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GOVERNMENT OF QUEBEC
DEPARTMENT OF NATURAL RESOURCES

RENÉ LÉVESQUE, Minister

P.-E. AUGER, Deputy Minister

GEOLOGICAL REPORT 102

YAMASKA-ASTON AREA

NICOLET, YAMASKA, BERTHIER
RICHELIEU AND DRUMMOND COUNTIES

by

T.H. CLARK

PROPRIÉTÉ DU GOUVERNEMENT DU QUÉBEC
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St-François river, looking downstream, 3 miles above Pierreville. Prior to 1922, when the Yamaska topographic map was made, Vaches river followed the course indicated by the broken line, later breaking through a peninsula extending downstream from the hill in the right foreground as far as the shrub-covered hill near the old mouth, isolating the latter hill and shortening its course. Geology is largely concerned with change, of which this is one example.

GOVERNMENT OF QUEBEC
DEPARTMENT OF NATURAL RESOURCES

RENÉ LÉVESQUE, Minister

P.-E. AUGER, Deputy Minister

GEOLOGICAL EXPLORATION SERVICE

H.W. McGERRIGLE, chief

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YAMASKA - ASTON AREA

NICOLET, YAMASKA, BERTHIER, RICHELIEU AND DRUMMOND COUNTIES

by

T. H. Clark

INTRODUCTION

General Statement

The Yamaska-Aston area is partly in the St. Lawrence Lowlands and partly in the Appalachians*. The writer devoted parts of the seasons of 1943 to 1946 to the surveying of this area, and has frequently revisited critical localities. The records of deep wells and of quarries are up to date as of June 1, 1961.

The geological survey of this area has delimited the belts of outcrop of the Upper Ordovician rocks of the Lowlands, and in particular has established the stratigraphic development and subdivision of those rocks. This has allowed serious prospecting for oil and natural gas to be undertaken, and has provided drilling operators with a reliable key to the understanding of the logs of wells drilled, or to be drilled, in this area. The survey also provides a guide for future prospecting.

Location

The Yamaska-Aston area lies athwart, but largely southeast of St. Lawrence river. It is bounded by longitudes 72°15' and 73°00' and by latitudes 46°00' and 46°15' and comprises 620 square miles. It includes parts of Drummond, Nicolet, Berthier, Richelieu and Yamaska counties.

*The extreme northwestern corner of the area lies north of St. Lawrence river. Because there are no outcrops in that corner, the discussion of the distribution of its rocks will be deferred to the treatment of the Trois-Rivières area, to which it may be considered an extension. For completeness, however, the logs of two deep wells (Louiseville Nos. 1 and 2) are given in Appendix D.

Nicolet (pop. 3,772)* and Pierreville (pop. 1,586) are the chief towns. Others, in order of population, are St. Léonard d'Aston, La Baie, St. Zéphirin, St. Célestin, St. Wenceslas, Yamaska East, and Ste. Brigitte des Saults. Parts of Louiseville and of Notre Dame du Bon Conseil lie within this area, and there are a dozen other smaller settlements.

Means of Access

An abundance of sand and gravel in the western part of this area has allowed the development of a network of improved roads. Route 3 roughly parallels St. Lawrence river, connecting Yamaska East, Pierreville, La Baie and Nicolet. Route 12 runs from near Nicolet through St. Célestin, to Notre Dame du Bon Conseil, and Route 9, now being developed as part of the Trans-Canada highway, cuts across the southeast corner of the area. Rail transportation is furnished by the main line (Montreal to Lévis) of the Canadian National Railways which passes through St. Léonard, whence a branch goes off northwestward to Grand St. Esprit and Nicolet, and a subsidiary line crosses the main line at Aston Junction, leading northwest to St. Célestin and southeast towards Victoriaville. Another Canadian National Railways line passes through Yamaska East and Nicolet.

Field Work and Acknowledgments

The base maps used throughout this work were the west half of the Aston map (Sheet 31 $\frac{1}{4}$, Department of National Defence, 1932) and the Yamaska map (Sheet 31 $\frac{1}{2}$, Department of National Defence, 1937), both on a scale of one mile to one inch. Results of traverses, etc., were plotted on half-mile-to-the-inch enlargements. No aerial photographs were available.

Outcrops are largely confined to river valleys. Every stream of consequence was explored, and pace and compass traverses were made through wooded areas and over open country wherever necessary. Several weeks were devoted to the magnificent section of Upper Ordovician strata exposed along Nicolet river.

Field work was carried out during parts of the seasons of 1943 to 1946. Satisfactory assistance was rendered by Jules Arcand, Gilles Breault (two seasons), Jean Préfontaine, Mousseau Tremblay, and the Rev. Father Léo Morin.

*Population data are taken from Canadian Official Railway Guide with Airlines. Montreal, June, 1960.

The cooperation of numerous local proprietors in furnishing information concerning their water wells, etc., is gratefully acknowledged. The writer is deeply indebted to Imperial Oil Limited for permission to use information gained during the drilling campaign carried out by Lowlands Exploration Limited. Thanks are also due the Geological Survey of Canada whose library of well samples, together with well logs and other information, was freely placed at the writer's disposal. Lastly, a word of thanks goes to the Redpath Museum of McGill University for permission to use storage space for the extensive collections, mostly of fossils, which accumulated during the progress of field work. These collections have already formed the basis for two doctorate theses successfully submitted at McGill University; one on Bryozoa and Scolecodonta by B.R. Husein, the other on Ostracoda by G.F.E. Carter.

Previous Work

The earliest record of the geology of this area is to be found in Logan's Geology of Canada (1863). Very little of consequence was published thereafter until Foerste's memoirs on the formations, and later the faunas, of the Upper Ordovician of Ontario and Quebec were published by the Geological Survey of Canada in 1916 and 1924. Since then additional information has been forthcoming from a few workers, among whom are Parks (1930, 1931), Clark (1947), and Belyea (1952). R.S. Dean (unpublished M.Sc. thesis, McGill, 1958) has recently recorded a thorough study of the calcareous beds of the Richmond and Lorraine formations. The latest publication is by DeBlois on Deep Wells in the St. Lawrence Lowlands published by the Quebec Department of Mines (1959).

DESCRIPTION OF THE AREA

Topography

A line passing through Aston Station and Ste. Brigitte des Saults, which corresponds approximately to the trace of the Champlain fault, roughly divides the region into two different topographies. East of this line the surface is uneven and rolling. To the west of this line, the land is monotonously flat, broken only by river valleys and by a low, west-facing escarpment 10 to 20 feet high, more or less parallel to Route 3. Below this escarpment a flat lowland extends northwestward to the St. Lawrence, ending in a marsh exposed at seasonal low water. These lower topographic features are repeated along the north shore of the St. Lawrence. From the river southeastward the land rises gently at an average rate of 12 1/2 feet per mile as far as the trace of the Champlain fault, where elevations of 250 and 300 feet occur, and beyond which no generalization can be made.

Drainage

Drainage is entirely into the St. Lawrence. The main streams are, from north to south, Bécancour, Nicolet, Pontgravé, St. Francis, and Yamaska rivers (Plate I). Rapids are common along all these rivers, except the Yamaska, rendering them unfit for navigation other than by rowboat. Both Nicolet and Pontgravé rivers have been dammed to supply power for grain and lumber mills, and remains of numerous old dams attest the once greater use of this power.

Natural Resources

Most of the area is poor to good farming country. Barren sandy soils can be found at some of the higher elevations but the greater part of the area consists of a mosaic of sandy and clayey soils capable of producing a variety of crops. Peat occurs in a few places, but is not utilized. [For a complete treatment of the soils of this area see Laplante and Choinière (1954), and Choinière and Laplante (1948)]

More than half of the population lives outside the towns and villages. Nicolet, Pierreville, and Notre Dame du Bon Conseil have small but important industries. These and the remaining villages serve their surroundings as marketing centres. Almost every community has its sawmill; lumber and cordwood are still important products, though in time the increasing demand for cleared land will see these products decline in importance.

Sand and gravel are fairly common in the eastern part of the area. No building stone is produced. Rock is quarried for crushed stone only at Notre Dame du Bon Conseil. No limestone sufficiently rich in lime to be profitably exploited was found. Natural gas has been found in a dozen wells, and may, possibly with oil, become the most valuable natural resource of this area.

GENERAL GEOLOGY

General Statement

Geologically, if not strictly physiographically, this area covers parts of two widely diverse regions. The southeastern corner is part of the folded terrane of the Appalachian mountain-built province of North America, whereas the rest lies within the St. Lawrence extension of the Interior Basin province. The two parts are separated by a thrust fault referred to usually as the Champlain fault, or occasionally, in tribute to its discoverer, as Logan's Line.

There are fundamental differences between the rocks and their structures in these two parts. Southeast of the fault, the rocks consist of a variety of clastic sediments, placed under the convenient name "Sillery group" and presumably of Cambrian and possibly early Ordovician ages, together with basic intrusive and extrusive rocks. The northwestern and larger portion of the area is occupied by marine beds of Utica and Lorraine ages, and by both marine and non-marine beds of Richmond age. The rocks of the Sillery group are everywhere folded, faulted, and in some places mildly metamorphosed. Such features are interpreted as the result of these rocks having been thrust over the western part during the Taconic revolution of late Ordovician age. The northwestern part of the area consists of sedimentary rocks whose structure ranges from nearly horizontal in the west to intensely complicated within a few miles of the Champlain fault where they were overridden by the Sillery thrust slice (and possibly others). The intensely deformed rocks, whose precise formational identification is usually in doubt, are set apart from the less deformed as the St. Germain complex.

The main Chambly-Fortierville syncline which dominates the geological structure of the lowlands south of the St. Lawrence passes diagonally across the Yamaska area. Its axis enters the area from the south near St. Gérard, passes in a northeasterly direction close by La Visitation, and leaves by the northeastern corner. Red non-marine Richmond shale (hitherto usually called Queenston shale) with dips generally less than 6° occupies a belt 7 to 10 miles wide in the central part of the syncline. This is flanked on the southeast (and presumably also on the northwest, although there is no confirming exposure) by a narrow belt of grey, marine Richmond shale, which is in turn followed by marine beds of Lorraine age. Towards the southwest corner of the Yamaska area the syncline becomes complicated by faults and steeper dips, as is well shown along both banks of St. Francis river for the upper 3 miles of its course in this area.

West of the Champlain fault exposures are largely limited to the banks of Bécancour, Nicolet, Pontgravé, and St. Francis rivers. East of the fault Nicolet and Pontgravé rivers contribute most of the exposures, but between St. Wenceslas and Notre Dame du Bon Conseil there are a few knolls mostly of igneous rocks, all basic, some intrusive, some extrusive.

Table of Formations

		West of Champlain fault		East of Champlain fault
		Group	Formation and Member	Formation
	Post-Ordovician			St. Flavien (igneous)
PALEOZOIC	Ordovician	Richmond	Bécancour River Carmel River Pontgravé River	St. Germain Complex
		Lorraine	Nicolet River St. Hilaire Chambly Breault	
		Utica Trenton Black River	Found in well borings only	
		Chazy		
		Beekmantown		
	Cambrian	Potsdam		"Sillery"

With very few exceptions, exposures of rock are confined to river valleys. The unsatisfactory nature of such a distribution is compensated for by their excellence in some places. On Nicolet river there is a nearly continuous section of 2,782 feet of Ordovician beds. Such a section, unparalleled elsewhere in Quebec, gives the only sure key to the stratigraphic succession within the Lorraine and Richmond formations. Abundant exposures of the Sillery beds along the three main rivers allow a reasonably comprehensive, although incomplete, picture to be drawn of the rock types concerned. However, their structure is not well indicated.

Historical Review

Only a few earlier references have been made to the rocks of this area. Logan (1863, p. 205) mentioned "fossiliferous grey shales of the Hudson River formation ... on the Nicolet, about fourteen miles from its mouth". Giroux (1897, p. 71A) referred briefly to the Lorraine section on the Nicolet as follows: "A paced survey of part of the north-east branch of the Nicolet River was made, in order to locate, on that stream, an anticline in the Hudson River formation. These Hudson River rocks are much twisted, altered and faulted on both sides of the anticline and more particularly to the south of it". Ellis (1901, p. 21J) devoted a paragraph to the distribution of the "Medina" red shales and sandstones in this area, and also rephrased and amplified Giroux's statement given above

In spite of the splendid exposures, the Nicolet River section was not systematically described until 1916, when the Geological Survey of Canada published a memoir by Foerste entitled "The Upper Ordovician Formations of Ontario and Quebec". On pages 14 and 41, and again on page 56, Foerste described in some detail the Lorraine part of the section, and on pages 141 to 150 the Richmond part. On pages 173 and 174 he described some of the Queenston rocks along the same river. Eight years later the Geological Survey published his accompanying memoir on "The Upper Ordovician Faunas of Ontario and Quebec". These two memoirs, taken together, provided the only detailed treatment of the sedimentary rocks and fossils of the Nicolet river cliffs. The only other known references to rock exposures in this area are the sections recorded by

Parks (1931, p. 89-90, 94, 95) along Nicolet, Pontgravé, and St. Francis rivers, and a note by Keele (1915, p. 32) concerning the use of the Queenston shale for brickmaking. To the Geology of Quebec (Dresser and Denis, 1944) the present writer contributed a few pages describing the geology of the unfolded rocks of the Lowlands, and in 1947 the Quebec Department of Mines published a general statement (Clark, 1947) of the geology of the St. Lawrence Lowlands south of the St. Lawrence river.

Much information has been obtained from the logs of deep wells (Appendix D). Their numbers and names are taken from DeBlois (1959). Some information can be obtained from Ingall (1926; 27), Parks (1930; 1931), Maddox (1931; 1931a), Johnston (1934, 1935), Snider and Farish (1935), and Belyea (1952).

In addition to deep wells a fair amount of information, usually reliable, was obtained from farmers concerning the rock encountered in drilling their domestic water wells.

