareous; and gypsum.
1,027-1,106	79	Limestone, light grey, sandy; with thin bands blue-grey to light grey shale, non-bituminous, calcareous.
1,106-1,126	20	Limestone, brown, hard, sandy; and thin shale, blue-grey, non-bituminous, calcareous; and light grey sandstone, fine-grained, micaceous, calcareous.
1,126-1,236	110	Shale, blue-grey to light grey, generally non-bituminous, calcareous; with some light grey limestone bands; and light grey, cemented, fine-grained, calcareous, micaceous, sandstone and calcite veins.
1,236-1,295	59	Shale, blue-grey, generally non-bituminous, calcareous, slightly carbonaceous; some gypsum 1,236-46. Traces of NaCl 1,236-56. Flame of Na 1,280-89. Mixture of shale and white soluble salt (largely NaCl; traces K).

D'ARCY WELL (Gautreau No. 1), Albert Formation—*Continued*

Depth feet—inches	Thickness feet—inches	Description
1,295-1,784	489	Rock salt, generally large crystals; and fine-grained, cemented, calcareous sandstone 1,300-14; some efflorescence 1,319-25, 1,540-44 and 1,771-84; and large crystals of NaCl 1,410-20.
1,784-1,863	79	Shale, blue-grey to light grey, generally non-bituminous, calcareous, cherty, slightly carbonaceous and bands very slightly bituminous to bituminous 1,806-11, slightly bituminous 1,811-16, very slightly bituminous to non-bituminous 1,816-20, slightly bituminous to non-bituminous 1,820-25, slightly bituminuous to very slightly bituminous 1,825-35, non-bituminous to bituminous 1,835-45, light brown to grey-green. Some sand limestone 1,860-63, Na 1,789-1,806. Na color in flame 1,857-60.
1,863-1,878	15	Shale, blue-grey, non-bituminous; and thin light grey, fine-grained, cemented sandstone.
1,878-		End of hole.

GAUTREAU No. 88

Hillsborough Formation

0-15	15	Overburden.
15-41	26	Conglomerate, red.
41-79	38	Conglomerate and grit, red; with some dark red sandstone, fine- to medium-grained cemented, calcareous.
79-83	4	Sandstone, dark red, fine- to medium-grained, cemented, calcareous.
83-93	10	Grit and sandstone, red.
93-138	45	Conglomerate and grit, red, with dark red bands (chocolate); sandstone, fine- to medium-grained cemented, calcareous.
138-174	36	Conglomerate, red; with dark red, marly sandstone bands; fine- to medium-grained, cemented, micaceous.
174-203	29	Conglomerate, red; with dark red, chocolate colored, sandy, micaceous marl; and dark red, marly, hard sandstone.
203-214	11	Grit and conglomerate, red.
214-244	30	Conglomerate, red; with bands of dark red, chocolate, sandstone, fine- to medium-grained, hard, cemented micaceous. 214-25, 230-39, some dark red, sandy, marl.
244-258	14	Marl, red; marly red sandstone; and arkosic sandstone.
258-273	15	Conglomerate, red; and dark red, sandy marl bands; and arkosic sandstone 258-63.
273-292	19	Marl, red, sandy, micaceous, hard; and some red conglomerate.
292-337	45	Conglomerate, red to grey, hard; and some red sandy marl bands 302-10.
337-353	16	Marl, red, sandy, micaceous; with red marly sandstone; and red conglomerate.
353-382	29	Conglomerate, red to grey, hard.
382-405	23	Conglomerate, red; with red sandstone, fine- to medium-grained, cemented hard, micaceous; and thin red marl.

D'ARCY WELL (Gautreau No. 88)—*Continued*

Depth feet—inches	Thickness feet—inches	Description
405-429	24	Limestone, brown to grey, hard, sandy; with some red and green sandstone; and red marl.
429-501	72	Volcanic ash bed, generally grey to white; with some pink and red jasper grains 481-501.
		Weldon Formation
501-511	10	Limestone, brown to grey, hard; with thin greenish grey shale; and some red jasper grains.
511-665	154	Marl, sandy, brownish red; or marly red sandstone, micaceous, hard; with thin bands of brown limestone; and greenish grey shale.
		Albert Formation
665-710	45	Shale, blue-grey with brown bands; abundance of gypsum and calcite.
710-779	69	Shale, blue-grey; and shaly limestone hard, grey.
779-937	158	Shale, grey; and brownish grey limestone, sandy, gritty in parts.
937-955	18	Shale, bluish grey; with some brownish grey, fine-grained, cemented, micaceous, calcareous sandstone; and thin grey limestone.
955-1,024	69	Limestone, grey to brownish grey, shaly; with some pure grey limestone, plus calcite.
1,024-1,062	38	Sandstone, light grey to white, hard, cemented; with little shale; blue-grey and grey limestone.
1,062-1,110	48	Limestone, grey, shaly; with blue-grey shale 1,062-84, grey and light grey and brown 1,084-1,110; and some sandy limestone.
1,110-1,182	72	Limestone, shaly, generally blue-grey, hard; with some bands of glauconitic sandstone; some thin blue-grey shale; and light grey limestone 1,110-76; blue-grey to very dark and transparent crystalline gypsum or selenite 1,176-82.
1,182-1,196	14	Limestone, grey; and gypsum, white; with some sandstone, fine-grained, brown, calcareous.
1,196-1,203	7	Limestone, shaly, grey to blue-grey.
1,203-1,214	11	Shale, blue-grey, highly calcareous, micaceous with fissure calcite.
1,214-1,222	8	Limestone, grey; and gypsum, white; with some sandstone, grey to greenish grey, calcareous.
1,222-1,229	7	First evidence of salt as small veinlets in grey limestone.
1,229-1,245:6	16:6	Limestone, grey, shaly with thin sandy bands in upper half.
1,245:6-1,253:3	7:9	Top of rock salt formation. Rock salt, yellowish; and brecciated grey calcareous shaly silt, thin bedded.
1,253:3-1,254	9	Thin-banded, light and dark grey, calcareous, shaly, silt; with salt veinlets intergrown throughout.
1,254-1,258:7	5:7	Thin-banded, fine-grained, calcareous shaly silt, bands horizontal with respect to the core; with numerous veinlets of red salt vertical to the core. Several small bands of calcareous sandstone, some of salt is fibrous in texture.
1,258:7-1,264:7	5	Discolored rock salt, reddish brown to grey in color with numerous inclusions of calcareous shaly silt in thin parting planes.

D'ARCY Well (Gautreau No. 88)—*Continued*

Depth feet—inches	Thickness feet—inches	Description
1,264:7-1,268	3:5	Thin-banded, light and dark grey calcareous shaly silt. Attitude of bands horizontal to core. Dark red salt in fissures. Dark grey shale; not so calcareous as light grey.
1,268-1,275	7	Thin-banded, dark and light grey calcareous shaly silt with only occasional veinlets of reddish fibrous salt.
1,275-1,299:3	24:3	Rock salt, grey to brown to brownish red in color with occasional inclusions of calcareous silt. Salt becomes more yellowish brown in color in lower part of bed. There are also a number of translucent bands of smoky colored salt about middle of bed. Between 1,293-1,295:2 white efflorescence of salt following crystal edges.
1,299:3-1,299:9	0:6	Thin band of calcareous shaly silt with salt veinlets.
1,299:9-1,301:3	1:6	Fine-grained, calcareous, shaly, silt with bands showing selenite crystals. Occasional thin veinlet of red salt.
1,301:3-1,313	11:9	Impure rock salt, yellowish brown in color, translucent in places with numerous fragments and thin bands of calcareous shaly silt. The last 6 inches show reddish salt, fibrous in texture in horizontal bands of calcareous shaly silt.
1,313-1,314:3	1:3	Thin-banded, light grey, calcareous silt with occasional salt veinlets and selenite crystals.
1,314:3-1,326	11:9	Impure rock salt, yellowish brown in color, mostly crushed by drill. Translucent in places with numerous fragments of calcareous shaly silt and parting planes.
1,326-1,326:9	0:9	Thin-banded, grey, calcareous silt with salt veinlets.
1,326:9-1,330:4	3:7	Fine-grained, slightly calcareous, sandy shale with salt veinlets. Both shale and salt reddish pink in color.
1,330:4-1,337:9	7:5	Rock salt, yellowish brown in color with inclusions of calcareous silt. Salt translucent and coarsely crystalline in places.
1,337:9-1,348:7	10:10	Impure rock salt interbanded with calcareous shaly silt about 50-50. Salt is yellowish brown in color while silt is light grey.
1,348:7-1,360:3	11:8	Brown to yellowish rock salt; translucent with occasional inclusions of calcareous silt, badly fractured.
1,360:3-1,361:3	1	Fine-grained, calcareous, shaly, silt banded horizontally with a little reddish salt.
1,361:3-1,373:1	11:10	Impure brown rock salt, interbanded with calcareous shaly silt about 50-50.
1,373:1-1,375:11	2:10	Medium-grained, calcareous, shaly, silt badly shattered with about 25% salt, some patches showing banding.
1,375:11-1,491:2	175:3	Rock salt, brown to yellowish in color with occasional bands and inclusions of calcareous, shaly, silt forming parting planes, translucent to opaque. Some efflorescence.
1,491:2-1,495:6	4:4	Interbanded, calcareous, shaly silt with brownish salt, the latter predominating.
1,495:6-1,612	116:6	Rock salt, brownish to white in color, opaque to translucent with occasional bands and inclusions of calcareous, shaly, silt, thin-banded and lying horizontally with respect to the core.
1,612-1,615	3	Thin-banded, calcareous, shaly, silt with veinlets of fibrous reddish salt about 50-50.

D'ARCY WELL (Gautreau No. 88)—*Continued*

Depth feet—inches	Thickness feet—inches	Description
1,615-1,692:10	77:10	Rock salt, brownish red to white in color, translucent to opaque with occasional bands of clear salt 1 inch thick. Also occasional inclusions and parting planes of calcareous silt.
1,692:10-1,696:8	3:10	Rock salt, with a number of ½-inch to 1-inch bands of light grey, calcareous, silt somewhat shaly.
1,696:8-1,764	67:4	Rock salt, brownish red in color with occasional inclusions and parting planes of calcareous shaly silt.
1,764-1,764:7	0:7	Band of mixed calcareous, shaly, grey, silt and brownish salt.
1,764:7-1,818	53:5	Rock salt, brownish to white in color, transparent to translucent; with numerous thin silt parting planes. In this section there are a few thin bands of water-white, transparent, salt up to 6 inches thick and coarsely crystalline.
1,818-1,821:9	3:9	Interbanded salt; and shaly silt about 50-50. Salt dark brownish red in color.
1,821:9-1,863:6	41:9	Rock salt, brownish to white in color, transparent to translucent with numerous shaly parting planes and fragments of calcareous silt imbedded in salt.
1,863:6-1,865:6	2	Interbanded, calcareous, shaly, silt with fibrous salt veinlets about 50-50.
1,865:6-1,868	2:6	Rock salt, brown in color with parting planes.
1,868-1,871:1	3:1	Core lost. The 6 inches that were recovered is mostly salt.
1,871:1-1,977:8	106:7	Rock salt, brownish red to white in color, transparent to translucent with several bands up to 6 inches thick of water-white, coarsely crystalline, salt. Occasional intrusions and parting planes of calcareous, shaly, silt.
1,977:8-1,980	2:4	Fine-grained, dark grey, calcareous, shaly, silt with fibrous salt veinlets.
1,980-2,015	35	Rock salt, brownish grey in color, transparent to translucent. Occasional inclusions and parting planes of dark grey, calcareous, shaly, silt.
2,015-2,022:3	7:3	From this point downwards salt gradually becomes darker and more reddish in color, coarsely crystalline in texture until it grades into next division.
2,022:3-2,030	7:9	Fine-grained, thin-banded, dark grey, calcareous shaly, silt horizontally bedded with numerous veinlets of dark red fibrous salt.
2,030-2,034:6	4:6	Fine-grained, thin-banded, dark grey, calcareous shaly, silt vertically bedded with respect to core, grading to horizontal at bottom. Veinlets of fibrous salt, dark reddish in color included.
2,034:6-2,037	2:6	Horizontally bedded, fine-grained, calcareous, shaly, silt; veinlets of salt.
2,037-2,038	1	Vertically and obliquely bedded, calcareous, shaly, silt.
2,038-2,040:5	2:5	Fine-grained and horizontally bedded, calcareous silt with numerous veinlets dark reddish fibrous salt.
2,040:5-2,048:5	8	Fine-grained, horizontally bedded, thinly laminated, calcareous, shaly, silt with occasional veinlets of fibrous dark reddish salt. Occasional bands of sandy texture beds.
2,048:5-2,053:7	5:2	Dark red rock salt; with occasional inclusions dark grey, shaly, silt. Salt is coarsely crystalline.

D'ARCY WELL (Gautreau No. 88, Albert Formation—*Continued*

Depth feet—inches	Thickness feet—inches	Description
2,053:7-2,065	11:5	Fine-grained, thin-banded, calcareous, shaly, silt with numerous veinlets of dark reddish fibrous salt, cutting horizontal and vertical silt beds at various angles.
2,065-2,135	70	Dark brown rock salt, transparent; with inclusions and thin parting planes of fine-grained, calcareous, shaly, dark grey, silt.
2,135		Bottom of salt.
2,135-2,139:3	4:3	Dolomite, dark grey, hard.
2,139:3-2,143:8	4:5	Sandstone, dark grey, medium-grained, cemented hard; with some milky quartz and brown limestone at base.
2,143:8-2,156:4	12:8	Shale, dark grey; and grey limestone; and bands of brown, fine-grained, cemented hard, sandstone, micaceous 2,147-52:8.
2,156:4-2,193	36:8	Shale, blue-grey to dark, slightly calcareous; and brown limestone 2,179:7-2,188:3.
2,193-2,199	6	Poor gas and oil sand, brown to brownish grey, medium- to coarse-grained 2,193-96; dark grey, fine-grained, cemented, 2,196-99; generally loose, open.
2,199-2,215	16	Shale, dark grey, sandy in parts; and bands of dark grey, fine-grained, cemented sandstone 2,214-15.
2,215-2,221	5	Sandstone, dark grey to brownish grey, fine-grained to medium-grained, cemented.
2,221-2,224	3	Shale, dark grey, sandy.
2,224-2,249	25	Dry gas and oil sand, dark brown with light grey bands, fine- to medium-grained, cemented, highly micaceous.
2,249		Bottom of hole.

TEST WELL No. 112

Hillsborough Formation

0-17	17	Overburden.
17-48	31	Conglomerate, red; sandstone and grit.
48-173	125	Grit and conglomerate, red; and sandstone bands, red, cemented 162-173.
173-180	7	Sandstone and grit, red, hard.
180-328	142	Conglomerate and grit, red; with red and green-grey, cemented sandstone 258-328.
328-338	10	Sandstone, dark red, marly.
338-348	10	Conglomerate and grit, red.
348-356	8	Sandstone, dark red, marly.
356-385	29	Conglomerate and grit, red.
385-425	40	Sandstone, dark red, marly, cemented, micaceous; and green-grey arkosic, sandstone bands.
425-466	41	Conglomerate and grit, red; and bands of dark red, marly, sandstone.
466-471	5	Sandstone, dark red, marly.
471-523	52	Conglomerate and grit, and bands of dark red, marly sandstone 471-94.
523-528	5	Marl, dark red, sandy.
528-549	21	Conglomerate and grit, red.
549-571	22	Sandstone, dark red, marly with red and white quartz grains; and thin brown limestone bands.