Formations Exposed West of the Champlain Fault

Bécancour River Formation

The highest formation exposed anywhere in the Chambly-Fortierville syncline is one of red and green shales, siltstones, and sandstones usually referred to as the Queenston formation. The present name is given because of the excellent exposures of these beds along Bécancour river. The greater part of the Yamaska area south of the St. Lawrence is occupied by these rocks. Their boundary on the north-west cannot be located with precision because of the absence of exposures. On the southeast, however, actual contacts on Nicolet, Pontgravé, and St. Francis rivers serve to limit the formation.

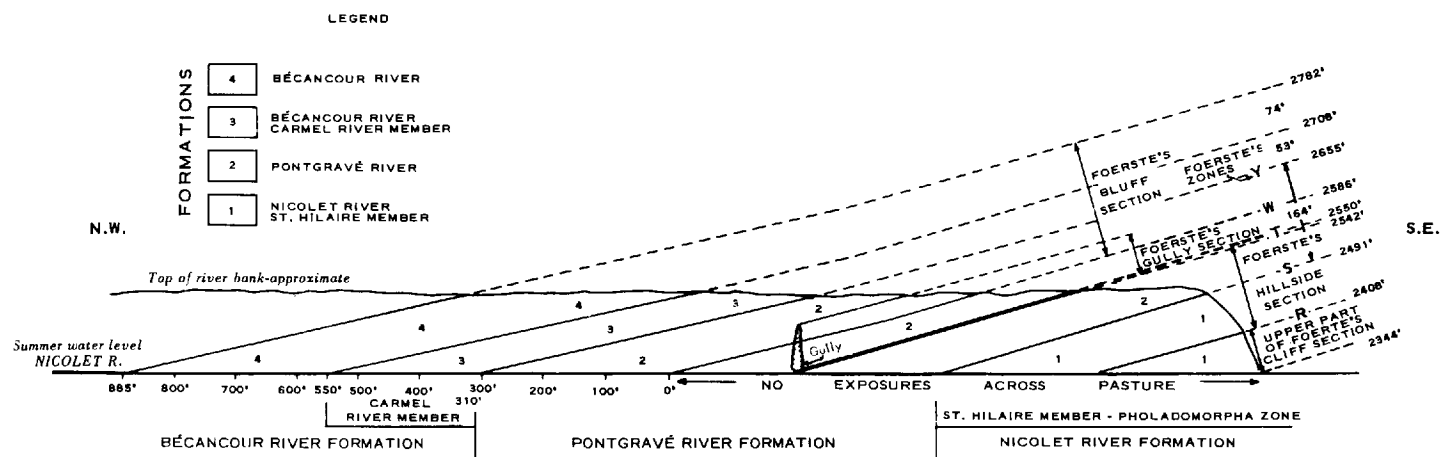


FIGURE 1

CROSS-SECTION ALONG RIGHT (NORTHEAST) BANK OF NICOLET RIVER INCORPORATING EXPOSURES OF FOERSTE'S BLUFF SECTION, GULLY SECTION, HILLSIDE SECTION, AND UPPER PART OF CLIFF SECTION. SEE FIGURE 4 FOR RELATIONSHIP OF THIS PART TO THE ENTIRE NICOLET RIVER SECTION.

Nicolet River Exposures

Just before leaving the Aston area Nicolet river makes a half-mile-wide horseshoe bend to the southwest, and then resumes its northwesterly course. At the lower end of the bend on the northeast bank, there is a cliff about 1/6 mile long where the Bécancour River and underlying beds are well shown. The entire section dips uniformly downstream at an angle of about 13° . The stratigraphic units, with their calculated thicknesses are given in Figure 1. A similar section can be worked out on the southwest bank, though the exposures are discontinuous. Except at the base, the Bécancour River formation consists largely of a deep brick-red shale grading into siltstone, with sandstone occurring in thin beds rarely more than a few inches thick. Mica flakes are common, and cross-bedding is present, though rare. Grooves, flow rolls and other bedding plane characteristics are exceedingly rare.

In the northeast bank section, the lowest 53 feet of the Bécancour River beds consist of rocks lithologically identical with the red beds above, except for their greenish grey colour. These basal shales are named the Carmel River member of the Bécancour River formation, taking their name from a tributary of Pontgravé river along the banks of which they are well exposed (see below). The shales of this member show no stratification except when seen from across the river. They have a tendency to break with curving fractures which have neither coincidence with bedding planes nor constancy in direction or distance; this peculiarity is common to all the shales of the Bécancour River formation.

The contact between the Carmel River greenish grey shale and the underlying grey fossiliferous Pontgravé River shale is difficult to determine lithologically. Neither shale is well bedded within a few feet of the contact, and both break with the peculiar curved fractures. The Carmel River beds are in most places distinctly greenish, but the difference between greenish-grey and grey is not one of great critical value. Here, as elsewhere, the top of the Pontgravé River formation is placed immediately above the highest fossiliferous horizon.

Within the Yamaska area exposures of the Bécancour River beds occur discontinuously on both sides of Nicolet river downstream as far as the bridge at Ste. Monique. Here the Bécancour River beds are almost all red shales, with minor amounts of red siltstone and sandstone. A top section is that recorded along the south bank from Ste. Monique bridge upstream, as follows:

Top of section. 400 feet east of the eastern end of the bridge at Ste. Monique.

Feet	Inches	
10		Red shale with green layers
3		Grey shale
2		Red shale
	3	Grey sandstone
4		Red shale
2	6	Red sandstone
2		Red shale
	6	Hard grey sandstone
8		Soft red shale
2	4	Hard green sandstone
1	3	Red shale
	3	Red sandstone
1	6	Soft red shale
	6	Soft green sandstone
1		Soft red shale
	4	Hard red and green sandstone
2		Fairly soft red shale
	2	Hard red sandstone
4		Fairly hard red shale
	6	Fairly soft green sandstone
10		Soft red crumbly shale with 2' 6" red sandstone in middle
	3	Hard green sandstone
	9	Soft red crumbly shale
	2	Hard grey sandstone
1	6	Red crumbly shale
	4	Soft grey sandstone
1	6	Soft crumbly red shale
2		Medium hard red sandstone
	2	Hard red sandstone
5		Crumbly red shale, containing 1/2" beds of soft green sandstone

Feet	Inches	
1	6	Hard green sandstone
	6	Soft grey sandstone
3		Crumbly red shale
1		Crumbly grey sandy shale. Topmost surface carries burrows
3	3	Grey sandstone in 3" beds
3		Red shale
80	0	Total thickness.

On the basis of an average dip of 5° (the dips range from 2° to 8° to the northwest), the thickness seen in the Yamaska area along Nicolet river is 381 feet. If the section be continued to the contact with the Pontgravé River beds in the Aston area, and if allowance be made for increased dips, it appears that the beds exposed at the bridge at Ste. Monique are 498 feet above the base of the Bécancour River formation.

Pontgravé River Exposures

Bécancour River beds occur in two widely separated localities. One group occurs about 3 miles southeast of Nicolet, and another can be seen 1/4 mile below the dam 2 miles southeast of the bridge at La Visitation. The former group shows a prevailing southeast dip of from 3° to 8° , and consists of red and grey sandstone with minor amounts of shale. The prevalence of sandstone is presumptive evidence of their position fairly close to the top of the Bécancour River formation, a conclusion which is corroborated by their position near the axis of the syncline. A calculation based upon an average dip of 5° yields a thickness of 226 feet for this group of beds.

In the second group of exposures (below the dam), fossiliferous Pontgravé River beds grade upward into grey unfossiliferous shales of the basal part of the Bécancour River formation. The lower 40 feet of the latter are composed of grey shales which pass upward into an alternation of grey and red shales, and, before the limit of the exposure is reached, red shales predominate. Not more than 100 feet of Bécancour River beds are exposed here. The exposures of the basal grey beds of the Bécancour River formation along Pontgravé river and along the tributary Carmel river constitute the type locality for the Carmel River member.

St. Francis River Exposures

Ascending the river, the first exposures occur at the mouth of Vaches river, 3 miles above Route 3 bridge at Pierreville. Here about 3 feet of red and grey-green shale can be seen at the junction of the two streams. After a 1/2-mile gap, exposures of red and green sandstone and shale, with grey and white sandstone beds, extend for about 1/2 mile along the southern bank. The reversal and the amounts of dip indicate a synclinal axis close to the mouth of Vaches river and possibly an anticlinal axis just beyond the southeast end of the exposure here described. The succession of strata at this locality is given below:

Top of section

Feet	Inches	
7		Thin- and thick-bedded grey sandstone, finely cross-bedded
2		Missing
1		Red sandstone and sandy shale. The lithologic nature of the rock changes along the bedding.
2		Grey sandstone, ripple marked. Ripples strike N.20°E.
1		Thin-bedded grey sandy shale
	6	Grey sandstone
	6	Thin-bedded grey shale
3		Thick- and thin-bedded grey sandstone
17		Total thickness

The sandstone at the top of the section (Plate 5B) occurs in beds up to 2 feet thick, but most of it is in beds of 6 to 8 inches. It splits into good rectangular slabs and, if there were more of it, it would be a very desirable building material on account of its hardness and low content of argillaceous impurities. Locally, one house has been constructed of this stone. In places it appears to be nearly 100% quartz. In a few beds it is conglomeratic, with pebbles up to one inch in diameter.

On the opposite (northern) shore, a somewhat longer exposure occupies a mile of the river bank. Starting at the abandoned ferry crossing southwest of St. Elphège and going downstream, no exposures are found for 3/4 mile. Red and green sandstones then appear, and give way to disconnected exposures of white and grey quartz sandstone in beds 6 inches and more thick. It is highly probable that this is the same sandstone noted at the top of the section along the south shore of the river;

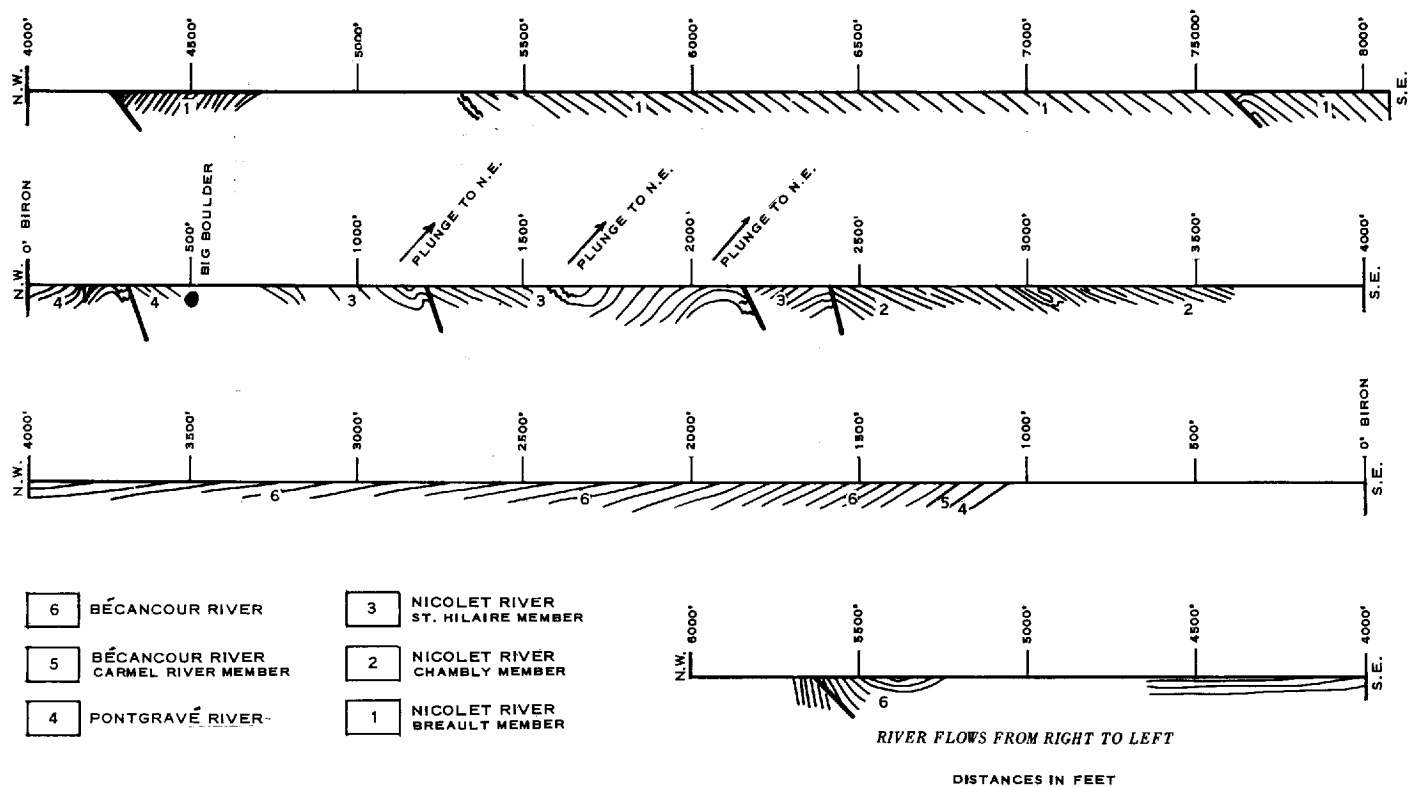


FIGURE 2
GEOLOGICAL EXPOSURES ALONG RIGHT (NORTHEAST) BANK ST. FRANCIS RIVER
ABOVE AND BELOW HOUSE OF L. G. BIRON - 2 MILES ABOVE ABANDONED ST. EL PHÈGE FERRY.

if so, it is the highest bed exposed along St. Francis river for it lies close to the synclinal axis noted near Vaches river. Also, the areal distribution indicates that the synclinal axis is located within the river and more or less parallel to the east-west course of the river at this spot. Continuing downstream along the northern bank, the exposures are almost all shale and, apart from one inconsiderable outcrop, do not reach a point opposite the mouth of Vaches river.

Upstream from the abandoned ferry landing on the north bank, a small outcrop of red shale occurs at about 1/2 mile, and nearly continuous outcrops begin after another 1/2 mile. At the western end, the exposure is complicated by a fault (Figure 2), but eastward of this, the beds are mostly red shale and are approximately horizontal for more than 1/4 mile, thereafter dipping more and more to the north. These inclined beds, with dips of 5° to 10° , are predominantly red shales, with minor amounts of green shales and sandstones. They continue for 3/4 mile, and give way to grey shales of the Carmel River member, which are in direct contact with the fossiliferous Pontgravé River shales and limestones. (This contact is about 1,000 feet downstream from a road which descends the cliff from a point opposite the house of L.G. Biron, and is also almost due east of the old dam site on the south bank). There is no sharp break between the two formations and the boundary has to be drawn immediately above the highest fossiliferous bed. The apparent thickness of the Carmel River beds here is exceptionally great, and it may be that an unobserved fault causes some duplication of the beds.

On the south bank of the St. Francis, about 1 1/2 miles above the abandoned ferry landing 5 miles above Pierreville, and at the site of an old dam, exposures begin and are nearly continuous upstream for a couple of miles (Figure 3). At the old dam site, red shales with minor amounts of red and grey sandstone dip 20° N.W. An abundance of moulds of star-shaped clusters of gypsum occurs here; such moulds are commonly seen wherever shale is the dominant lithologic type of rock in this formation. Continuing upstream, red and green shales alternate, sandstone becomes rare and disappears after 1/8 mile. A quarter of a mile still farther the red shale is succeeded by the grey shales of the Carmel River member, which continue as far as the contact with the marine Pontgravé River beds at a locality one mile east-southeast of the junction of the river road and a side road going toward St. Pie de Guire. The dips in the Carmel River shale are not consistent, and as usual stratification is not well shown (Figure 3).

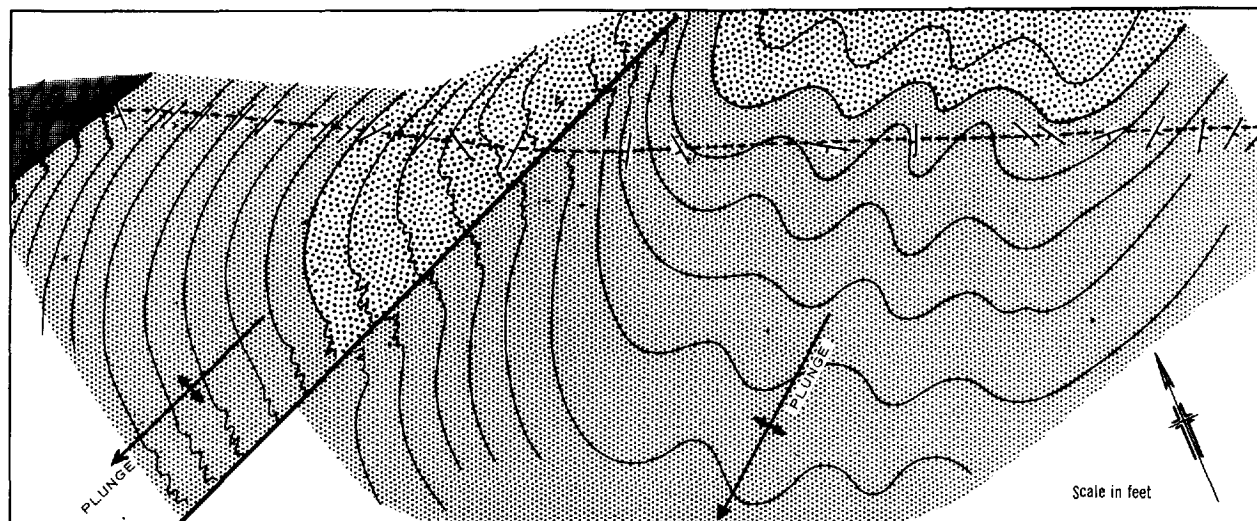
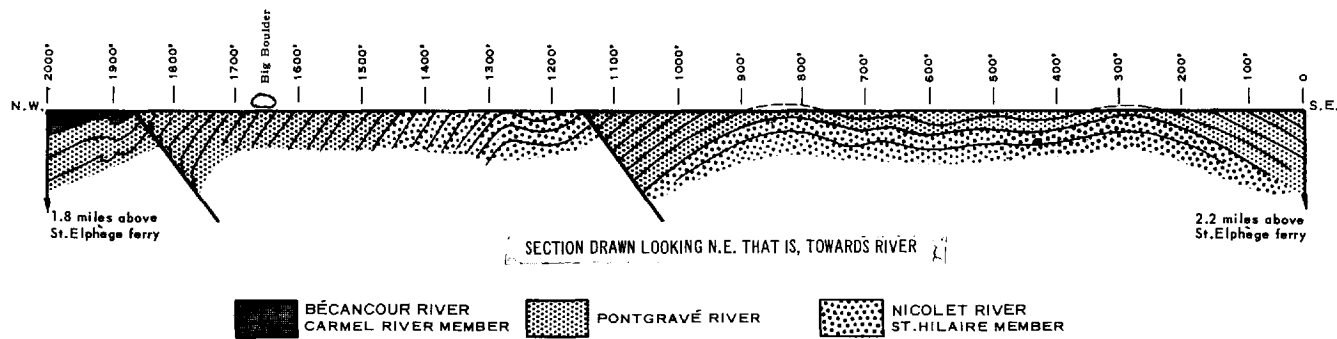


FIGURE 3.
MAP AND SECTION OF THE EXPOSURES ON THE LEFT (SOUTH WEST)
BANK OF ST. FRANCIS RIVER. FROM 1.8 TO 2.2 MILES ABOVE ST. ELPHÈGE FERRY.

La Baie Exposures

Red shales are exposed 1 3/4 miles due east of the church at La Baie, in the bed of a small stream just downstream from a northeast-southwest road. These beds all dip toward the southwest at about 5°, and hence, like the downstream beds exposed on Pontgravé river, lie on the northwest limb of the Chambly-Fortierville syncline.

Information from Wells

Of the deep wells drilled in this area only two have penetrated the Bécancour River formation. The records are as follows (see also Appendix D): 1. Quebec Fuel No. 1. After passing through 180 feet of overburden, this well penetrated 360 feet of Bécancour River beds before passing into marine Richmond-Lorraine beds below.

2. Trudel Well. Below 80 feet of overburden, 560 feet of Bécancour River beds were cut by the drill.

3. Canadian Seaboard St. Gérard No. 1 (DeBlois, 1959, p. 25). This is situated about 1 1/2 miles south of the boundary of the Yamaska area but is included for the information it provides. The following is an abbreviated log:

50 feet	Overburden	
90 feet	Red shale and sandstone	
160 feet	Grey sandstone and shale	{ 1230 feet
		{ Bécancour
		{ River
980 feet	Red shale	

The St. Gérard well was drilled close to the axis of the syncline, and its section should, therefore, be a fair expression of the development of the Bécancour River in this area. The log suggests that the hard grey sandstone so prominently displayed along the St. Francis near the mouth of Vaches river is in all probability not at the top of this section as proposed by Snider and Farish (1935, p. 92) but should be considered merely as a grey sandstone within the Bécancour River formation.

Correlations with Sections Elsewhere

The Bécancour River formation is recognized throughout eastern and southern Ontario as the Queenston shale. Farther north, in the Manitoulin Islands, the Kagawong limestone was deposited at the same time. In Anticosti Island the Vauréal, and possibly the Ellis Bay, limestones were also laid down during this time.

Pontgravé River Formation

Immediately below the grey shales of the Carmel River member of the Bécancour River formation, on Bécancour, Nicolet, Pontgravé, and St. Francis rivers, there are 100 - 200 feet of grey calcareous shales and limestones with fossils indicative of a Richmond age. All of the known exposures are on the southern limb of the main syncline. Because they are so well shown on Pontgravé river, they have been named the Pontgravé River formation.

The contact between the Pontgravé River and the overlying Carmel River beds is drawn, wherever possible, immediately above the highest fossiliferous horizon. In most cases this is indicated by a fair abundance of Zygospira kentuckiensis. Where fossils are not available, and where both formations are shale, there is usually a greenish tint to the Carmel River beds, whereas the Pontgravé River shales are grey or faintly bluish grey.

The distinction between the Pontgravé River and the underlying Lorraine (Nicolet River formation) is made chiefly upon the basis of their contained fossils. True, the Pontgravé River formation carries neither heavy beds of sandstone nor thin, fissile, black shale beds, both of which are common at certain horizons within the Nicolet River, but as both formations are made up largely of grey argillaceous and calcareous shales, the only practical way of differentiating them is by their fossil content. In order to facilitate this task, and in order to present a complete list of the paleontological data from this area, all Richmond and Lorraine fossils collected and identified during the course of the present work are given below.

List of All Richmond and Lorraine Fossils
Collected and Identified during the Course of the
Present Work, with Their Known Stratigraphic Ranges

X - Stratigraphic range previously determined x - Extension of range resulting from present work	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St. Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
<u>COELENTERATA</u>					
<u>Streptelasma rusticum</u>	X	x			
<u>Favistella alveolata</u>	X				
<u>Calapoecia huronensis</u>	X				
<u>Protarea richmondensis</u>	X				
<u>Beatricea undulata</u>	X	x			
<u>VERMES</u>					
<u>Cornulites flexuosus</u>	X	X	X	X	x
<u>CRINOIDEA</u>					
<u>Compsocrinus harrisi</u>	X				
<u>BRYOZOA</u>					
<u>Constellaria polystomella</u>	X				
<u>Coeloclema commune</u>				X	
<u>Fenestella</u> sp.			x		
<u>BRACHIOPODA</u>					
<u>Leptobolus insignis</u>				X	X
<u>Lingula hyacinthensis</u>				X	
<u>L. rectilateralis</u>	x				X
<u>Trematis millepunctata</u>	X	X	X	X	X

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St. Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic range previously determined					
x - Extension of range resulting from present work					
<u>Schizocrania filosa</u>		X	X	X	X
<u>Pholidops subtruncata</u>	X	X	X	x	
<u>Resserella</u> sp., cf. <u>R. roqata</u>		X	X	X	X
<u>Hebertella occidentalis</u>	X	X	x		
<u>Glyptorthis insculpta</u>	X				
<u>G. crispata</u>		X	X	x	
<u>Platystrophia clarksvillensis</u>	X				
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>R. nasuta</u>			X	X	
<u>R. mucronata</u>	X	X	X		
<u>Leptaena moniquensis</u>			X	X	
<u>Strophomena planumbona</u>	X	X			
<u>S. planumbona chamblensis</u>			X		
<u>S. huronensis</u>	X				
<u>S. vetusta</u>	X				
<u>S. neglecta</u>	X				
<u>S. hecuba</u>	X				
<u>Holtehdahlina sulcata</u>	X				
<u>H. sulcata moniquensis</u>	X				
<u>H. varsensis</u>	X				
<u>Rhynchotrema capax</u>	X				
<u>R. perlamellosum</u>	X				
<u>R. (?) tamarackensis</u>	x			X	
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Z. kentuckiensis</u>	X				
<u>Z. meafordensis</u>	X				
<u>Catazyga headi</u>	X	X	X	X	

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St. Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic range previously determined					
x - Extension of range resulting from present work					
<u>PELECYPODA</u>					
<u>Cuneamya neglecta</u>	X			X	
<u>C. scapha</u>	X				
<u>C. scapha brevior</u>	x	X			
<u>Ctenodonta madisonensis</u>	X				
<u>C. chamblensis</u>		x	X	x	
<u>C. hyacinthensis</u>			X	X	
<u>C. lorrainensis</u>	x	X	X		
<u>C. borealis</u>		X	X		
<u>Clidophorus planulatus</u>		X	X	x	
<u>C. praevolutus</u>	X	X	X	x	
<u>C. postvolutus</u>				X	
<u>C. brevis</u>				X	
<u>Whitella complanata</u>	X	x	x		
<u>W. sp., cf. W. impressata</u>			x	X	
<u>W. complanata moniquensis</u>		x	X		
<u>W. securiformis</u>	X	x			
<u>W. goniumbonata</u>	X			x	
<u>W. sterlingensis</u>	X	x			
<u>W. obliquata</u>	X		x		
<u>W. huguesensis</u>			x	X	
<u>Pterinea demissa</u>	X	X	X		
<u>Clionychia curta</u>		X	X	X	
<u>Byssonychia radiata</u>	x	X	X	X	
<u>B. hyacinthensis</u>				X	
<u>B. borealis</u>	X				
<u>B. suberecta</u>	X				
<u>B. vera</u>			X	X	
<u>B. praecursa</u>		X	X	X	

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St. Hilaire member Pholadomorpha zone	Chambly member Proetus zone	Breault member Cryptolithus zone	
X - Stratigraphic range previously determined					
x - Extension of range resulting from present work					
<u>Opisthoptera fissicosta</u>	X				
<u>Lyrodesma poststriatum</u>		X	X	X	
<u>L. huguesensis</u>				X	
<u>Colpomya faba pusilla</u>	x		X	X	
<u>C. faba constricta</u>				X	
<u>Cymatonota pholadis</u>	x	X	X	x	
<u>C. parallela</u>			X	X	
<u>C. recta</u>	X	X	X	X	
<u>C. lenior</u>	X	X			
<u>C. semistriata</u>	X				
<u>Modiolodon poststriatus</u>	X				
<u>Modiolopsis concentrica</u>	X	x			
<u>M. concentrica</u> var. <u>chambliensis</u>			X		
<u>M. anodontoides</u>		X	X		
<u>M. meafordensis</u>	X	X			
<u>M. borealis</u>		X	x		
<u>M. hvacinthensis</u>				X	
<u>Modiodesma modiolare</u>	x	X	X	x	
<u>Orthodesma postplicatum</u>	X	x			
<u>O. approximatum</u>			X		
<u>O. pulaskiense</u>	x	X	X		
<u>O. prolatum</u>	X				
<u>Psilococoncha sinuata</u>				X	
<u>P. sinuata borealis</u>		X			
<u>P. inornata</u>		X	X		
<u>Pholadomorpha pholadiformis</u>	X	X			
<u>P. chambliensis</u>			X		
<u>Rhytimya colemani</u>	x				
<u>R. oehana</u>		x		x	
<u>R. radiata</u>			X		