TEST WELL No. 112—*Continued*

Depth feet—inches	Thickness feet—inches	Description
571-596	25	Marl, dark red, sandy; some mica.
596-605	9	Conglomerate and grit, red.
605-619	14	Marl, dark red, sandy, micaceous; some light grey limestone.
619-645	26	Sandstone, dark red, marly; and thin grey conglomerate bands.
645-666	21	Conglomerate and grit, red.
666-669	3	Sandstone, dark red, marly.
669-681	12	Grit and conglomerate, red.
681-718	37	Sandstone, dark red, marly; and white to grey limestone bands 699-713.
718-733	15	Grit and conglomerate, red.
733-739	6	Marl, dark red.
739-765	26	Grit and conglomerate, red.
765-800	35	Sandstone, dark red to purple; and much red jasper grains 771-90, and some volcanic ash.
800-805	5	Volcanic ash, generally purple.
805-834	29	Sandstone, dark red, marly and grey; and white bands of limestone.
834-870	36	Volcanic ash.
		Weldon Formation
870-891	21	Marl, dark red, sandy, some mica.
891-896	5	Shale, generally green, some marly.
896-901	5	Sandstone, dark red, marly.
901-1,122	221	Marl, dark red chocolate, some sandy, micaceous.
1,122-1,128	6	Shale, green-grey; and fissure gypsum.
1,128-1,157	29	Marl, dark red, chocolate, some sandy, micaceous.
1,157-1,163	6	Shale, green-grey; and fissure gypsum.
1,163-1,177	14	Marl, dark red.
1,177-1,183	6	Shale, grey to green-grey, calcareous.
1,183-1,212	29	Marl, dark red; and anhydrite and glauberite—traces from 1,202.
1,212-1,231	19	Shale, grey; and dark red marl; and some anhydrite and glauberite.
		Albert Formation
1,231-1,375	144	Shale, blue-grey to dark, calcareous; with grey limestone bands 1,339-45; some anhydrite; with traces to thin bands of glauberite.
1,375-1,376	1	Dark grey, fine-grained, thin-banded, shale; with occasional white veinlets of fibrous gypsum. Non-calcareous except on partings. Non-bituminous. This was cored 1,375-76. Sample ran 96.35% water insoluble.
1,376-1,380	4	Not cored.
1,380-1,383	3	Dark grey, fine-grained, thin-banded, shale; with thin, white, gypsum veinlets and partings. Slightly calcareous on partings. Non-bituminous.
1,383-1,384	1	Dark grey, fine-grained, thin-banded, shale; with occasional thin bands of glauberite from paper thickness to ¼ inch. This is the first indication of glauberite. Non-calcareous except on partings.
1,384-1,387	3	Fine-grained, dark grey, thin-banded, shale; with interbanded anhydrite and some glauberite. Occasional gypsum stringers. 1,380-85 sample ran 93.41% water insoluble.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,387-1,394	7	Fine-grained, dark grey, and brown, thin-banded, shales; with interbanded, thin bands of anhydrite and glauberite. Non-calcareous. 1,389-94 sample ran 93.97% water insoluble.
1,394-1,397	3	Missing core.
1,397-1,400	3	Fine-grained, dark grey and brown, banded shales; with only occasional thin bands of anhydrite and glauberite. 1,397-1,402 sample ran 93.13% water insoluble.
1,400-1,403	3	Banded, dark grey, shale and anhydrite-glauberite mixture. Coarsely crystalline and non-calcareous.
1,403-1,412:6	9:6	Fine-grained, dark grey, shale; with many minute gypsum veinlets cutting in all directions. Only occasional indications of glauberite.
1,412:6-1,416	3:6	Fine-grained, dark grey, shale; with fibrous gypsum partings and carrying frequent thin bands and inclusions of glauberite crystals.
1,416-1,421:6	5:6	Fine-grained, dark grey, shale; with many minute gypsum veinlets cutting in all directions. Numerous bands and patches of crystalline glauberite.
1,421:6-1,425	3:6	Fine-grained, dark grey, shale; with minute veinlets of pink gypsum and small amounts of glauberite.
1,425-1,429	4	Fine-grained, dark grey and brown, interbanded shale; with occasional stringers of glauberite.
1,429-1.435	6	Interbanded, fine-grained, light and dark grey, shale; with thin bands of glauberite and irregular patches of solid glauberite becoming more massive in lower part.
1,435-1,440	5	Interbanded, light and dark grey, shale; with crystalline glauberite (about 50-50?).
1,440-1,443	3	Interbanded, light, fine-grained, grey, shale; with numerous bands and heavy patches of glauberite. (S. 40 - G. 60 ?).
1,443-1,446	3	Interbanded, light and dark grey, shale; with occasional bands and patches of glauberite; and transverse veinlets of glauberite or selenite, sometimes reddish in color.
1,446-1,453	7	Massive glauberite; with irregular and thin bands of black, to dark grey shale. Glauberite translucent and coarsely crystalline. (G. 75 - S. 25 ?).
1,453-1.455:10	2:10	Interbanded, light and dark grey, shale; with irregular patches of crystalline glauberite in upper part, becoming more definitely solid shale towards bottom. 1455 ft. 6 in. - 10 in. core missing.
1,455:10-1,456:8	0:10	Fine-grained, black to dark grey, shale; with minute stringers of white glauberite. Slickensides.
1,456:8-1,471:8	15	Interbanded glauberite and shale; with patches of massive crystalline glauberite. (G. 40 - S. 60 ?).
1,471:8-1,473:2	1:4	Fine-grained, grey, shale; with bands of crystalline glauberite (S. 70 - F. 30 ?). 1,473:2 top of rock salt.
1,473:2-1,475:10	2:8	Start of massive rock salt. This section consists of brown to reddish rock salt; with inclusions of shale and coarse crystals of glauberite.
1,475:10-1,476:6	0:8	Badly shattered shale; with considerable glauberite in crystalline form; and some sodium chloride.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,476:6-1,493:8	17:2	Massive brown to reddish salt; with numerous inclusions of shale or silt. At 1,480:10 there is a 2-inch band of fine-grained, light grey, siliceous, shale. From 1,488-90 the salt is dark grey. Some glauberite is present.
1,493:8-1,497	3:4	Massive shale and salt interbanded with salt of reddish color; shale predominating.
1,497-1,498:10	1:10	Light, fine-grained, grey shale band cut by reddish salt veinlets.
1,498:10-1,500:2	1:4	Light brownish, massive, rock salt with fine shale partings and inclusions.
1,500:2-1,503:6	3:4	Fine-grained, grey, shale cut by veins and inclusions of massive rock salt (red) with patches showing glauberite crystals.
1503:6-1515:10	12:4	Massive, brownish, rock salt; with many shale partings and inclusions and indications of glauberite crystals in several places.
1515:10-1517:6	1:8	Fine-grained, light grey, shale cut by reddish salt veinlets and inclusions.
1517:6-1519:7	2:1	Massive, crystalline, rock salt, translucent and brown in color; with light grey shale inclusions.
1519:7-1531:1	11:6	Core mostly lost but judging from chippings it appears similar to section immediately above.
1531:1-1538	6:11	Massive, crystalline, rock salt, translucent and brown in color. Occasional bands of light grey salt. Light grey shale inclusions.
1538-1540	2	Massive, greyish, crystalline, rock salt; with occasional shale bands and inclusions.
1540-1543	3	Massive, reddish, rock salt cut by numerous bands and inclusions of fine-grained grey shale about 50-50?
1543-1548	5	Massive, brownish, rock salt; with occasional inclusions of light grey shale.
1548-1551:6	3:6	Fine-grained, grey shale cut by numerous veinlets and inclusions of reddish rock salt about 60-40?
1551:6-1553:8	2:2	Brownish to reddish rock salt with shale inclusions. Some indications of glauberite crystals.
1553:8-1561:6	7:10	Brownish to greyish rock salt. Occasional shale bands and inclusions.
1561:6-1563:8	2:2	Light grey shale bands cut by numerous veinlets and inclusions of reddish rock salt.
1563:8-1565	1:4	Fine-grained, light grey, shale; with cross bedding and occasional thin veinlets of reddish rock salt.
1565-1568:6	3:6	Badly contorted mixture of grey shale and light brown rock salt about 50-50.
1568:6-1590:4	21:10	Massive, brownish, rock salt; with occasional white translucent patches of salt and numerous minute bands and inclusions of shale. At 1,585:2 band of light grey shale.
1590:4-1593	2:8	Badly shattered shale bands with brown to reddish salt cutting it by veinlets and inclusions in all directions.
1593-1622:7	29:7	Massive, reddish brown to greyish white salt with shale inclusions; these latter becoming heavier around 1,600. At 1.600:4 there is a band of pure, transparent, water-white salt. At 1,601:6 there is a 4-inch band of shale cut by salt veinlets.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1622:7-1625:7	3	Massive shale and salt, interbanded. Light grey shale and reddish brown salt. Shale bands horizontal.
1625:7-1671	45:5	Massive, brownish, salt with numerous shale bands and inclusions up to 1½ inches thick.
1671-1672	1	Heavy bands of light grey, fine-grained, shale with inclusions.
1672-1674	2	Massive, brown, salt with shale inclusions.
1674-1675	1	Thick shale bands, light grey; with brown salt inclusions.
1675-1706	31	Massive, brown, salt with shale inclusions. Occasional patches of greyish white salt. At 1,687 and also at 1,703:4 shale is heavier.
1706-1710:5	4:5	Massive, pink to greyish, translucent salt with occasional inclusions of light grey shale.
1710:5-1730:4	19:11	Massive, brown salt with shale inclusions. In some parts the salt is grey and in others it becomes darker. Efflorescence showing.
1730:4-1732:6	2:2	Fine-grained, light grey, shale with salt inclusions.
1732:6-1748:10	16:8	Massive, light brown, translucent, rock salt with only occasional shale inclusions. Some efflorescence.
1,748:10-1,765:6	16:4	Massive, light grey to brownish, salt with light grey shale inclusions. These are heavy at 1,746.
1,765:6-1,767:6	2	Interbanded salt and shale badly shattered. Shale contains translucent crystals that look like glauberite.
1,767:6-1,770	2:6	Massive, brownish, rock salt with badly contorted shale fragments throughout. Glauberite crystal bands? in shale.