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St. Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic range previously determined					
x - Extension of range resulting from present work					
<u>GASTROPODA</u>					
<u>Archinacella pulaskiensis</u>	x	x	X	X	
<u>Cyrtolites ornatus</u>	X	X	X		
<u>Sinuities cancellatus</u>	X	X	X	x	X
<u>Tetranota rugosa</u>			x	x	
<u>Liospira micula</u>	X			X	
<u>L. helena</u>	X				
<u>Eotomaria remotistriata</u>		x	X		
<u>Clathrospira subconica</u>	X	x	X	X	X
<u>Lophospira beatrice</u>	X	x			
<u>L. hyacinthensis</u>				X	
<u>L. manitoulinensis</u>	X				
<u>L. bowdeni</u>	x	X	X	X	X
<u>Hermotoma gracilis</u>		x	x	x	
<u>H. gracilis sublaxa</u>			X	X	
<u>Cyclonema bilix conicum</u>	X	x			
<u>Holopea nicolettensis</u>	X	x			
<u>H. insignis</u>		x			
<u>Pterotheca pentagona</u>		x	X		
<u>P. harrisi</u>				X	
<u>TRILOBITA</u>					
<u>Cryptolithus bellulus</u>				X	
<u>C. recurvus</u>				X	
<u>Triarthrus huguesensis</u>				X	
<u>Isotelus(?) sp.</u>					
<u>Calymene sp.</u>					

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St. Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic range previously determined					
x - Extension of range resulting from present work					
c - From G.F.E. Carter manuscript thesis					
<u>C. retrorsa minuens</u>	X				
<u>Calyptraulax</u> sp.	x				
<u>Proetus chamblensis</u>			X	x	
<u>BRANCHIOPODA</u>					
<u>Technophorus quincuncialis</u>			X		
<u>CIRRIPEDIA?</u>					
<u>Lepidocoleus jamesi</u>	X	X	X	X	X
<u>OSTRACODA</u>					
<u>Schmidtella brevis</u> var. <u>sulcata</u>	c				c
<u>Eridocconcha elegantula</u>	X	X			
<u>Milleratia cincinnatiensis</u>	X	X	c	c	
<u>Macronotella venosa</u>		c			
<u>Kiesowia insolens</u>	X	c			
<u>Aechmina maquoketensis</u>	X	c			
<u>Jonesella centralis</u>				c	
<u>Ctenobolbina obesa</u>	c	c			
<u>C. ciliata</u>		X			
<u>C. sp.</u> , cf. <u>C. petigera</u>				x	
<u>C. sp.</u> , cf. <u>C. emacerata</u>		x			
<u>Ravella parvispina</u>	c	c			
<u>Bythocypris cylindrica</u>	x	x	X	X	X
<u>B.(?) extenuata</u>	c				
<u>B.(?) pyriformis</u>	c	c			c
<u>B.(?) subcylindrica</u>	c				
<u>Ceratopsis oculifera</u>		X			

Nicolet River Exposures

Underlying the greenish grey shales of the Carmel River member of the Bécancour River formation is a development of calcareous shales with some limestone and a few sandstone beds belonging to the Pontgravé River formation (see Figure 1). Some of these latter strata are replete with fossils. This formation can be seen on both banks of Nicolet river near the lower end of the horseshoe bend 1/2 mile upstream from the boundary between the Aston and the Yamaska areas (Plate IIA, B).

On the northeast bank, 69 feet of these beds are exposed, (not 60 feet as reported by Foerste, 1916, p. 144). The bulk of the formation is a micaceous kaolin shale, more or less calcareous, with thin bands of limestone rarely more than 1/2 inch thick, though Foerste (1916, p. 146) recorded a bed of limestone 17 1/2 feet thick as part of his Hillside Section. There are also a few beds of sandstone up to 2 inches thick. The sandstone resists weathering far better than does the shale, which crumbles and falls to the base of the cliff, carrying whole or comminuted fossils with it. The fauna is an abundant one, as can be seen from the accompanying list. Foerste's Gully Section (1916, p. 144) is still exposed much as it was when he explored it, but his Hillside Section (1916, p. 146) is now overgrown with woods and trees, and only minor parts of it can be recognized. A development of 30 feet corresponding to the beds of the Gully Section is splendidly exposed on the southern bank just before the river straightens out after making the big bend. The stratigraphic positions and relationships of these various exposures can be seen in Figure 1.

Pontgravé River Exposures

Carmel river enters Pontgravé river from the north about 2 miles upstream from La Visitation. Red and grey shales of the Bécancour River formation are exposed along the lower course of the tributary, and, immediately above its mouth and as far as the dam 1/4 mile upstream, discontinuous exposures of calcareous Pontgravé River shales, in places rich with fossils, can be seen on both banks of Pontgravé river (Plate III A). The division between the basal bed of the grey Carmel River shale and the topmost bed of the fossiliferous grey Pontgravé River shale is easily determined on the southern bank (which can be taken as the type section for this formation), but is less readily determined on the northeast bank because of overburden. It is placed here, as in other localities, immediately above the uppermost fossiliferous horizon, usually marked by Zygospira kentuckiensis. The long list of fossils (see below) can be seen to be almost solidly Richmond, only two species not having been previously reported from Richmond beds (Figure 4).

Immediately above the dam, on the southwest bank of Pontgravé river, there is a 1/4-mile exposure of westward dipping beds, made up of alternating shale and limestone in the upper part and shale and sandstone in the middle and lower parts (Plate III B). Pholadomorpha is common throughout. The presence of Favistella alveolata in the uppermost beds, which are dominantly calcareous, indicates for them a Richmond age. Reference of all of this exposure, together with the strata below the dam, to the Pontgravé River would give an exceptional thickness to this formation. Therefore it is probable that the middle and lower parts of the exposure belong to the top of the Nicolet River formation.

Fossils Identified from Southwest Bank,
Pontgravé River, Immediately above Dam, La Visitation

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member Pholadomorpha zone	Chambly member Proetus zone	Breault member Cryptolithus zone	
X - Stratigraphic range previously determined					
x - Extension of range resulting from present work					
Algae					
<u>Favistella alveolata</u>	X				
<u>Protarea richmondensis</u>	X				
<u>Streptelasma rusticum</u>	X	x			
<u>Cornulites</u> sp.					
<u>Compsoocrinus harrisi</u>	X				
<u>Pholidops subtruncata</u>	X	X	X	x	
<u>Resserella</u> sp.					
<u>Hebertella occidentalis</u>	X	X	x		
<u>Platystrophia clarksvillensis</u>	X				
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>Strophomena huronensis</u>	X				
<u>S. hecuba</u>	X				
<u>Holtehdahlina sulcata</u> var. <u>moniquensis</u>	X				
<u>Rhynchotrema tamarackensis</u>	x			X	
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Z. kentuckiensis</u>	X				
<u>Catazyga headi</u>	X	X	X	X	
<u>Ctenodonta madisonensis</u>	X				
<u>Whitella securiformis</u>	X	x			
<u>W. complanata</u>	X	x	x		
<u>W. sterlingensis</u>	X	x			
<u>Pterinea demissa</u>	X	X	X		
<u>Byssonychia radiata</u>	x	X	X	X	
<u>Cymatona pholadis</u>	x	X	X	x	
<u>C. recta</u>	X	X	X	X	
<u>Modiolopsis meafordensis</u>	X	X			
<u>Pholadomorpha pholadiformis</u>	X	X			
<u>Cyrtolites ornatus</u>	X	X	X	X	
<u>Clathrospira subconica</u>	X	x	X	X	X
<u>Lophospira beatrice</u>	X	x			
<u>L. manitoulinensis</u>	X				
<u>Hormotoma gracilis</u> , var.					
<u>Holopea nicolettensis</u>	X	x			

St-Francis River Exposures

On this river fossiliferous beds of the Pontgravé River formation can be seen in contact with the unfossiliferous beds of the Carmel River member on both banks. Both formations have suffered a mild amount of faulting and folding in the vicinity of the contact, which is, however, itself unmarred by structural complications. Toward the south-east the sections exposed along the banks of the river are so faulted that it is almost impossible to work out the original sedimentary sequence. On the north bank (Figure 3), starting at the contact with the Becancour River formation, Pontgravé River beds a few tens of feet thick underlie the contact (see faunal list below). Then follows a gap upstream of 1,000 feet, after which exposures begin again at the foot of a road leading down to the water's edge from the home of L.G. Biron. Here, shales, sandstones, and limestones, with abundant Richmond fossils (see below), occur for 450 feet along the river bank, disposed in general in an anticlinal form and ceasing to outcrop just before a large boulder close to the edge of the river is reached. These beds contain a solidly Richmond fauna, except for two pelecypods.

On the south bank the structure would be impossible to unravel without the information supplied by fossils. Very careful mapping of the exposures allows the following cross-section and accompanying map to be worked out (Figure 3; Plate IC). The beds from station O to station 1,150 all lie, without doubt, within the Pontgravé River formation, as is well shown by the following list of fossils. Of the species definitely identified, only three have not been previously reported from Richmond beds. One of these, Pholidops subtruncata, has been repeatedly found in beds of assured Richmond age in this area. The aspect of this fauna is therefore strongly Richmond.

Because of the relatively great thickness of beds exposed between stations 1,150 and 1,860 (probably 500 feet), an attempt was made to separate these beds into an upper (Pontgravé River) portion, and a lower (Nicolet River) portion. After preliminary inspection, a boundary was chosen at 1,430, and the lists of fossils from the two parts of the section are given below. The list from station 1,430 to station 1,860, like the one from station O to station 1,150, is solidly Pontgravé River. However, the list of fossils occurring between stations 1,150 and 1,430 shows four species not known to occur in the Pontgravé River beds, and only two of these species are elsewhere confined to the Richmond.

A. Fossils Identified from Northeast Bank
of St-Francis River Immediately
Upstream from Carmel River Contact

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Hebertella occidentalis</u>	X	X	x		
<u>Platystrophia clarksvillensis</u>	X				
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>Strophomena huronensis</u>	X				
<u>Holtehdahlina</u> sp., cf. <u>H. varsensis</u>	X				
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Catazyga headi</u>	X	X	X	X	
<u>Pterinea demissa</u>	X	X	X		
<u>Pholadomorpha pholadiformis</u>	X	X			
<u>Cyrtolites ornatus</u>	X	X	X	X	

B. Fossils Identified from Northeast Bank
of St-Francis River for 450 Feet above House of L. G. Biron

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member Pholadomorpha zone	Chambly member Proetus zone	Breault member Cryptolithus zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Pholidops subtruncata</u>	X	X	X	x	
<u>Resserella</u> sp.					
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Rafinesquina mucronata</u>	X	X	X		
<u>R. alternata</u>	X	X	X	X	X
<u>Strophomena huronensis</u>	X				
<u>Catazyna headi</u>	X	X	X	X	
<u>Cuneamya scapha</u>	X				
<u>Ctenodonta madisonensis</u>	X				
<u>C. sp., cf. C. madisonensis</u>					
<u>Clidophorus praevolutus</u>	X	X	X	x	
<u>Whitella obliquata</u>	X		x		
<u>Colpomya faba pusilla</u>	x	x	X	X	
<u>Gymatonota recta</u>	X	X	X	X	
<u>Modiolopsis</u> sp., cf. <u>M. anodontoides</u>		X	X		
<u>M. borealis</u>		X	x		
<u>Pholadomorpha pholadiformis</u>	X	X			
<u>Cyrtolites</u> sp.					

Fossils Identified from Southwest Bank of St. Francis River.

Station O to Station 1150 of Figure 3.

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Streptelasma rusticum</u>	X	x			
<u>Cornulites</u> sp.					
<u>Pholidops subtruncata</u>	X	X	X	x	
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>R. mucronata</u>	X	X	X		
<u>Strophomena neqlecta</u>	X				
<u>S. huronensis</u>	X				
<u>S. planumbona</u>	X	X			
<u>Holstedahlina</u> sp.	X				
<u>Rhynchotrema perlamellosum</u>	X				
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Catazyga headi</u>	X	X	X	X	
<u>Cuneamya</u> sp., cf. <u>C. scapha brevior</u>	x	X			
<u>Pterinea demissa</u>	X	X	X		
<u>Byssonychia radiata</u>	x	X	X	X	
<u>Colpomya faba</u> , cf. var. <u>pusilla</u>	x		X	X	
<u>Cymatonota pholadis</u>	x	X	X	x	
<u>Modiolopsis</u> sp.					
<u>Orthodesma</u> sp., cf. <u>O. pulaskiense</u>	x	X	X		
<u>O. prolatum</u>	X				
<u>Rhytimya colemani</u>	x				
<u>Cyrtolites ornatus</u>	X	X	X	X	
<u>Lophospira beatrice</u>	X	x			
<u>Bythocypris cylindrica</u>	x	x	X	X	X

Fossils Identified from Southwest Bank of St. Francis River.
Station 1150 to Station 1860 of Figure 3.

X - Stratigraphic ranges previously determined x - Extension of ranges resulting from present work List of fossils from between stations 1150 and 1430	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
<u>Platystrophia</u> sp.					
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>R. mucronata</u>	X	X	X		
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Catazyga headi</u>	X	X	X	X	
<u>Clidophorus praevolutus</u>	X	X	X	x	
<u>Whitella complanata moniquensis</u>		x	X		
<u>Byssonychia radiata</u>	x	X	X	X	
<u>Cymatonota pholadis</u>	x	X	X	x	
<u>Modiolopsis</u> sp.					
<u>Pholadomorpha pholadiformis</u>	X	X			
<u>Rhytimya oehana</u>		x		x	
<u>Clathrospira subconica</u>	X	x	X	X	X
<u>Lophospira beatrice</u>	X	x			
<u>Isotelus</u> sp.					
<u>Proetus</u> sp.					
<u>Calymene</u> sp.					
<u>Bythocypris cylindrica</u>	X	x	X	X	X
Stations 1430 to 1860					
<u>Streptelasma rusticum</u>	X	x			
<u>Constellaria</u> sp., cf. <u>C. polystomella</u>	X				
<u>Hebertella occidentalis</u>	X	X	x		
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Strophomena planumbona</u>	X	X			
<u>Rhynchotrema perlamellosum</u>	X				
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Catazyga headi</u>	X	X	X	X	
<u>Pterinea demissa</u>	X	X	X		
<u>Orthodesma prolatum</u>	X				
<u>Bythocypris cylindrica</u>	X	x	X	X	X

Because the list of fossils is not solidly Richmond, but shows a mixture of Richmond and Lorraine types, the writer has allotted this part of the section to the Pholadomorpha zone (St. Hilaire member) of the Lorraine Nicolet River formation). The fossils certainly allow a distinction to be made between these two faunas, though as Foerste (1916, p. 150) remarked, "there is nowhere in these provinces any sharp demarcation between the Richmond and the Lorraine".

Thickness of the Pontgravé River Formation

The thickness of this formation on Nicolet river has been given as 164 feet. On both Pontgravé and St. Francis rivers, width of outcrop and dip of beds give thicknesses somewhat greater, possibly because of irregularities in sedimentation, or of duplication of parts of the sections by faults.

Information from well logs is as follows (see Appendix D):

South Shore No. 2. Below 110 feet of overburden, 100 feet of Pontgravé River beds overlie the Nicolet River formation.

Nicolet No. 1. 140 feet of Pontgravé River beds lie between the Bécancour River and the Nicolet River formations.

Quebec Fuel No. 1. 30 feet of Pontgravé River beds are listed between Bécancour River and Nicolet River formations. (No authority for this is given by DeBlois 1959).

In the Canadian Seaboard St. Gérard No. 1 well (DeBlois, 1959, p. 25), south of the area, 220 feet of Pontgravé River beds are indicated between the Bécancour River and the Nicolet River formations.

As there is considerable difficulty in differentiating in cable-rig cuttings between the Carmel River shale and the Pontgravé River shale, and between the Pontgravé River shale and the Nicolet River shale, results based upon the examination of such cuttings do not have the reliability of the measured section of the beds along Nicolet river.

Correlation with Sections Elsewhere

Foerste's conclusion, that the fauna of the Pontgravé River formation most closely approximates that of the Waynesville of Ohio is accepted here. The Pontgravé River formation can also be correlated with the Russell dolomite of the Ottawa-St. Lawrence Lowland, and with the Meaford shale and limestone of southern Ontario. To the northeast it was probably deposited coincidentally with the English Head limestone of Anticosti.

Nicolet River Formation

Because of the magnificent section of Lorraine beds exposed with hardly a break along Nicolet river, yielding a thickness of nearly half a mile, these beds are designated the Nicolet River formation (Plates IB, IV A,B,C). Although the section is very thick there is no justification for splitting it into separate formations. There is, however, as was well demonstrated by Foerste (1916; 1924), a faunal zoning, which, combined with recognizable lithological differences, has made it desirable to divide the formation into three members, corresponding very closely with Foerste's faunal zones, as follows:

Formation	Faunal zones	Members
Nicolet River (2491+')	<u>Pholadomorpha</u>	St-Hilaire (61')
	<u>Proetus</u> (including <u>Leptaena</u>)	Chambly (860')
	<u>Cryptolithus</u>	Breault (1020+')

Beds of this formation are abundantly displayed along the banks of Bécancour, Nicolet, Pontgravé, and St. Francis rivers. The most nearly complete section, along Nicolet river, will be treated first, and will be used as a basis for the correlation of the sections along the other rivers.

Section along Nicolet River

Stratigraphic Analysis. In 1916 Foerste published the results of his careful foot by foot study of this section, without, however, paying much attention to the sedimentary rock types involved. Such brief descriptions of the rock types as he gives in his memoir are, as he admits, based on memory. So interesting, and indeed so critical, is this exposure, that the writer too made a foot by foot survey, recording lithological types with their dips and strikes, and later calculated all the measurements to fit against a hypothetical section line at right angles to the strike of the beds (Figure 4). The dips gradually and progressively lessen from bottom to top of the section, and careful measurements

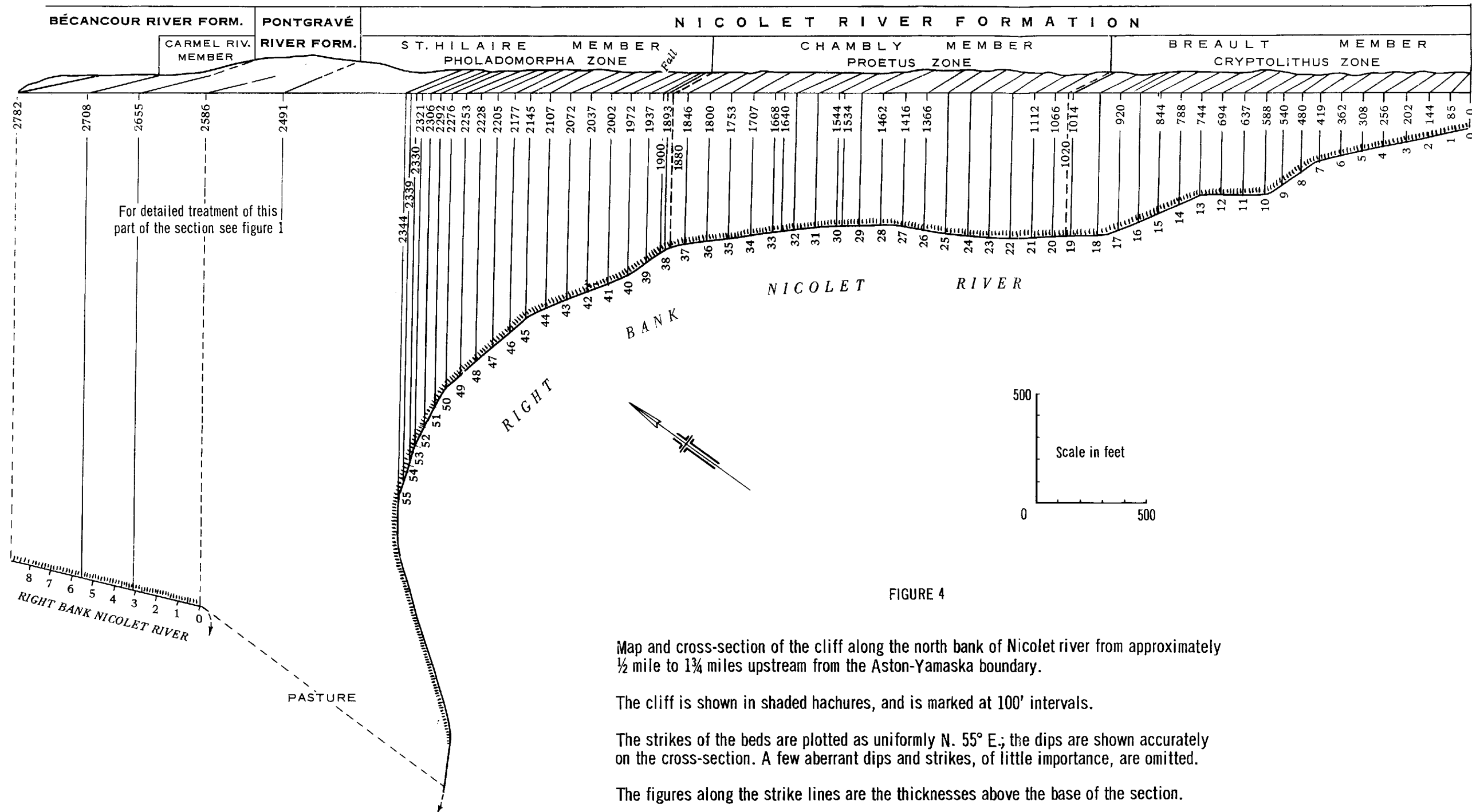


FIGURE 4

Map and cross-section of the cliff along the north bank of Nicolet river from approximately $\frac{1}{2}$ mile to $1\frac{3}{4}$ miles upstream from the Aston-Yamaska boundary.

The cliff is shown in shaded hachures, and is marked at 100' intervals.

The strikes of the beds are plotted as uniformly N. 55° E.; the dips are shown accurately on the cross-section. A few aberrant dips and strikes, of little importance, are omitted.

The figures along the strike lines are the thicknesses above the base of the section.

of both dips and strikes were taken every hundred feet along the river bank. A simple trigonometrical formula based upon the distance and direction along the shore, direction of strike, and amount of dip, served to give the correct thicknesses involved per unit distance. For the purpose of this work one general strike, N.55°E., was taken for the entire Lorraine section. The occasional variations found may well be the results of irregular sedimentation, and have been disregarded, with probably only inconsequential errors.

There is no record of how Foerste calculated his thicknesses. They are substantially in accord with those of the present writer from the base upward for about 1,600 feet; above that horizon Foerste's figures are the lower of the two. Between 1,600 and 2,344 feet there is a marked divergence. For instance, in one interval where the writer measured 744 feet of beds, Foerste recorded only 610 feet. Measurements are apt to be too high as the river begins to make the big bend to the west, but Foerste's data show the opposite tendency. Checking and rechecking have demonstrated the essential correctness of the present calculated thicknesses, and for the purpose of plotting faunal vertical distribution Foerste's stratigraphic horizons have been adjusted to fit into the section given below.

On the accompanying map of part of the north bank of Nicolet river (Figure 4) there are 100-foot marks along the river shore, beginning at the base of the section. (Foerste's measurements, less logically, begin at the top and progress downward.) On the figure the strike lines are all shown as parallel. The dips on the accompanying section are correctly plotted at the river level, but minor flexures make minor modifications between river level and cliff top necessary. For simplicity in draughting it has been assumed that exposures are complete along the whole expanse of the mile-long cliff, and the insignificant interruptions caused by landslides, fallen trees, etc. are not recorded.

The thicknesses, as calculated, are introduced on the chart and, wherever appropriate, Foerste's figures are added. A table of measured dips and strikes along the section, and a record of the data used in constructing the map of the river bank are given in Appendix A and Appendix B, respectively.

The composite section along the river follows, from the Bécancour River beds at the top down through the Pontgravé River and Nicolet River formations, ending at a prominent anticline which is taken as the base of the section. The sources of the information used are given below:

2782' - 2586'	--	Present work
2586' - 2344'	--	Mostly Foerste's data. The exposures upon which he based his Hillside Section are no longer visible
2344' - 0'	--	Present work

Stratigraphic Section Along Nicolet River				
Geological formations	Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
BÉCANCOUR RIVER	2782			Top of section. Downstream end of continuous exposures
		74		Red shales and sandstones
	2708			
		53		Carmel River member Grey-green unfossiliferous shales
PONTGRAVÉ RIVER	2655			
		9		Grey shale, sparsely fossiliferous
	2646			
		32		Grey shale, with sandstone and limestone beds about 2" thick
	2614			
		28		Soft shale, with sandstone and limestone beds up to 2" thick
				The entire section above corresponds to Foerste's Bluff Section (1916, p.18)
	2586			
		36		Calcareous shale, with limestone beds up to 2" thick
				Foerste's Gully Section (1916, p. 18)
	2550			
		59		Shale, in part calcareous, with a few thin limestone beds.
				Foerste's Hillside Section down to base of Zone S. (1916, p. 19)
	2491			

Stratigraphic Section Along Nicolet River				
Geological formations	Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER ST - HILAIRE MEMBER		83		Shale, with very few limestone beds, none more than 1" thick. Foerste's Hillside Section from base of Zone S to base of Zone R (1916, p.19)
	2408	64		Soft shale, with a few conspicuous sandstone beds. Exposed only on cliff face, almost inaccessible. Base of this unit is highest bed to outcrop at river level. Beginning of Foerste's Cliff Section (1916, p. 23, 24). Approximately 300 feet below Foerste's top of Waynesville.
	2344	199	1:2	Top of section as exposed along the river level. Shale, with conspicuous sandstone beds up to 6" thick. 2247-2252 - several limestone beds, 2" thick 2247 - 4" limestone bed 2227 - 4" limestone bed 2192 - Sandstone beds here have basal 1" of limestone
	2145	108	3:1	Shale, with sandstone beds up to 2" thick 2141 - Several 2" sandstone beds each with basal 1" of limestone 2116 - Prominent 6" sandstone bed
	2037	65	4:1	Shale, with a few sandstone beds up to 1"
		55	3:1	Shale, with prominent sandstone beds up to 6" thick
	1917			Waterfall
	1900			

Stratigraphic Section Along Nicolet River					
Geological formations		Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER CHAMBLY MEMBER			59	2:1	Shale and sandstone; sandstone scarce in upper half
	1358		12	3:2	Very soft shale, with sandstone beds up to 3" thick
	1846		33	6:1	Shale, with very little sandstone in beds up to 6" thick
	1813		60	4:1	Shale, with sandstone in beds up to 4" thick
	1753		46	3:2	Shale, with sandstone in beds up to 15" thick 1747 - 6" bed, upper 2" sandstone, lower 4" limestone 1739 } At each horizon there is a 3" bed; 1737 } the upper 2" sandstone, the lower 1735 } 1" limestone
	1707		13	10:1	Shale, with practically no sandstone
	1694		18	1:1	Shale and sandstone. Above the 1676 horizon the shale is soft, probably a kaolin-shale. Below here it is a harder, silty shale.
	1676		8	1:1	Shale, with sandstone in beds up to 4" thick 1675 } At each horizon a 2" limestone bed 1670 }
	1668		19	2:1	Siltstone, with sandstone beds up to 6" thick
	1649				