1,770-1,791:9	21:9	Massive, light brown, salt with some efflorescence; and small badly contorted shale inclusions. Salt in places is translucent and greyish white.
1,791:9-1,801	9:3	Thin-banded, grey, shale; with salt veinlets and inclusions; also bands of glauberite crystals?
1,801-1,819:7	18:7	Massive, light brown, rock salt; with some badly contorted shale inclusions.
1,819:7-1,821	1:5	Fine-grained, greyish black, shale; with salt veinlets and inclusions.
1,821-1,826	5	Massive, light brown, rock salt; with heavy shale inclusions badly contorted. Glauberite crystal patches.
1,826-1,828	2	Heavy, light grey, shale bands; with salt veinlets and inclusions.
1,828-1,834	6	Massive, brown, rock salt badly broken and mixed with shale bands and fragments.
1,834-1,836	2	Heavy shale bands with rock salt inclusions.
1,836-1,838:6	2:6	Badly contorted massive, brown, rock salt, with shale inclusions.
1,838:6-1,840:6	2	Massive shale bands with rock salt inclusions.
1,840:6-1,844	3:6	Badly contorted mixture of brown rock salt and fragments of shale. Evidence of glauberite crystal patches.
1,844-1,878:5	34:5	Massive, light brown rock salt with badly contorted shale inclusions.
1,878:5-1,879:5	1	Brownish shale with brown salt inclusions.
1,879:5-1,901:10	22:5	Massive, brown to greyish, rock salt; with light grey shale inclusions; salt becoming more reddish in bottom.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,901:10-1,903:7	1:9	Badly contorted mixture of light grey shale and reddish rock salt with indications of glauberite.
1,903:7-1,905	1:5	Massive, light brown rock salt; with shale inclusions; shale badly contorted.
1,905-1,910	5	Massive glauberite; with some salt and shale inclusions; shale badly contorted.
1,910-1,912	2	Massive rock salt; shale and glauberite crystals.
1,912-1,969:7	57:7	Massive, brown rock salt with shale inclusions. At 1,931-1,931:7 salt is translucent and greyish white. At 1,966:6-1,967:6 there is a one-foot shale band.
1,969:7-1,970:7	1	Massive, light grey, shale band with small salt veinlets and inclusions.
1,970:7-2,033	62:5	Massive, reddish to brownish, rock salt with shale fragments and inclusions. Salt becoming translucent in places.
2,033-2,036	3	Massive, light grey, shale with salt inclusions. Banding vertical?
2,036-2,037:9	1:9	Massive, reddish to brownish, rock salt with shale inclusions.
2,037:9-2,041:9	4	Mixed shale and salt, badly contorted.
2,041:9-2,052:9	11	Massive, reddish to brownish, rock salt with shale inclusions.
2,052:9-2,054:9	2	Mixed shale and salt, badly contorted.
2,054:9-2,083:5	28:8	Massive, reddish to brownish, rock salt with shale inclusions.
2,083:5-2,086:10	3:5	Light grey, thin-banded, shale with occasional salt inclusions. Salt translucent and brownish white.
2,086:10-2,115:9	28:11	Massive, brownish, rock salt mixed with shale and all badly contorted. Shale heavier at 2,101:7, 2,110 and 2,113:8 to 2,115.
2,115:9-2,143:7	27:10	Massive, reddish rock salt; with light grey shale inclusions, badly contorted.
2,143:7-2,147	3:5	Fine-grained, light and dark grey, shale; interbanded with reddish salt masses and veinlets.
2,147-2,160	13	Light to dark brown, massive, rock salt; with shale inclusions.
2,160-2,165	5	Light, grey, thin-banded, shales; with occasional salt inclusions. Glauberite crystals at 2,163:9.
2,165-2,204	39	Massive, brownish, rock salt; with dark grey shale inclusions.
2,204-2,213:9	9:9	Mixed salt and shale, badly shattered; with shale carrying coarse crystals of glauberite which is also seen in bands.
2,213:9-2,217:9	4	Mixed reddish to brownish salt with contorted shale.
2,217:9-2,220:9	3	Mixed shale and rock salt.
2,220:9-2,236:4	15:7	Reddish to brownish rock salt; with light grey shale inclusions. Numerous glauberite crystals and other salts?
2,236:4-2,237:4	1	Thin-banded, grey, shale.
2,237:4-2,240:9	3:5	Brownish rock salt; with glauberite crystals and shale inclusions.
2,240:9-2,242:11	2:2	Brownish rock salt; with shale inclusions. No glauberite visible.
2,242:11-2,246:11	4	Grey shale; with massive inclusions of brown rock salt.
2,246:11-2,270	23:1	Massive, brown, rock salt; with shale inclusions and white efflorescence.
2,270-2,272	2	Heavy shale beds; with salt inclusions.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
2,272-2,272:11	0:11	Heavy shale beds; with salt inclusions.
2,272:11-2,274	1:1	Heavy shale beds; with salt inclusions.
2,274-2,276	2	Brown salt; and banded shale inclusions.
2,276-2,279	3	Heavy shale bands; with salt inclusions.
2,279-2,312:6	33:6	Massive brown rock salt; with black shale inclusions and efflorescence.
2,312:6-2,320	7:6	Mixed shale and salt bands, shale predominating.
2,320-2,397	77	Massive, brown, rock salt; with light grey shale inclusions and efflorescence. In this section the beds of salt in many places are very uniform, the parting planes being horizontal and of even thickness.
2,397-2,408:10	11:10	Massive, light grey, shale; with salt veinlets. White efflorescence at 2,401:4.
2,408:10-2,412:6	3:8	Fine-grained to medium-coarse, light pink, rock, with reddish salt inclusions. May be volcanic ash? but some is quite sandy with rounded grains.
2,412:6-2,413:6	1	Translucent, brown, rock salt; with thin shale partings.
2,413:6-2,414:10	1:4	Volcanic ash? as above only finer-grained.
2,414:10-2,421:6	6:8	Massive, brown, rock salt; with only few shale inclusions.
2,421:6-2,423:6	2	Massive, grey, shale; with salt inclusions.
2,423:6-2,445:10	7:4	Thin-banded, grey, shale; with salt inclusions and sandy beds (ash)? Another mineral? (bluish).
2,445:10-2,448:10	3	Mixed grey shale; and reddish rock salt in veinlets. Efflorescence.
2,448:10-2,451:10	3	Light brown rock salt; with occasional shale bands. Efflorescence.
2,451:10-2,502	50:2	Massive, brownish to blackish brown salt; with brown to black shale inclusions. Efflorescence.
2,502-2,503:11	1:11	Grey shale; with salt inclusions. Vertical bedding.
2,503:11-2,508	4:1	Core lost.
2,508-2,510:6	2:6	Horizontal, grey, shale; with red salt veinlets.
2,510:6-2,512	1:6	Fine-grained, light pink, volcanic ash?; with salt inclusions.
2,512-2,517:2	5:2	Brown rock salt; with shale inclusions and efflorescence.
2,517:2-2,523:2	6	Core lost (salt?).
2,523:2-2,530	6:10	Brown to black shale; and red to brown rock salt.
2,530-2,535:2	5:2	Most of core lost but similar to above according to few pieces saved.
2,535:2-2,556	20:10	Massive, dark brown, rock salt; with occasional black shale inclusions.
2,556-2,557:6	1:6	Black shale; with salt inclusions.
2,557:6-2,558	0:6	Brown rock salt; black shale inclusions.
2,558-2,566:6	8:6	Most of core lost but what was recovered was same as previous section.
2,566:6-2,582	25:6	Brown rock salt; black shale inclusions. Some of core lost.
2,582-2,586	4	Same as above.
2,586-2,605	19	Shale, grey; and red salt veins; followed by reddish sandy shale and red salt veins and green to grey shale, all steeply dipping with glauberite at 2,598.
2,605-2,673	68	Rock salt, generally red to grey.
2,673-2,678	5	Shale, grey with red salt veins.
2,678-2,688	10	Glauberite, and grey silt.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
2,688-2,728	40	Rock salt, grey to red; with grey silt fragments and layers of silt 2,693-95 and 2,698-2,700.
2,728-2,821	93	Rock salt, generally grey to white with red zones. Generally coarse to granular with bands of water-white crystals at 1,736, 2,739-40, 2,807-8, 2,811-19, with grey shale fragments and bands at 2,738, 2,750-52, 2,764-5 and 2,807-8. Some efflorescence at 2,744-6, 2,756-64, 2,722-4, 2,781-4, 2,798-2,800 and 2,811-19. Rhombohedral cleavage at 2,808.
2,821-2,827	6	Shale predominant with ⅓ salt veins.
2,827-2,871	44	Rock salt, generally white to grey, some pink with fragments of grey shale. Dark glauberite at 2,866-71. Silt 2,841:3 to 2,841:11, 2,864-66. Some efflorescence 2,827-41, 2,842-3.
2,871-2,894	23	Shale, dark, laminated; thin beds red sandstone up to 2 inches. Interbedded glauberite and veins of red salt.
2,894-2,911	17	Rock salt, red to white; fragments of shale.
2,911-2,913	2	Silt, grey; and red salt.
2,913-2,927:6	14:6	Rock salt, red to grey; some sandstone; much glauberite.
2,927:6-2,930	2:6	Silt, red salt, and glauberite.
2,930-2,943:6	13:6	Rock salt, grey and white. Shale fragments.
2,943:6-2,966	22:6	Shale, with thin bands of sandstone.
2,966-2,969:6	3:6	Rock salt, red to white; and glauberite.
2,969:6-2,975	5:6	Shale, dark, laminated; veins of red salt.
2,975-2,985:6	10:6	Rock salt, grey to white; silt. Traces of glauberite.
2,985:6-2,993:3	7:9	Shale, anhydrite, and glauberite.
2,993:3-3,045	5:9	Shale, blue-grey, calcareous; and gypsum veins.
3,045-3,052	7	Sandstone, light grey, calcareous, fine-grained, cemented; and dark shale.
3,052-3,060	8	Shale, blue-grey to dark.
3,060-3,079	19	Shale, blue-grey to dark; and sandstone grey, fine-grained, cemented.
3,079-3,093	14	Shale, blue-grey to dark.
3,093-3,106	13	Shale, blue-grey to dark; and sandstone, grey, fine-grained, cemented.
3,106-3,126	20	Shale, dark grey, sandy.
3,126-3,139	13	Oil sand, brown, fine-grained, cemented.
3,139-3,163	24	Sandstone, brownish grey, fine-grained, cemented; and blue-grey shale.
3,163-3,186	23	Oil sand, grey to dark grey, hard.
3,186-3,201	15	Shale, blue-grey to dark.
3,201-3,220	19	Shale, blue-grey to dark; and grey, fine-grained sandstone.
3,220-3,228	8	Sandstone, grey, fine-grained, cemented; and dark shale.
3,228-3,243	15	Oil sand, grey to light grey, fine-grained, micaceous, cemented.
3,243-3,267	24	Shale, dark grey; and sandstone, grey, fine-grained, cemented.
3,267-3,289	22	Shale, blue-grey.
3,289-3,297	8	Oil shale, brown.
3,297-3,318	21	Shale, blue-grey.
3,318-3,337	19	Oil sand, brown, fine-grained, cemented.
3,337-3,346	9	Shale, dark grey, hard, sandy.

TEST WELL No. 112, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
3,346-3,362	16	Oil sand, brown, fine-grained, cemented.
3,362-3,540	178	Shale, blue-grey.
3,540-3,564	24	Oil sand, light brown, cemented, fine-grained, micaceous; with blue-grey shale. (Slight show of black oil).
3,564-3,611	47	Gas and oil sand, light brown, medium-grained, open, loose; with some grey shale parts.
3,611-3,666	55	Shale, blue-grey to dark; and thin grey sandstone bands 3,611-31.
3,666		Bottom of hole.

WELDON No. 117, (Incomplete)

(New Brunswick Gas & Oilfields Limited)

Albert Formation

0-1,185	1,185	Barren rock.
1,185-1,208	23	Glauberite; with fragments of shale.
1,208-1,259	51	Rock salt, white; some veinlets of shale and some reddish stain.
1,259-1,262	3	Shale, grey.
1,262-1,269	7	Rock salt, reddish; veinlets of shale.
1,269-1,271	2	Glauberite, white; and some rock salt.
1,271-1,287	16	Rock salt, white and pink; and thin fragments of shale.
1,287-1,292	5	Rock salt, red; and grey shale 50-50.
1,292-1,303	11	Shale, red to grey; and veinlets of rock salt.
1,303-1,335	32	Rock salt, white to red; with bands of shale up to 1 inch; 1,321-22 light grey silt.
1,335-1,341	6	Shale, grey to red; rock salt veinlets.
1,341-1,350	9	Rock salt, white to red; and thin shale.
1,350-1,352	2	Shale, grey; and light grey silt.
1,352-1,356	4	Rock salt, white to pink; and thin veinlets of shale.
1,356-1,366	10	Shale, grey; and thin white to red rock salt.
1,366-1,376	10	Rock salt, red to white; and thin silt.
1,376-1,385	9	Lost core.
1,385-1,386	1	Glauberite; some fragments of silt.
1,386-1,406	20	Lost core.
1,406-1,412	6	Rock salt, red to white.
1,412-1,421	9	Shale, dark to light grey; and veinlets of red rock salt.
1,421-1,443	22	Rock salt, white to red; veinlets of shale.
1,443-1,457	14	Shale, dark grey; with thin veinlets of rock salt.
1,457-1,475	18	Silt, grey to light grey; liquid oil and thin rock salt from 1,457-62; and glauberite up to 1 inch thick 1,462-75.
1,475-1,487	12	Shale, dark; glauberite beds up to 1 foot thick.
1,487-1,498	11	Shale, dark; and thin veinlets of red rock salt.
1,498-1,505	7	Shale, blue-grey; and grey limestone; rock salt veinlets.
1,505-1,770	265	Barren shale, oil shale, dry and wet oil sands.
1,770		Bottom of hole.

WELDON No. 108

Hillsborough Formation

Depth feet—inches	Thickness feet—inches	Description
0-25	25	Overburden, and grey to red quartz conglomerate.
25-28	3	Sandstone, gritty, red.
28-43	15	Quartz conglomerate and grit, red; rounded pebbles.
43-49	6	Sandstone, red.
49-81	32	Quartz conglomerate, grey to red; large rounded pebbles; and some grey limestone bands 63-69.
81-108	27	Grit, dark red, hard; and grey limestone bands 90-102.
108-137	29	Grit, dark red to grey; and conglomerate, red.
137-152	15	Quartz conglomerate, red jasper, and dark red cemented sandstone bands. Red jasper bed 138-145.
152-180	28	Sandstone, dark red, medium to hard; some conglomerate pebbles.
180-233	53	Volcanic ash, purple and white; and red jasper grains.
233-250	17	Sandstone, dark red, cemented, marly; and some green sandstone.
250-260	10	Shale, dark grey, marly.
260-296	36	Marl, dark red chocolate, sandy; and dark red marly sandstone.
296-365	69	Sandstone, dark red, cemented, marly; and grey limestone bands 317-323; and grey, fine-grained, cemented, sandstone bands 334-45.
365-390	25	Shale, dark grey, marly, salt.
390-720	330	Marl, generally dark red chocolate, some sandy, micaceous parts, with dark purple bands 543-513; some gypsum with grey limestone bands 581-96; and green-grey shale bands.
720-740	20	Shale, grey; and fissure gypsum.
740-864	124	Marl, dark red chocolate, some sandy, hard parts; with some green-grey shale and fissure gypsum.
864-880	16	Shale, grey.
880-894	14	Marl, dark red, sandy, hard in parts; some fissure gypsum.
894-926	32	Shale, grey to green-grey; fissure gypsum; and some dark red, marl bands 916-26.
926-949	23	Marl, dark red; and thin bands grey to green-grey, shale.
949-986	37	Shale, green to green-grey; and fissure gypsum.
986-998	12	Marl, dark red, sandy, hard; and thin shale, grey to green-grey; and some fissure gypsum.
998-1,018	20	Shale, grey to blue-grey; and thin marl, dark red bands.
1,018-1,034	16	Marl, dark red to purple, hard in parts; and fissure gypsum.
1,034-1,062	28	Shale, grey to green-grey; and thin bands of dark red marl.
1,062-1,072	10	Marl, dark red to purple; with some thin green-grey shale.
1,072-1,112	40	Shale, grey to green-grey; and some fissure gypsum.
1,112-1,170	58	Marl, dark red to purple.
1,170-1,177	7	Shale, grey, sandy.
1,177-1,220	43	Marl, dark red, brown, hard, sandy; and thin, green-grey shale bands.
1,220-1,242	22	Shale, grey to green-grey; and thin, dark red marl and gypsum.
1,242-1,248	6	Marl, dark red.

WELDON No. 108—*(Continued)*

Albert Formation

Depth feet—inches	Thickness feet—inches	Description
1,248-1,515	267	Shale, blue-grey and grey, appears sandy in parts; with thin grey limestone 1,342-48, 1,430-36, with fissure gypsum.
1,515-1,529	14	Mixed anhydrite or shale with some chocolate marl (probably cavings). Occasional transparent crystals of anhydrite or selenite. Between 1,517 and 1,522 some of the selenite is pinkish in color.
1,529-1,540	11	Highly calcereous shale; with crystals of calcite and selenite.
1,540-1,615	75	Calcereous shale and anhydrite with selenite and calcite crystals. Traces of metallic sulphides in the shale. At 1,650-10 feet there is a little trace of sandstone.
1,615-1,621	6	Anhydrite and shale.
1,621-1,633	12	Interbanded anhydrite and selenite with slight traces of glauberite.
1,633-1,640	7	Interbanded anhydrite and selenite with heavy precipitate with BaCl. (glauberite?).
1,640		Start of mixed anhydrite and glauberite.
1,640-1,649	9	Interbanded anhydrite and selenite, with glauberite.
1,649-1,662	13	Interbanded anhydrite and selenite, with only slight glauberite.
1,662-1,664	2	Glauberite, with occasional shale (?), or anhydrite bands.
1,664-1,665	1	Minute parallel bands of glauberite(?), and anhydrite.
1,665-1,666	1	Dark anhydrite with small amounts of glauberite.
1,666-1,671:5	5:5	Interbanded glauberite and dark anhydrite about 50-50.
1,671:5-1,672	0:7	Dark anhydrite; with small amounts of glauberite.
1,672-1,680	8	Interbanded glauberite and dark anhydrite about 50-50.
1,680-1,684	4	Interbanded anhydrite and glauberite 75-25.
1,684-1,689	5	Interbanded glauberite and anhydrite 50-50.
1,689-1,691	2	Interbanded glauberite and anhydrite 75-25.
1,691-1,699	8	Banded anhydrite and glauberite partings.
1,699-1,709	10	Interbanded glauberite and anhydrite 50-50.
1,709-1,710	1	Interbanded anhydrite and glauberite 75-25.
1,710-1718	8	Interbanded glauberite and anhydrite 60-40.
1,718-1,739	21	Interbanded anhydrite and glauberite 60-40.
1,739-1,744	5	Shale, interbanded with halite and glauberite; with a little anhydrite.
1,744-1,749	5	Anhydrite; with some glauberite and halite.
1,749-1,754	5	Banded glauberite and anhydrite; with halite.
1,754-1,764	10	Anhydrite; with halite and traces of glauberite.
1,764-1,783	19	Anhydrite; with glauberite and rock salt.
1,783-1,789	6	Anhydrite; with strong glauberite and halite.
1,789-1,799	10	Anhydrite; with slight glauberite and heavy halite.
1,799-1,825	26	Anhydrite; with heavy glauberite and heavy halite (1,805-11 glauberite is not so heavy).
1,825-1,828	3	Interbanded, light grey, shale; and dark reddish rock salt up to 1½ inches thick. 60-40.
1,828-1,830	2	Mixed, reddish grey salt; and grey shale or silt. 75-25.
1,830-1,901	71	Anhydrite; with medium to heavy glauberite and heavy halite. 1,841-51 medium glauberite.
1,901-1,906	5	Anhydrite; with heavy glauberite and halite about 30%.

WELDON No. 108, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,906-1,911	5	A little anhydrite with heavy glauberite and much rock salt.
1,911-1,915	4	Anhydrite; with heavy glauberite and heavy halite.
1,915-1,926	11	Rock salt; with a little anhydrite showing small amounts of glauberite.
1,926-1,931	5	Intimately mixed salt and shale about 50-50. NaCl mostly dark red.
1,931-1,942	11	Rock salt, white to translucent to brown. Thin anhydrite and heavy glauberite.
1,942-1,946	4	Rock salt, transparent to translucent to dark grey. Medium glauberite and some anhydrite.
1,946-1,950	4	Rock salt, translucent white to pink. Occasional anhydrite; heavy glauberite.
1,950-1,955	5	Rock salt, translucent white to pink. Occasional anhydrite; medium glauberite.
1,955-1,960	5	Rock salt, translucent, white to grey. Occasional anhydrite; medium glauberite.
1,960-1,966	6	Rock salt, white, translucent to opaque. Medium glauberite.
1,966-1,972	6	Rock salt, translucent to transparent, white. Occasional chips of white salt with pink salt inclusions. Slight glauberite.
1,972-1,984	12	Rock salt, white to pink to grey. 1,972-78 medium glauberite. 1,978-84 heavy glauberite.
1,984-1,996	12	Rock salt, translucent to opaque, white to grey; some anhydrite; heavy glauberite.
1,996-2,025	29	Rock salt, transparent to translucent, white. Some anhydrite. 1,996-2,002 heavy glauberite. 2,002-2,008 medium glauberite. 2,008-2,025 medium glauberite with occasional pink salt.
2,025-2,030	5	Rock salt, transparent to translucent, white; with occasional anhydrite; medium glauberite.
2,030-2,037	7	Rock salt, transparent to grey; occasional anhydrite; heavy glauberite.
2,037-2,046	9	Practically all rock salt, white to water-white.
2,046-2,050	4	Greyish white to reddish salt; with narrow silt or shale bands. 80% NaCl.
2,050-2,074	24	Rock salt; with slightly thicker bands of shale or silt.
2,074-2,093	19	Shale or silt; with salt interbanded.
2,093-2,105	12	Salt; with shale or silt. 2,100-2,105 mostly rock salt.
2,105-2,146	41	Mostly red and white rock salt.
2,146-2,158	12	Salt, white to water-white; with thin veinlets of shale or silt.
2,158-2,163	5	Tried to core but lost samples.
2,163-2,167	4	Massive, reddish rock salt; with ¼ inch to ½ inch bands of grey shale badly contorted and lying at all angles to the horizontal.
2,167-2,261	94	Rock salt, generally white to water-white crystals, with some thin reddish colored salt and very thin veinlets of silt.
2,261-2,264	3	Interbanded, reddish white, salt and shale about 75-25.
2,264-2,368	104	Rock salt, generally white to water-white crystals, with thin reddish colored salt; and very thin veinlets of silt.
2,368-2,373	5	Mostly shale or silt, with a little salt.
2,373-2,374	1	Core lost.