Stratigraphic Section Along Nicolet River					
Geological formations		Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER	CHAMBLY MEMBER		39	2:1	Siltstone, with thin beds of sandstone
		1610	76	2:1	Siltstone, with sandstone beds up to 2" thick 1543 - 3" limestone bed 1537 - 3" limestone bed
		1534	44	5:1	Silty shale, with 1" sandstone beds and two 2" limestone beds
		1490	19	3:2	Silty shale, with sandstone beds up to 9" thick 1482 - stream
		1471	9	3:1	Silty shale, with thin sandstone layers
		1462	25	3:1	Silty shale, with thin sandstone layers
		1437	21	1:10	Sandstone in beds up to 4" thick, with thin interbeds of shale 1435-1437 - bedding vertical
		1416	50	2:1	Silty shale, with sandstone beds up to 2" thick 1389-1394 - hidden by fallen trees, etc.
		1366	9	1:10	Nearly all sandstone. A few shaly interbeds
		1357			

Stratigraphic Section Along Nicolet River					
Geological formations		Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER	CHAMBLY MEMBER	1357	291	1:1	Silty shale, with thick sandstone beds up to 15" 1313) 1282) 2" limestone bed at each station 1267) 1257) 1215 - 1" limestone bed 1212) 1169 - 4" limestone bed at each station 1136) 1070 - 3" limestone bed
		1066	46	2:1	Silty shale, with sandstone beds up to 15" thick 1055) 1034) - 2" limestone bed at each station
		1020	122	1:2	Silty shale, with sandstone beds up to 5" thick 925 - 3" limestone bed with bryozoa
		898	19	2:1	Silty shale, with sandstone beds up to 2" thick
		879	14	2:3	Silty shale, with sandstone in beds up to 15" thick, thinner beds towards top
	BREAULT MEMBER	865	24	1:3	Sandstone in beds up to 4" thick, with lesser amounts of silty shale
		841	30	3:1	Silty shale, with sandstone in beds up to 2" thick
		811			

Stratigraphic Section Along Nicolet River				
Geological formations	Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER BREAULT MEMBER	810	1	1:3	Sandstone, one bed of 6", and silty shale
	744	66	3:1	Silty shale, with sandstone beds up to 2" thick
	741	3	1:1	Silty shale, with sandstone in beds up to 4" thick
	683	58	2:1	Silty shale, with sandstone beds up to 6" thick
	675	8	1:1	Shale, and thin sandstone beds
	657	18	1:1	Silty shale, with sandstone in beds up to 2" thick
	653	4	1:2	Silty shale, with sandstone beds up to 6" thick 653-- 2" limestone bed
	637	16	1:2	Silty shale, with 6" beds of sandstone
	601	36	1:1	Silty shale, with prominent sandstone beds up to 6" thick 618 - 2" limestone bed
	586	15	2:1	Silty shale, with sandstone in 1" beds grading upwards to more shale and less sandstone
	547	39	4:1	Silty shale, with minor but prominent sandstone beds up to 3" thick. One 1" bed of limestone at 547

Stratigraphic Section Along Nicolet River					
Geological formations		Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER	BREAULT MEMBER	547	40	1:1	Silty shale and sandstone in equal amounts 532 - 1" bed of limestone with bryozoa
		507	22	3:1	Silty shale, with sandstone beds from 2" to 6" thick
		485	13	2:1	Silty shale, with thin-bedded sandstone
		472	12	1:1	Sandstone, with interbeds of silty shale
		460	5	4:1	Silty shale, with a little thin-bedded sandstone
		455	55	4:1	Silty shale, with sandstone in beds from 2" to 4" thick
		400	2	1:6	Sandstone in 2" to 4" thick beds, minor amounts of silty shale
		398	23	4:1	Silty shale, with many 1" sandstone beds
		375	67	4:1	Silty shale, with sandstone beds up to 6" thick
		308	32	4:1	Silty shale, with many 1" sandstone beds
		276			

Stratigraphic Section Along Nicolet River					
Geological formations		Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER BREAULT MEMBER	276	20	4:1	Silty shale, with sandstone in beds up to 6" thick	
	256	12	4:1	Sandy shale, with a few 2" sandstone beds	
	244	32	4:1	Silty shale, with some 6" sandstone beds	
	212	23	4:1	Silty shale, with sandstone beds from 1" to 2" thick, one 4" sandstone bed at base	
	189	5	1:1	Silty shale and sandstone	
	184	11	1:1	Silty shale and sandstone	
	173	29	2:1	Silty shale and fine-grained sandstone	
	144	1	1:1	Well banded sandstone in beds of 1" to 2"	
	143	7	5:1	Silty shale, very little sandstone, mostly in beds less than 1" thick	
	136	1	1:10	Sandstone in beds of 1" to 2", very thin interbeds of silty shale	
	135				

Stratigraphic Section Along Nicolet River					
Geological formations		Height above base in feet	Thickness of interval in feet	Proportion shale: sandstone	Lithologic Description, etc.
NICOLET RIVER	BREAUULT MEMBER	135	46	5:1	Silty shale, with a few 1" to 2" sandstone beds 112 - small fault
		89	4	2:1	Silty shale, with 2" beds of sandstone 85 - small fault
		85	14	4:1	Silty shale, with 1" sandstone beds
		71	71	4:1	Soft micaceous, silty shale, for the most part considerably smashed and contorted in detail. Sandstone in thin 1" beds
		0			Axis of steep anticline. Base of section. Exposures continue upstream, but are not in structural continuity. Should properly be placed in St. Germain Complex.
St-Germain Complex					

The last column in the foregoing table records estimates, formed during the survey of the river section, of the relative amounts of shale and sandstone in each unit of beds measured. Though no great accuracy is claimed for this subjective method of determination, it is fairly reliable. The following computations, based upon the proportions recorded and upon the thicknesses of the stratigraphic units concerned, are of interest.

	Clay shale	Silty shale	Sand- stone
1676' to 2344' Almost all the shale is argillaceous	412'		256'
0' to 1676' Almost all the shale is arenaceous		1051'	525'
0' to 2344'	412'	1051'	881'
Approximate percentages	18%	45%	37%

The shale in the lower 1,676 feet of the section is a medium grey, well-bedded, silty and micaceous rock, grading imperceptibly into micaceous sandstone, which in many places is thin-bedded, and, when so, can be separated with difficulty from the shale. The shale above the 1,676-foot horizon is dark grey, finely micaceous, much softer than the shale of the lower part of the section, and disintegrates readily upon exposure to the weather. Hence, the two types are shown separately.

The sandstone is everywhere fine to very fine grained, compact, quartzose, and, except in its transitional phases toward shale, rarely shows much mica or muddy matter. Stratification is readily apparent where it is bounded by shale beds, but within a, say, 3-inch bed of sandstone bedding is hardly noticeable. In a few cases cross-bedding is strongly marked. Above the continuous section along the water's edge just before the river starts to make its strong swing to the southwest, there is a very prominent sandstone bed one to two feet thick whose lower surface preserves an abundance of "flow rolls" (Plate V A), presumably recording the movement and the resulting deformation of the sand bed under pressure of overlying sediments before consolidation was complete. These curved surfaces can be seen to good advantage both in the fallen blocks along the shore, and on the under side of the sandstone layer as it projects a foot or more and overhangs the shale beds below it.

Limestone is only a minor feature of the rocks of this section. Nowhere is there a bed, with any marked continuity, more than 6 inches thick. It grades into both shale and sandstone, and is usually medium grey where it is associated with sandstone, or almost black where it accompanies shale. Some limestone beds are veritable coquinoids, mostly of bryozoan colonies, with brachiopods, pelecypods, and gastropods. Nowhere is there any limestone approaching the lithographic type; such limestone betokens clear quiet waters, which were almost non-existent in the shallow waters where most of the Lorraine beds accumulated.

Dean (1958) has recently completed a petrographic and geochemical study of the calcareous layers within the Pontgravé River and the Nicolet River formations, particularly along Nicolet river. He showed that recrystallized mollusk skeletons are preserved within the calcareous layers of the Pontgravé River formation and throughout all but the lowermost 70 feet of the St. Hilaire member of the Nicolet River formation. Within the underlying beds, however, the shells of mollusks have disappeared, and the fossils occur as internal and external moulds. He also noted that silicification of trilobites and certain bryozoa is common in the Nicolet River formation from the base upward, but decreases abruptly within the upper part of the St. Hilaire member, and is absent within the Pontgravé River formation.

The geochemical study of these calcareous units showed the presence of a manganese-rich interval, 370 feet thick, in the upper part of the St. Hilaire member. Moreover all but the upper 65 feet of the Breault member is marked by a low titanium content, in contrast to much higher average values in the overlying beds.

Thus, there is a practically uninterrupted section of 2,782 feet of Upper Ordovician rocks along Nicolet river, 2,491 feet of which belong to the Nicolet River formation. Such an exposure is without parallel in Quebec. Approximately 2,500 feet of both Ordovician and Silurian limestones outcrop on Anticosti island, and approximately the same thickness of Lower Ordovician limestones can be measured at Philipsburg. Great distances in the former, and gaps and faults in the latter, tend to spoil the values of those otherwise splendid sections. In Canada, east of the Rockies, this is certainly the finest continuous section of Ordovician rocks.

Faunal Content and Relationship. The lowest 2,000 feet of the measured section contains a Lorraine fauna although a few recurrent Trenton species can be found. A couple of species of questionable Richmond age appear at about the 1,600-foot horizon, but it is not until the 2,000-foot level is passed that definite and undoubted Richmond species come in. From that horizon upward, Richmond species are introduced one by one, with little loss of the Lorraine fauna, until, at about the 2,500-foot level, the Richmond species become an outstanding feature of the faunal assemblage. An abundance of Lorraine species continues almost to the top of the fossiliferous section. Thus, no definite faunal level can be decided upon as a boundary between the Lorraine and the Richmond beds. Foerste used his Zone S (the 2,491-foot level of this report) as the separation between the two formations, but questioned whether or not the next lower 591 feet (his Pholadomorpha zone, between Zones S and N) should not be included also in the Richmond (Foerste, 1916, pp. 21-22).

Figure 5 gives the consolidated ranges, in detail, of all species identified from this section by Foerste or by the writer. It appears that there were three intervals during which introduction of Richmond species was marked: from 1,600 feet to 1,650 feet, from 2,039 feet to 2,230 feet, and from 2,491 feet to the top of the Pontgravé River beds. This makes it virtually impossible to limit the Richmond on paleontological data. There is, however, one important lithological distinction between Foerste's Richmond and his Lorraine — that is, the relative abundance of limestone in the Richmond. It is proposed to utilize this lithologic difference, together with the maximum Richmondian aspect of the fauna, as the criterion for the differentiation of the Richmond (Pontgravé River formation) from the underlying Lorraine (Nicolet River formation). Throughout the St. Lawrence Lowlands this lithologic characteristic has been found to be trustworthy, and provides a means of separating into two fossiliferous formations 2,782 feet of Upper Ordovician beds that were deposited under continuous, or nearly continuous, sedimentary accumulation.

Abundant evidence can be obtained from an examination of the tabulation of the ranges of fossil species in the Nicolet River section to substantiate Foerste's subdivision of the Lorraine beds into faunal zones. His Pholadomorpha, Proetus, and Cryptolithus zones are therefore retained as useful bio-zones, to all intents and purposes coincident with the St. Hilaire, Chambly, and Breault members in time extent. Foerste's Leptaena zone, however, is not used in this report, for no justification for its retention can be found. Not only does the Cryptolithus fauna slightly overlap the Proetus fauna, leaving no gap between them demanding, or deserving, a name, but within Foerste's Leptaena zone there is no group of fossils which sets a section of the Lorraine apart from the rest, faunally. The Leptaena zone is therefore dropped, and the Cryptolithus zone is carried up to horizon 1,020 feet to include the highest recorded Cryptolithus. The beds between 1,020 feet and 1,880 feet comprise the Proetus zone, characterized by fragmentary remains of Proetus chamblensis. The Pholadomorpha fauna characterizes the section from 1,880 feet to 2,491 feet.

Upstream exposures along Nicolet River. The 2,782-foot section described above, spread along 1 1/2 miles of Nicolet river, occupies only one-half of the total exposures of Upper Ordovician rocks seen along that river. From the anticline (Station 0 feet) at the base of Foerste's section (Plate IVc) nearly continuous exposures extend 2 miles upstream, ending 3 1/2 miles (straight line) below the bridge at St. Léonard. They are monotonously alike, thin-bedded sandy shales and thin-bedded sandstones, doubtless a downward continuation of the beds of the Breault member already described. Fossils were found at two places. The following species have been identified:

Cornulites flexuosus

Dalmanella cf. rogata

Cryptolithus recurvus

Lepidocoleus jamesi

These betray a Cryptolithus zone relationship. Evidence for a Utica age for a minor part of these exposures occurs in one or two places, and is entirely lithologic. Because of the generally contorted condition of the beds, and the great amount of faulting, it seems best to place them in the St. Germain complex. A section constructed from the exposures examined along the right bank is given in Figure 6.

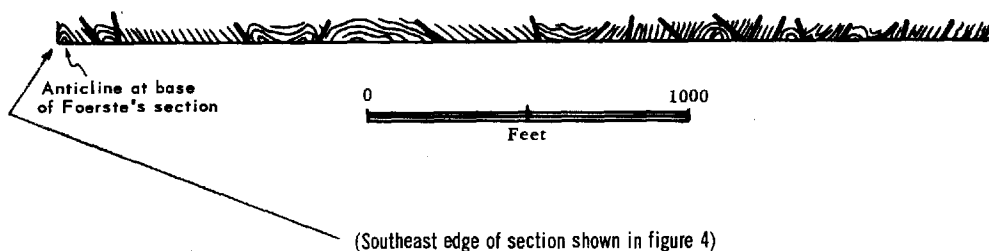


FIGURE 6

SECTION OF ST. GERMAIN COMPLEX ALONG THE RIGHT BANK OF NICOLET RIVER ABOVE THE BASE OF FOERSTE'S SECTION TO SHOW THE COMPLICATED STRUCTURE. COMPARE WITH THE SIMPLE STRUCTURE ALONG THE RIVER BANK BELOW THIS ANTICLINE; SEE FIGURE 4

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Bécancour River Exposures

Two miles below the village of Breault, in the beds of tributaries entering the Bécancour on its northeastern bank, there are a few exposures of unfossiliferous shale, possibly belonging to the Chambly member of the Nicolet River formation. The exposures in the vicinity of Breault are described below. From Breault upstream for about 5 miles or to the eastern boundary of the area, the rocks are exposed discontinuously along both banks. In that distance, all the rocks seen belong to the Nicolet River formation, probably to its Breault member. Everywhere they conform to the pattern displayed by the lower part of the Lorraine beds wherever these are involved in the St. Germain complex. Petrographically, they are sandy shales and thin-bedded sandstones in which only very poor and very few fossils have been found. In the exposures at the southwest end of the steel bridge northwest of Aston Station, there are traces of graptolites, and in the next exposure downstream crinoid stems and a poor gastropod were found. Otherwise these shales, as is usually the case with the lower part of the Cryptolithus zone, are barren. Structurally, they conform in strike with the regional pattern, and dip for the most part steeply (40° to vertical) to the west. Few strong complications occur here. For 3 miles beyond the limit of this area more such shales are exposed upstream, in places very strongly folded and crushed, with Utica beds definitely, and Trenton beds probably, involved in one exposure. For another 2 miles farther upstream the Champlain or Appalachian boundary fault is exposed wherever it transects the sinuous course of the river. Details of this are given below under Structural Geology.