WELDON No. 108, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
2,374-2,376	2	Light colored, greenish grey, shale; interbanded with veinlets of brick-red salt. 12-15% NaCl.
2,376-2,393	17	Salt, red to water-white; with quite thick interbanded shale.
2,393-2,414	21	Shale and silt; with salt veinlets throughout; reddish brown to white salt crystals.
2,414-2,421	7	Mostly shale, with a little salt.
2,421-2,467	46	Rock salt, white to water-white crystals; with thin veinlets of shale.
2,467-2,474	7	Mostly shale, with thin veinlets of salt.
2,474-2,478	4	Interbanded, brick-red, salt; and grey shale about 50-50. In places the salt is transparent with only faint, reddish tinge. 4 inches of 3½ feet core taken. Beds show vertical dip.
2,478-2,483	5	Missing core.
2,483-2,493	10	Salt, water-white crystals; with quite thick shale interbedded.
2,493-2,527	34	Salt, generally water-white crystals; with veinlets of shale.
2,527-2,538	11	Mostly shale and silt with a little salt.
2,538-2,562	24	Salt, water-white; with shale and silt interbedded.
2,562-2,574	12	Mostly salt, water-white to red; with shale and silt veinlets.
2,574-2,578	4	Interbanded, light and dark grey, shale or silt with secondary veinlets of brick-red rock salt. Banding in cores seems to be perpendicular to hole. Material seems to be crushed and squeezed.
2,578-2,638	60	Salt, water-white to red; with shale and silt interbanded. 2,582-98 mostly salt. 2,598-2604 light grey silt bands thicker. 2,604-38 mostly salt.
2,638-2,658	20	Half shale and silt, and half light colored, crystalline salt (glauberite?) This reacts strongly with $BaCl_2$.
2,658-2,668	10	Shale; with light colored mineral (glauberite?) and some white rock salt.
2,668-2,673	5	Shale; with light colored mineral (glauberite?). Probably no NaCl.
2,673-2,676	3	Interbanded, dark and light grey, shale; with anhydrite and glauberite stringers.
2,676-2,693	17	Shale; with light colored, crystalline mineral, (glauberite?) with fibrous gypsum.
2,693-2,713	20	Shale, grey; with some fibrous gypsum.
2,713-2,755	42	Dry oil sands.
2,755-2,949	194	Shale, blue-grey, sandy 2,778-82, 2,787-92; grey limestone bands 2,921-27, 2,943-49; with thin white sandstone bands cemented with lime 2,798-2,850.
2,949-2,973	24	Dry oil sand, grey, very fine-grained.
2,973-3,007	34	Shale, blue-grey, some sandy.
3,007-3,020	12	Limestone, grey, hard, siliceous.
3,020-3,074	54	Dry oil sand, grey, very fine-grained.
3,074-3,153	79	Shale, blue-grey to dark; with sandstone bands 3,087-95, 3,101-07.
3,153-3,178	25	Dry oil sand, greyish brown, fine- to medium-grained, cemented, hard.
3,178-3,204	26	Shale, blue-grey, hard.
3,204-3,227	23	Dry oil sand, light brown, fine- to medium-grained.
3,227-3,289	62	Shale, blue-grey.

WELDON No. 108, Albert Formation—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
3,289-3,331	42	Dry oil sand, grey to brown, fine-to-medium-grained; with thin blue-grey shale partings.
3,331		Bottom of hole.

GAUTREAU SALT

Diamond-drill Hole No. 1

Angle 54 degrees, towards S 24° W magnetic. Depth 503 feet. Elevation 79.2 feet.

Depth feet—inches	Thickness feet—inches	Description
0-45	45	Conglomerate and red sandstone.
45-87	42	Reddish marl.
87-317	230	Greenish grey shale; veinlets of anhydrite, fibrous gypsum, calcite, etc. Struck water at 281 feet.
317-503	186	Core not examined.
		Total depth 503 feet.

Diamond-drill Hole No. 2

Angle 54 degrees, towards S 24° W magnetic.

0-13	13	Reddish conglomerate. Hole abandoned.

Diamond-drill Hole No. 3

Angle 54 degrees, towards S 24° W magnetic. Elevation 89.0 feet.

0-82	82	Red conglomerate; pebbles of limestone and manganese oxide.
82-84	2	No core.
84-108	24	Weldon shale. Angle 15 degrees.
108-136:4	28:4	Albert. Angle 15 degrees.
136:4-146	9:8	Albert shale. Irregular.
146-226	80	Albert shale. Cavities at 218 feet 6 inches.
226-269	43	Albert shale; with a 4-inch gypsiferous band at 247 feet.
269-297	28	Albert shale; some gypsiferous zones.
297-301	4	Albert shale; some anhydrite; remainder grey Albert veinlets of gypsum. Angle 20 to 90 degrees.
*		
332:10-358	25:2	Mostly Albert, some cavities. Angle 20 degrees.
358-388	30	Albert; with abundant streaks of anhydrite. Angle 45 to 50 degrees.
388-415	27	Albert, massive; considerable anhydrite.
415-446	31	Mostly massive Albert; with considerable anhydrite.
446-456	10	Considerable anhydrite.
456-484	28	Chiefly Albert; with traces of anhydrite.
484-517	33	Albert; with considerable anhydrite especially at 509-510 feet. See sample.
517-547	30	Anhydrite and Albert about 50-50.
547-575	28	Anhydrite and Albert 30-50.
575-601	26	Albert shale; some anhydrite. Angles 15 to 20 degrees.

Diamond-drill Hole No. 4

Angle 65 degrees from horizontal. Elevation 73.3 feet. Bearings S 12° W magnetic.

0-23	23	Casing. No core.
23-223	200	Red conglomerate with calcareous cement, pebbles of limestone, manganese oxide and greenish volcanics, interbeds of chocolate brown sandstone.
223-233	10	Breccia of grey to khaki colored weathered Albert shale, cemented with gypsiferous material. Veins of white fibrous gypsum.

* 301-332:10 log not available

GAUTREAU SALT—Diamond Drill Hole No. 4—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
233-240	7	Blue-grey Albert shale; with mixture of gypsum.
240-260	20	Khaki colored Albert shale, impregnations of gypsum, some veinlets of fibrous gypsum.
260-272	12	Massive core, chiefly Albert shale mixed with gypsum. Bedding 45 degrees.
272-443	171	Laminated grey Albert shale, massive Albert shale, veinlets of gypsum. Angle 15 to 90 degrees.
443-461:6	18:6	Chiefly massive gypsum with grey shale impurities.
461:6-797	335:6	Chiefly massive gypsum and Albert shale. At 474 take sample for Ottawa to identify gypsum and very small soft black specks.
797-912	115	Very poor core recovery. The samples suggest rock salt of varying impurities all the way down.

Log based on a hasty examination by W. J. Wright. Core stored with New Brunswick Gas & Oilfields Limited, Moncton.

Diamond-drill Hole No. 5

Angle 65 degrees. Elevation 23.1 feet.

0-102	102	Red conglomerate.
102-133	31	Chocolate shale. Vertical.
133-503	370	Grey Albert shale, bed vertical. Bottom of hole.

Diamond-drill Hole No. 6

Angle 65 degrees. Eelevation 71.6 feet.

0-134	134	Red conglomerate.
134-158	24	Reddish shale.
158-181	23	Grey Albert shale.
181-819	638	Chiefly anhydrite and gypsum.

PART OF WELDON No. 49-1 DRILL HOLE

1,245-1,247	2	Mixed shale; and anhydrite 40% irregular seams and small nodules.
1,247-1,248:6	1:6	Greenish grey shale; with a few irregular seams of anhydrite.
1,248:6-1,249:6	1	Anhydrite (70%); and shale.
1,249:6-1,250	0:6	Shale; a few seams of anhydrite.
1,250-1,252:5	2:5	Missing core.
1,252:5-1,259	6:7	Shale and anhydrite. Some fibrous veinlets of gypsum. 40 to 50% anhydrite.
1,259-1,262:4	3:4	Missing core.
1,262:4-1,265	2:8	Mixed shale; and anhydrite 40%.
1,265-1,266:6	1:6	Banded shale and anhydrite. Some calcareous material in some anhydrite bands.
1,266:6-1,267:6	1	Missing core.
1,267:6-1,270	2:6	Irregularly mixed shale and anhydrite. Some regular banding. Probably 60% anhydrite.
1,270-1,272:6	2:6	Missing core.
1,272:6-1,278:6	6	Shale with a few anhydrite bands. Some calcareous material in the anhydrite bands.
1,278:6-1,280	1:6	Missing core.