Breault Member at Breault

The brief mention made by Foerste (1916, p. 56, 57) of these exposures is inadequate. He evidently intended to return to complete their study, but did not do so. There are exposures in three places. First, at various points in the gully which trenches the south bank northeast of the village; these are unsatisfactory both as to exposures and fossils, and save for repeating Foerste's faunal list no further notice will be taken of them. Second, there is a continuous cliff exposure on the opposite (north) bank of Bécancour river, admirably seen from the road which descends the cliff from Breault. This road leads to an abandoned ferry, from which another road ascends the steep northern bank and makes available both natural and artificial cuts of great value. From this road a cliff extends 1/2 mile downstream along the northern bank until the river begins a wide turn to the north. Here the exposures cease on the northeast bank, but begin on the northwest bank and extend downstream for another 1/4 mile. The latter is the third group of exposures at Breault. These are shown in Figure 7.

From the village, according to Foerste (1916, p. 56)
"a road leads northeastward to a gully entering the Bécancour river less than a mile from the (railway) station. Exposures occur at various points in the bottom of this gully, and the following fossils were found toward the upper part of this set of exposures.

"Glyptocrinus columnals

Heterocrinus columnals

Coeloclema commune (determined by Ulrich).

Dalmanella "testudinaria"

Glyptorthis sp.

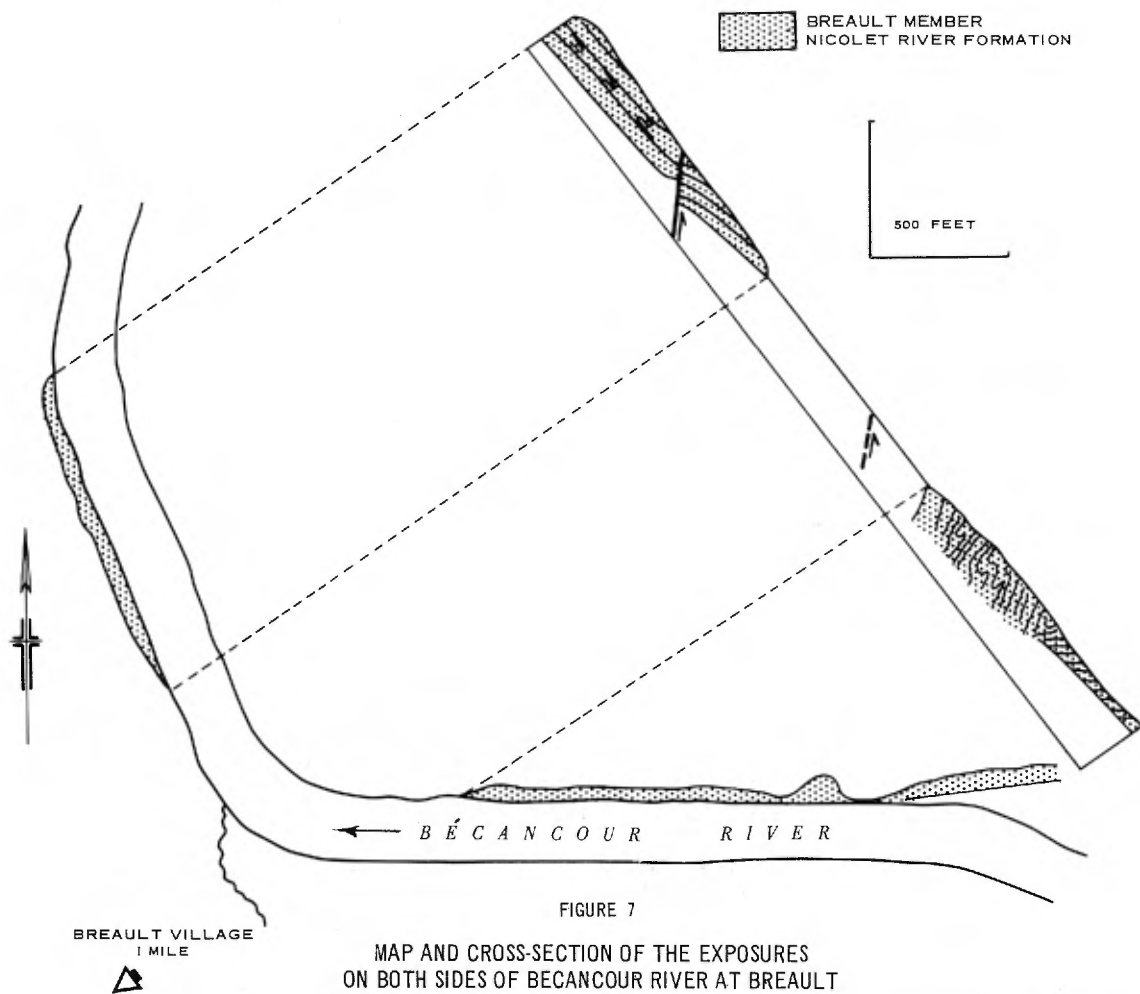
Byssonychia radiata

Clidophorus

Modiolopsis

Triarthrus becki

Trinucleus concentricus, common."



On the north bank of Bécancour river, there are nearly continuous exposures along the river bank and cliff, interrupted here and there by talus and cliff falls. In that part of the exposure west of the stream entering from the north and joining Bécancour river at the foot of the old ferry road, about 300 feet of beds can be seen, making allowances for the several drag folds in the section (Plate VI A,B). The section is as follows:

<u>Feet</u>	<u>Top of section</u>
30	Almost all sandstone, with small amounts of shale. Complications. Drag folds.
50	Shales and sandstones. Complications throughout. In part obscured by cliff-fall.
4	Shale and sandstone in 2- to 3-inch alternating beds.
40	Sandstone, much cross-bedded. Limestone in beds up to 6 inches thick, in places full of fossils.
25	Missing.
40	Thin-bedded dark shale and thin-bedded sandstone each in beds about 2 feet thick. A few limestone beds 1 to 2 inches thick.
10	Thick-bedded sandstone in beds up to 6 inches thick.
10	Dark grey shale, with a few beds of sandstone up to 2 inches thick.
23	Shale and sandstone in equal amounts, in beds from 1 to 3 inches thick.
20	Thick-bedded sandstone, and sandy shale.
62	Sandy shale and sandstone, thin-bedded, Base of section.

Lithologically, there is nothing here that is not seen elsewhere in the Nicolet River formation. The abundance of sandstone is generally more characteristic of the middle than of the lower part of the formation. Faunally, the beds fall within the Cryptolithus zone, as the following tabulation shows,

The exposures along the southwest bank begin 475 feet downstream from the mouth of the Breault gully, and are poorly exposed along the nearly flat river bank for 500 feet. Beyond that distance low cliffs begin, and culminate after a few hundred feet in high, nearly vertical cliffs of almost horizontal beds. More shale and less sandstone occur here than in the exposures on the northeast bank, In spite of the

Fossils Identified from Bécancour River at Breault

X - Stratigraphic ranges previously determined x - Extension of ranges resulting from present work * - Occurrence in Breault exposures	Foerste's gully exposures	Left bank exposures	Right bank exposures	Nicolet River (Lorraine)			Utica or Trenton
				St-Hilaire member Pholadomorpha zone	Chambly member Proetus zone	Breault member Cryptolithus zone	
<u>Glyptocrinus</u> sp.	*						
<u>Heterocrinus</u> sp.	*						
<u>Cornulites flexuosus</u>			*	X	X	X	
<u>Coeloclema commune</u>	*					X	
<u>Lingula</u> , sp. nov.			*				
<u>Reggerella</u> sp., cf. <u>R. rogata</u>	*	*	*	X	X	X	
<u>Glyptorthis</u> sp.	*						
<u>Sowerbyella sericea</u>			*	X	X	X	
<u>Leptaena moniquensis</u>		*			X	X	
<u>Catazyga headi</u>			*	X	X	X	
<u>Cuneamya</u> sp., cf. <u>C. neglecta</u>			*			X	
<u>Ctenodonta</u> sp., cf. <u>C. chamblensis</u>			*	x	X	x	
<u>Clidophorus praevolutus</u>	?		*	X	X	x	
<u>C. planulatus</u>			*	X	X	x	
<u>Whitella impressata</u>			*		x	X	
<u>W. huguesensis</u>			*		x	X	
<u>Byssonychia vera</u>			*		X	X	
<u>B. praecursa</u>			*	X	X	X	
<u>B. radiata</u>	*			X	X	X	
<u>Lyrodesma poststriatum</u>			*	X	X	X	
<u>Colpomya faba pusilla</u>			*		X	X	
<u>C. faba</u> , cf. var. <u>constricta</u>	*					X	
<u>Modiolopsis</u> sp.	*						
<u>Modiodesma modiolare</u>			?	X	X	x	
<u>Sinuities cancellatus</u>			*	X	X	X	
<u>Hormotoma</u> sp.			*				
<u>Bucanella</u> sp.			*				
<u>Tetranota</u> sp., cf. <u>T. rugosa</u>			*	x	x		
<u>Triarthrus huguesensis</u>	*	*				X	
<u>Cryptolithus bellulus</u>	?	*	*			X	
<u>Lepidocoleus jamesi</u>			*	X	X	X	
Eurypterid plate			*				

structural setting, which should place these beds below those of the northern bank, the abundance of Leptaena moniquensis proves that they are higher stratigraphically. Evidently a fault, probably a thrust, has brought the north bank exposures up from their inferior position. Nevertheless, both exposures belong to the Cryptolithus zone, for in spite of the occurrence here of several species which range throughout the entire Lorraine section, the only species which are elsewhere not known to occur in the Cryptolithus zone are one or two pelecypods. Moreover, the presence of Cryptolithus and Triarthrus is sufficient to fix the position of these beds within the Cryptolithus zone. The presence of Leptaena allows us to state that the southwest bank exposures must lie close to the top of the Cryptolithus zone.

Because of the excellent, though restricted, exposures, the name of this locality has been chosen to designate the member of the Nicolet River formation equivalent to the Cryptolithus zone, and the exposures on both sides of the river constitute the type section for this member.

Exposures on St. Wenceslas River

About midway between St. Léonard and St. Celestin there is a low, inconspicuous exposure of sandy shales on the west bank of St. Wenceslas river. Here, calcareous shales and sandstones carry crinoid stems and fragments of Cryptolithus. This is in accord with the distribution of the rocks of the Cryptolithus zone elsewhere.

Pontgravé River and Rivière des Saults Exposures

The exposures in the vicinity of Ste. Brigitte des Saults are more interesting from a structural aspect than from any information that they yield concerning their stratigraphic position. On Pontgravé river, at the crest of and immediately below the falls, brecciated micaceous shales with minor amounts of soft clay shales occur on both sides (Plates XI A, B; X B). They contain irregular-shaped masses of buff-weathering dolomitic limestone characteristic of the Lotbinière (Utica) formation, distributed without regard to structural pattern. No stratigraphic section can be made out because of the complex contortions shown by these shales, presumably as a result of their immediate juxtaposition to the frontal thrust of the Appalachian mountain-built terrane. A few poor graptolites, and nothing else, have been taken from the shale. Because of the impossibility of determining the formational equivalent of most, if not all, of this brecciated and contorted mass, it is better to place the entire exposure within the St. Germain complex.

Similar conditions are seen on Saults river. There the position of the frontal margin of the Appalachian province is approximately $3/4$ mile above the mouth of the river, where complexly folded Utica-Lorraine rocks give way to sandstones and shales of the Sillery group. The Utica-Lorraine beds contain abundant fragments of buff-weathering limestone blocks, and should be included within the St. Germain complex. A few grey-weathering limestone blocks may possibly belong to a Trenton formation.

Farther downstream, from 2 to 4 miles above La Visitation, the Pontgravé River shales are underlain by a discontinuous series of shales, sandstones, and thin limestones belonging to the Nicolet River formation. The very sharp bend in the river $1/2$ mile below the islands in this stretch is approximately on the site of an anticline, for beds dipping southeastward occur on the west (left) bank just above the bend. Within $1/3$ mile the westward dip is resumed again, and continues upstream increasing in amount until a point is reached about $1/4$ mile above Sullivan's dam. There a reversal of the dip shows the presence of another anticline. Within a mile above and below Sullivan's dam, the rocks are all thin-bedded argillaceous shales, with a very few fossils. Those identified are listed below.

These beds faunally and lithologically belong to the Cryptolithus zone of the Nicolet River formation. As with the exposures along the St. Francis, the succession upstream is from younger to older rocks, although in many places minor, or possibly major, folding and faulting may complicate this generalization.