PART OF WELDON No. 49-1 DRILL HOLE—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,280-1,285	5	Irregularly mixed anhydrite and shale.
1,285-1,289	4	Mixed shale and anhydrite irregularly mixed and banded.
1,289-1,290	1	Lost core.
1,290-1,292:7	2:7	Heavy bands of anhydrite in shale. Evidence of some glauberite in the anhydrite as efflorescence on outside of core, particularly from 1,290-1,290:6.
1,292:7-1,293	0:3	Special sample.
1,293-1,295	2	Anhydrite (80%); with thin seams of shale. Possibly thin seams of glauberite along the anhydrite bands.
1,295-1,300	5	Mixed shale and anhydrite.
1,300-1,310	10	Anhydrite (75%); with thin seams of shale.
1,310-1,314	4	Shale with thin seams of anhydrite. Probably some thin seams of glauberite.
1,314-1,334	20	Anhydrite and shale. Irregular seams and bands of anhydrite running along core. Some efflorescence. Some pinkish gypsum in irregular veinlets.
1,334-1,345	11	Predominantly black contorted shale; graphite in places, cutting core about 10° off right angles.
1,345-1,365	20	Missing core.
1,365-1,367	2	Shale with numerous bands of anhydrite. Some veinlets of fibrous gypsum.
1,367-1,368:1	1:1	Special sample.
1,368:1-1,369	0:11	Shale with some small bands anhydrite.
1,369-1,369:11	0:11	Special sample.
1,369:11-1,374:6	4:7	Dark graphitic shale. Some stringers and bands anhydrite. Cutting across core of from 10° to 20° from right angles.
1,374:6-1,382:6	8	Banded shale and anhydrite.
1,382:6-1,384:2	1:8	Missing core.
1,384:2-1,385	0:10	Banded shale and anhydrite.
1,385-1,386:6	1:6	Black shale; some small bands anhydrite.
1,386:6-1,400	13:6	Banded shale and anhydrite. 6-inch black shale band at 1,397 feet.
1,400-1,401:2	1:2	Special sample.
1,401:2-1,405	3:10	Black shale; some graphitic with small seams of anhydrite. Cutting across core 25° from right angles.
1,405-1,408:7	3:7	Banded anhydrite and shale. Cutting across core at 20° from right angles.
1,408:7-1,409:6		Special sample.
1,409:6-1,413	3:6	Black graphite shale; with irregular anhydrite seams at various angles.
1,413-1,423	10	Shale; with bands and seams of anhydrite. Some graphitic seams.
1,423-1,423:9	0:9	Missing core.
1,423:9-1,425	1:3	Shale; with irregular seams and splotches of red gypsum.
1,425-1,427	2	Shale; with some irregular bands of pink gypsum.
1,427-1,434:3	7:3	Banded anhydrite and shale. A few calcareous bands of shale. A small amount of glauberite in some of the anhydrite bands.
1,434:3-1,436	1:9	Glauberite (60%); banded with shale.
1,436-1,436:9	0:9	Missing core.
1,436:9-1,441:3	4:6	Glauberite (75%); banded with shale.
1,441:3-1,442:9	1:6	Shale; with irregular seams and bands of glauberite and anhydrite.
1,442:9-1,445	2:3	Glauberite; with bands of shale.
1,445-1,450:9	5:9	Glauberite (60%); with shale bands and inclusions.

PART OF WELDON No. 49-1 DRILL HOLE—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,450:9-1,451:4	0:7	Special sample. "Consists of an association of glauberite and rock matter. The glauberite is greyish to reddish in color and displays a coarse grained crystalline structure."
1,451:4-1,453	1:8	Shale.
1,453-1,455:6	2:6	Banded glauberite and shale (60%). Grading into anhydrite.
1,455:6-1,455:9	0:3	Special sample. "Fine grained glauberite interlaminated with rock matter. Small amounts of anhydrite are associated with glauberite."
1,455:9-1,462:9	7	Banded shale and glauberite.
1,462:9-1,465	2:3	Glauberite (75%); some shale.
1,465-1,466:8	1:8	Glauberite (60%); and shale.
1,466:8-1,467:6	0:10	Shale.
1,467:6-1,467:11	0:5	Special sample.
1,467:11-1,483	5:1	Missing core.
1,483-1,485	2	Shaley mud showing evidence of glauberite crystals. Some calcareous seams.
1,485-1,488	3	Mud (anhydrite); with glauberite crystals.
1,488-1,520	32	Only 6 inches of core recovered, mud with glauberite crystals.
1,520-1,530	10	Grey shaley mud. A few glauberite crystals.
1,530-1,541	11	Mud with some glauberite crystals. One piece shows evidence of a halite crystal.
1,541-1,559	18	Mud with some evidence of glauberite and halite.
1,559-1,562	3	Mud with considerable showing of halite.
1,562-1,564	2	Shaley mud with a considerable amount of glauberite.
1,564-1,573	9	Shale. (Angle 30° from right angles). A few vugs with reddish halite.
1,573-1,580	7	Dirty halite. Very little core recovery.
1,580-1,601	21	Missing core.
1,601-1,604	3	Banded shale and dirty red halite. Some crystals of glauberite along the core.
1,604-1,621:7	17:7	Alternate beds of shale and dirty reddish halite. Much missing core.
1,621:7-1,623	1:5	Special sample.
1,623-1,635	18	Dirty red halite with many inclusions of mud and an occasional shale band.
1,635-1,638:4	3:4	Dirty red halite with considerable irregular shale and mud inclusions. A few glauberite crystals, gradually increasing to perhaps 10%.
1,638:4-1,638:11	0:7	Special sample.
1,638:11-1,643:6	4:7	Reddish halite with considerable mud inclusions. Some glauberite crystals.
1,643:6-1,655:1	11:7	Mixture of halite and glauberite. Considerable inclusions of mud, probably anhydrite. Much missing core.
1,655:1-1,655:4	0:3	Special sample. Mainly an aggregate of glauberite crystals associated with small quantities of halite, pinkish in color.
1,655:4-1,663	7:8	Halite varying from white translucent to reddish in color.
1,663-1,670	7	Mud (anhydrite); with much included reddish halite. Much missing core.
1,670-1,680	10	Mixed halite and mud. A few glauberite crystals.
1,680-1,685	5	Halite, glauberite, and mud.

PART OF WELDON No. 49-1 DRILL HOLE—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,685-1,696	11	Coarse-grained, crystalline, greyish to reddish halite. About 10 to 15% included mud in patches and bands. Some sections show glauberite crystals.
1,696-1,702	6	Glauberite and halite. Some included mud.
1,702-1,706	4	Shale and anhydrite with included crystals of glauberite and red halite.
1,706-1,713	7	Halite, white to pinkish with some mud inclusions. Medium-grained crystalline halite with possible glauberite in thin coatings around the grains.
1,713-1,717	4	Halite, reddish with much mud in irregular inclusions. A little white efflorescence indicating the presence of some glauberite. Core badly broken.
1,717-1,732:8	15:8	Halite, reddish; much mud and a few glauberite crystals.
1,732:8-1,733	0:4	Special sample. "Is an association of glauberite, halite and anhydrite."
1,733-1,748	15	Halite, reddish; much mud and few tiny glauberite crystals.
1,748-1,758	10	Halite, pinkish to white. Some inclusions of mud. A little efflorescence on core indicating the presence of some glauberite.
1,758-1,760	2	Halite, red; with considerable mud inclusions. A few small glauberite crystals.
1,760-1,768	8	Halite, pinkish; with some mud inclusions.
1,768-1,773	5	Halite, pinkish; much included mud in patches and bands. Some glauberite crystals.
1,773-1,782	9	Halite, brownish to white translucent. Some included mud and white efflorescence.
1,782-1,790	8	Halite, brownish to white translucent. Considerable included mud in seams and patches.
1,790-1,795	5	Shaley mud containing a large number of tiny glauberite crystals and some red halite.
1,795-1,805	10	Halite, pinkish to white. Considerable included mud.
1,805-1,811	6	Halite, brownish to white. Some mud inclusions.
1,811-1,818:6	7:6	Halite, brownish to white, medium-grained, crystalline. Some mud inclusions and bands.
1,818:6-1,838	19:6	Halite, brownish to white. Some included mud. Some glauberite crystals in sections. 10 feet missing from core.
1,838-1,843	5	Shaley mud with considerable reddish halite and some glauberite.
1,843-1,847	4	Halite, pinkish to white. Some mud bands up to 2 inches in width.
1,847-1,861	14	Halite, pinkish to clear white; with considerable included mud.
1,861-1,870	9	Mud and shale bands with much reddish to white halite. A few glauberite crystals on core.
1,870-1,878	8	Mixed halite and mud.
1,878-1,881	3	Halite, pinkish to brownish; some mud inclusions.
1,881-1,883	2	Shaley mud; pink halite inclusions; quite vuggy but presume halite dissolved.
1,883-1,886	3	Halite, brownish to pinkish white. Considerable included mud and some tiny glauberite crystals.
1,886-1,892	6:6	Halite, pinkish to white, medium-grained, crystalline. Some mud inclusions.
1,892-1,898:6	6:6	Mud with considerable bands of dirty white to crystal clear halite. Some glauberite crystals.

PART OF WELDON No. 49-1 DRILL HOLE—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
1,898:6-1,908	9:6	Halite, white to pinkish; much mud in shaley bands and inclusions.
1,908-1,913	5	Halite, pinkish to brownish; with considerable included mud.
1,913-1,923	10	Missing core. Only 6 inches recovered which consisted of a mixture of shaley mud and pinkish halite.
1,923-1,931	8	Mud and halite; halite brownish to pinkish.
1,931-1,933	2	Halite, white to pinkish, medium-grained, crystalline. Fairly free from mud.
1,933-1,938:6	5:6	Halite, white to brownish; some included mud. Some glauberite or anhydrite crystals on core.
1,938:6-1,941	2:6	Halite, pinkish to brownish salt; fairly free from mud.
1,941-1,944	3	Halite, pink to brownish; some included mud. Glauberite crystals showing on core.
1,944-1,949	5	Shaley mud; much pinkish halite.
1,949-1,959	10	Halite, pinkish to brownish. Considerable included mud in bands and patches.
1,959-1,972	13	Halite, pinkish to brownish. Much included mud.
1,972-1,983:6	11:3	Halite, pinkish. Considerable mud inclusions and some fine glauberite crystals.
1,983:3-1,983:6	0:3	Special sample.
1,983:6-1,987	3:6	Halite, pinkish to brownish. Some included mud.
1,987-2,000	13	Mixture of mud and reddish halite. Considerable concentration of glauberite crystals in various sections.
2,000-2,010	10	Halite, reddish; with considerable included mud.
2,010,2,019	9	Halite, reddish to brownish; decreasing quantities of mud.
2,019-2,024	5	Halite, reddish to whitish; considerable mud.
2,024-2,030	6	Halite, reddish to whitish; some mud included and banded.
2,030-2,035	5	Banded shale and anhydrite with some glauberite crystals and a few included halite crystals. Some calcereous bands.
2,035-2,040	5	Halite, white to pinkish; crystalline; with considerable mud included in bands and patches.
2,040-2,046	6	Mixture of mud and salt; mud highly calcareous.
2,046-2,052	6	Halite, pinkish to brownish; some banded mud and inclusions.
2,052-2,055	3	Calcereous shale with some reddish halite; a few tiny crystals of glauberite.
2,055-2,061	6	Halite, pinkish to brownish; some mud inclusions.
2,061-2,069	8	Halite, whitish to brownish, crystalline; some included mud.
2,069-2,071	2	Halite, reddish; some glauberite and included mud.
2,071-2,073	2	Halite, white to brownish; some included mud.
2,073-2,081	8	Halite, reddish to brownish; considerable included mud.
2,081-2,085	4	Halite, reddish; some included mud.
2,085-2,091	6	Halite, white to brownish; considerable included mud.
2,091-2,092	1	Shale and anhydrite.
2,092-2,094	2	Halite, pinkish to brownish; some included mud.
2,094-2,104	10	Halite, pinkish to brownish; some included mud.
2,104-2,121	17	Mixture of halite and mud; glauberite crystals at many points.

PART OF WELDON No. 49-1 DRILL HOLE—*(Continued)*

Depth feet—inches	Thickness feet—inches	Description
2,121-2,130	9	Halite, whitish to pinkish; considerable banded and included mud.
2,130-2,134	4	Banded shale and anhydrite; some calcareous bands and a few irregular areas of glauberite crystals.
2,134-2,136	2	Halite, reddish to whitish; considerable mud.
2,136-2,141	5	Halite, whitish to brownish; some mud.
2,141-2,146	5	Halite, pinkish to brownish; much mud.
2,146-2,157	11	Halite, white to pinkish; considerable included mud.
2,157-2,160	3	Halite, white; considerable included mud.
2,160-2,170	10	Halite, pink to brownish; considerable included mud and some crystals of glauberite.
2,170-2,174	4	Halite, glauberite and mud.
2,174-2,178	4	Halite, pinkish to whitish; considerable mud.
2,178-2,186	8	Bands of shale-anhydrite and pinkish halite. Some irregular inclusions of mud.
2,186-2,199	13	Halite, pinkish to brownish; considerable bands and inclusions of mud.
2,199-2,207	8	Mixture of mud and halite, white to pinkish.
2,207-2,210:6	3:6	Banded anhydrite and shale. Some pinkish salt inclusions and a few glauberite crystals.
2,210:6-2,217	6:6	Mixture of mud and halite, pinkish to whitish.
2,217-2,225	8	Banded shale; anhydrite and halite pinkish to whitish.
2,225-2,235	10	Halite, whitish to brownish; some included mud.
2,235-2,238	3	Halite, crystalline with many glauberite crystals.
2,238-2,240	2	Halite, whitish; much included mud.
2,240-2,248	8	Halite, whitish to brownish; considerable included mud.
2,248-2,252	4	Halite, whitish; some included mud and glauberite crystals.
2,252-2,258	4	Halite, whitish to brownish; some mud inclusions.
2,258-2,258:6	2:6	Halite, whitish to pinkish; considerable included mud.
2,258:6-2,260:6	2	Shale and anhydrite; some pinkish halite.
2,260:6-2,273	12:6	Halite, white to brownish; considerable included mud; halite is medium-grained, crystalline.
2,260:*-2,273	18	Missing core. About 2 inches of recovered core appears to be fine-grained sandstone.
2,273-2,291	10	Mixture of anhydrite, shale and halite.
2,291-2,301	5:6	Halite, white to pinkish; considerable included mud. A few glauberite crystals. Brownish, some mud.
2,301-2,306:6		
2,306:6-2,316	9:6	Halite, white to pinkish; considerable included mud.
2,316-2,331	15	Halite, white to brownish; some mud.
2,331-2,385:6	54:6	Halite, narrow bands (2 inches to 6 inches) of clear white, translucent to transparent, halite and brownish halite with considerable mud. The brownish bands represent about two-thirds of the total thickness of this section.
2,285:6-2,387	1:6	Shale and anhydrite; some glauberite crystals.
2,387-2,391:6	4:6	Halite, banded, white to brown; some mud in bands.
2,391:6-2,404	12:6	Shale, bluish grey, some calcareous bands. Some included red halite and glauberite crystals chiefly 2,398-2,404.
2,404-2,407	3	Shale and anhydrite into reddish sandstone.
2,407-2,429	22	Halite; banded, dark brown, with a few bands of white to pink halite and many narrow bands of shale. One 8-inch band shale 2,417.
2,429-2,434	5	Halite, dirty brown; some calcareous inclusions. Some glauberite crystals.

PART OF WELDON No. 49-1 DRILL HOLE—*(Continued)*

Depth feet—inches	feet—inches	Description
2,434-2,443	9	Shale and anhydrite; some included halite.
2,443-2,452	9	Halite, pinkish to brownish; thin seams and bands of mud. Considerable calcareous mud.
2,452-2,481	29	Halite, white to brownish; considerable irregular mud inclusions.
2,481-2,493	12	Halite, white to brownish; medium-grained, crystalline; some mud.
2,493-2,501	8	Halite, broken white to pinkish; irregular bands calcareous shale.

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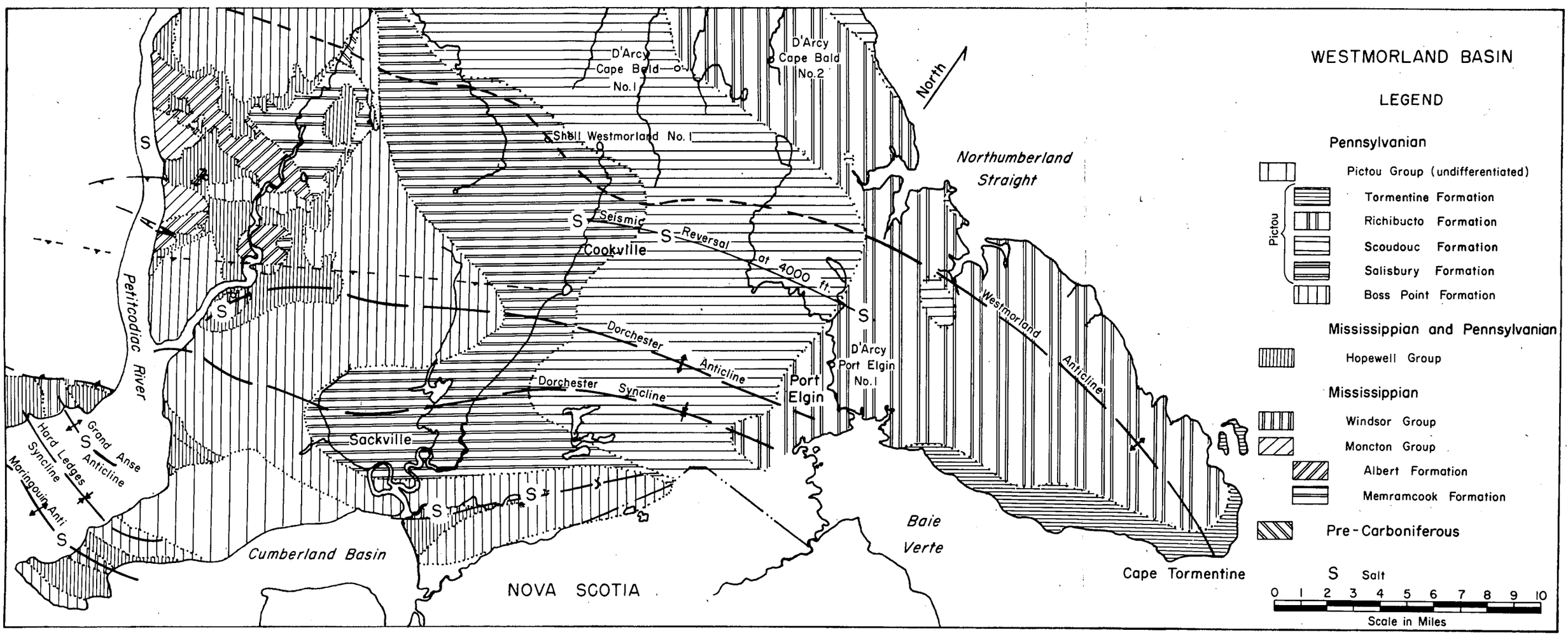

Modified after W.C. Gussow, 1953