St. Francis River Exposures

These are exposures on both north and south banks of this river. On the north bank, starting from Biron's cliff road, Richmond beds extend upstream for 450 feet (see Figure 2), or as far as the large boulder close to the edge of the river. Upstream from the big boulder, after a gap of 200 feet, the first beds belong to the Pholadomorpha zone, though most of the fossils are long ranging species. For another 500 feet upstream, the section ascends stratigraphically, and contains the following fossils:

Were it not for the absence of certain prominent and diagnostic Richmond species, e.g., Lophospira beatrice, these beds might well be considered to be of Richmond age. The presence of a fragment of Proetus favours a lower age, and the author has provisionally placed them in the St. Hilaire member (Pholadomorpha zone) of the Nicolet River formation.

Fossils Identified from Pontgravé River
One Mile above to One Mile below Sullivan's Dam

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Prasopora</u> -like bryozoa					
<u>Hebertella</u> sp., cf. <u>H. occidentalis</u>	X	X	x		
<u>Resserella</u> sp., cf. <u>R. rogata</u>		X	X	X	X
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Leptaena moniquensis</u>			X	x	
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Cryptolithus</u> sp., cf. <u>C. bellulus</u>				X	

Fossils Identified from North Bank of St. Francis River between
Stations 950 and 450 Feet Upstream from House of L.G. Biron

	Pontgrivé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member Pholadomorpha zone	Chambly member Proetus zone	Breault member Cryptolithus zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Cornulites</u> sp.					
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>Strophomena huronensis</u>	X				
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Catazyga beadi</u>	X	X	X	X	
<u>Cuneanysa scapha brevior</u>	x	X			
<u>Otenodonta</u> sp.					
<u>Cymatogaster recta</u>	X	X	X	X	
<u>Sinuities cancellatus</u>	X	X	X	x	X
<u>Proetus</u> sp.					

Continuing upstream, fossils are rare. From stations 3,500 to 4,000 above Biron's cliff road (Figure 2) there is a stretch with poor exposures, but with talus fragments containing abundant Leptaena moniquensis. The beds of this part of the section may therefore be placed in the lower part of the Proetus zone (Chambly member). Between the latter and the beds of the Pholadomorpha zone as exposed along this river bank, no critical information is obtainable. Beyond station 4,200, the beds, again with practically no fossils, appear to be disposed in a wide anticlinal, though probably concealed faults and possibly also fold axes complicate this simple concept. It is likely that these beds belong to the Cryptolithus zone, so that the absence of fossils is not surprising. At stations 5,900, 6,000, 6,800, 7,000, and 7,200 (Figure 2) the collected fossils were as follows:

Fossils Identified from North Bank of St. Francis River
at Stated Distances Upstream from House of L.G. Biron.

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Station 5990'</u>					
<u>Cryptolithus bellulus</u>				X	
<u>Station 6000'</u>					
<u>Pholidops subtruncata</u>	X	X	X	x	
<u>Resserella</u> sp.					
<u>Proetus</u> sp., cf. <u>P. chamblensis</u>			X	x	
<u>Station 6800'</u>					
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Station 7000'</u>					
Poor graptolites					
<u>Catazyga heedi</u>	X	X	X	X	
<u>Station 7200'</u>					
<u>Whitella</u> sp.					

These fossils tell little except that they probably indicate the Cryptolithus zone, although those from station 6,000 might be from the basal part of the Proetus zone. More collecting is needed to solve this problem, which is important insofar as it might provide a clue to the total thickness of the Cryptolithus zone. Lithologically, all of these beds agree with what is found in the Cryptolithus zone elsewhere.

After a gap of a little more than a mile, exposures of shale begin again within a mile from the boundary of the area, and continue upstream without interruption (see Figure 9 A). Fossils are exceedingly scarce, and consist of poor graptolites together with a few species which allow the allocation of these beds to the Cryptolithus zone without question, though the exposures as a whole should be included in the St. Germain complex. The list of fossils follows:

Fossils Identified from North Bank of St. Francis River
within One Mile of Boundary with Upton Area

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
Graptolites, unidentifiable					
<u>Sinuities cancellatus</u>	X	X	X	x	X
<u>Byssonychia hyacinthensis</u>				X	
<u>Geisonoceras</u> sp.					
<u>Cryptolithus bellulus</u>				X	

Hence, although along the north bank of St. Francis river the beds are folded and faulted, there is a gradation in age from the uppermost on the northwest to the lowermost on the southeast.

Crossing to the south bank of the St. Francis, and traversing upstream from the Bécancour River-Pontgravé River contact (Figure 3, station 1430), Pholadomorpha zone beds occur for 280 feet above that contact. These are succeeded upstream by more Pontgravé River beds. After about 1/2 mile, and beyond a small gap, a short outcrop extending along the shore for not more than 300 feet contains an abundant fauna (Plate I C). The list follows:

Fossils Identified from South Bank of St. Francis River
about 3000 Feet Upstream from Bécancour River Outcrop

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Compsocrinus harrisi</u>	X				
<u>Cornulites</u> sp.					
<u>Pholidops subtruncata</u>	X	X	X	x	
<u>Rafinesquina alternata</u>	X	X	X	X	X
<u>Strophomena huronensis</u>	X				
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Resserella</u> sp., cf. <u>R. rogata</u>		X	X	X	X
<u>Zygospira modesta</u>	X	X	X	X	X
<u>Catazyga headi</u>	X	X	X	X	
<u>Ctenodonta</u> sp.					
<u>C. lorrainensis</u>	x	X	X		
<u>Clidophorus praevolutus</u>	X	X	X	x	
<u>Pterinea demissa</u>	X	X	X		
<u>Byssonychia</u> sp.					
<u>Colpomya faba pusilla</u>	x		X	X	
<u>Cynatonota pholadis</u>	x	X	X	X	
<u>Pholadomorpha pholadiformis</u>	X	X			

The fossils in this list have a decided Richmond aspect, but only two have been previously reported as being restricted to the Richmond. On the other hand, two have not elsewhere been reported above the Pholadomorpha zone, and two others not above the Proetus zone. None is characteristic of the lowest zone. We have here another example of the mingling of Richmond and Lorraine species so common in the fauna of the Pholadomorpha zone.

Continuing upstream, exposures begin again at the mouth of a small stream one mile above the Pontgravé River-Bécancour River contact, and 1 5/8 miles downstream from the southern boundary of the Yamaska area (Figure 9 B). This exposure continues for about 3/4 mile. Fossils are not abundant, but the presence of Proetus, over the first 300 feet along the shore, shows that the beds of this part of the outcrop belong to a horizon below that of the previous exposure, and probably low in the Proetus zone. The list of fossils from these first 300 feet is as follows:

Fossils Identified from North Bank of St. Francis River
about a Mile and a Half Downstream from Southern Boundary of the Area.

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Trematis millepunctata</u>	X	X	X	X	X
<u>Resserella</u> sp.					
<u>Sowerbyella sericea</u>	X	X	X	X	X
<u>Whitella huguesensis</u>			x	X	
<u>Byssonychia radiata</u>	x	X	X	X	
<u>Cymattonota parallela</u>			X	X	
<u>Sinuities cancellatus</u>	X	X	X	x	X
<u>Proetus</u> sp.					

Separated from the former development by a disturbed zone (at 300' on Figure 9 B), and continuing for several hundred feet, there are argillaceous shales with the following fauna:

Fossils Identified from South Bank of St. Francis River about 6500 Feet Downstream from Southern Boundary of the Area.

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St-Hilaire member <u>Pholadomorpha</u> zone	Chambly member <u>Proetus</u> zone	Breault member <u>Cryptolithus</u> zone	
X - Stratigraphic ranges previously determined					
x - Extension of ranges resulting from present work					
<u>Lingula</u> sp.					
<u>Resserella</u> sp.					
<u>Rafinesquina</u> sp., cf. <u>R. mucronata</u>	X	X	X		
<u>Whitella</u> sp., cf. <u>W. complanata</u>	X	x	x		
<u>Byssonychia hyacinthensis</u>				X	
<u>B. radiata</u>	x	X	X	X	
<u>Sinuities cancellatus</u>	X	X	X	x	X

It is impossible to be certain whether this assemblage is characteristic of the Proetus or of the Cryptolithus zone. The writer inclines to the latter, supposing that the beds holding the Proetus fauna may have been eliminated by the disturbance referred to above. Concerning the species of Whitella in the above list, Foerste (1924, p. 153) mentions a Whitella, resembling W. complanata but probably belonging to another species, from the Cryptolithus zone at St. Hugues (Upton area, Clark).

Thickness of the Nicolet River Formation

The measured section along Nicolet river shows that the Nicolet River formation there exposed has a minimum thickness of 2,491 feet. What thickness of beds belonging to this formation lies below the anticline at the base of the measured section cannot be told.

Reference to the sections along various rivers (Figures 2, 6, 7, 9a, 9b) shows the uselessness of trying to compute the thickness of the Nicolet River beds from the folded and faulted sections along St. Francis and Pontgravé rivers. South Shore No. 2 Well (DeBlois, 1959, p. 122) at La Visitation went through 4,294 feet of Richmond and Lorraine beds. On the basis of a 15° dip, normal for that locality, such a depth represents a thickness of beds traversed of 4,149 feet. Of this total, it is exceedingly unlikely that more than 50 feet at the most belong to the Richmond, thus leaving 4,099 feet for the Lorraine. There is a distinct possibility that some of this thickness belongs to the Utica formation. We know almost nothing about the thickness of the Utica hereabouts. In the log of the Canadian Seaboard St. Gérard No. 1 well (DeBlois, 1959, p. 25) a thickness of 3,310 feet of shales is recorded between recognized Richmond and Trenton, and is labelled Lorraine-Utica. This is not out of harmony with the 4,099 feet arrived at above. In the Trois-Rivières area, just north of the Yamaska area, the log of Canadian Seaboard Ste. Angèle No. 1 well (DeBlois, 1959, p. 24) showed 3,800 feet of Lorraine-Utica beds, bounded above and below by Richmond and Trenton. Until some criterion is discovered which will allow the separation of Lorraine from Utica in well logs, the data at hand allow us to say that the Nicolet River formation is at least 2,491 feet thick, and that the combined Utica and Lorraine beds have a calculated thickness of 4,099 feet.

Correlation with Sections Elsewhere

The Nicolet River formation is made up of what elsewhere in northeastern North America has generally been known as the Lorraine group of strata, including both the Edenian and the Maysvillian stages. In the Ottawa - St. Lawrence Lowland the Breault member has no equivalent, but the Chambly and St. Hilaire members can be correlated with the Carlsbad shale. In the vicinity of Toronto it corresponds faunally with the Dundas shale and limestones. Its equivalent in the Manitoulin Islands is the Wekwemikongsing shale. There are no known correlatives in Anticosti. In New York State, the Breault member is probably of the same age as the Frankfort, the Indian Ladder, and perhaps the base of the Whetstone Gulf formations. The remainder of the Whetstone Gulf, the Pulaski and the Oswego formations are probably to be correlated with the Chambly and St. Hilaire members of the Nicolet River formation. No satisfactory correlation can be achieved with the far more detailed section of the Lorraine beds in Ohio.

Formations Exposed East of the Champlain Fault

General Statement

Sufficient data have not yet been accumulated to allow easy determination of the ages and relationships of the many Pre-Silurian formations distributed between the Champlain fault and the Sutton mountains. All such rocks are strongly folded and faulted. In the vicinity of Lévis, thrusting has further complicated the already difficult structure. Melihercsik (1954) and Osborne (1956) have given good accounts of the problems involved, and both recommend that Logan's term "Quebec Group" be retrieved from limbo and reinstated. For the region around Quebec City, Osborne proposes that the Quebec Group be considered to consist of four formations; the Quebec City, Lévis, Lauzon, and Charny. The first two are usually fairly well provided with fossils, the last two rarely so. Beyond the vicinity of Lévis, where structural relationships are obscure, where both stratigraphic continuity and similarity are indecisive and inadequate, and fossils generally absent, these formations can rarely be recognized. It seems, therefore, best to retain the veteran term "Sillery" to include rocks which are possibly but not demonstrably the equivalent of the Lauzon and the Charny formations, and possibly including also other formations of roughly similar ages. It is in this sense that the term Sillery is used in this report.

Sillery Series

With few exceptions Sillery rocks are exposed only in the Aston area, and there only along Nicolet and Pontgravé rivers. Just beyond the eastern limit of the area they can also be well seen along Bécancour river as far as Maddington Falls, Daveluyville. Poor exposures occur around the summit of a rounded hill 3 1/2 miles east of St. Léonard. Excellent exposures are available in fields and in a large quarry within a mile northeast of Notre Dame du Bon Conseil, and again 4 miles west of the same place.

Nicolet River Exposures

Within 1/4 mile of the spot where Nicolet river enters this area red slates are seen on its west bank. No bedding can be seen within the slates, but a 4-inch sandstone bed indicates a steep dip to the east-southeast, with many irregularities. From half a mile to a mile below the mouth of Bulstrode river a variety of black sandstones with black slates is exposed also on the south bank. The colour of the sandstone is due wholly to the matrix of the rock, for the grains are colourless quartz. Near the western end of this exposure red slate shows up. No uniform structure exists here. The strikes range from N. 10° E. to N. 10° W., and the dips from 20° E. to vertical. Proceeding downstream, one mile above the Route 9 bridge, discontinuous exposures over a distance of about 2,000 feet show many rock types. The upstream half is almost entirely diabase; the downstream part is mostly sandstone, here converted into quartzite and considerably brecciated. Both conditions may be results of the intrusion of the diabase. At the extreme western end contorted cherty slates occur, dipping approximately 20° N.E. Dark quartzitic sandstones are again seen in two exposures 1/4 and 1/2 mile below the bridge. Bedding is obscure, but easterly dips seem to prevail. In the second exposure, dark quartzites, grey sandy slate, dark cherty slate, fine-grained grey sandstone, and a little black slate are arranged with no stratigraphic regularity or significance. About a mile farther downstream quartz grit, combined with dark grey and black slate, and a little red slate are exposed on the northern bank. Contortions here make it impossible to work out any structural pattern. Two miles below Route 9 bridge, where the river makes a wide bend to the northeast there is a long exposure of slate and quartzitic sandstone, in general dipping to the southeast. The beds are so much interfered with by faulting and folding that no reliable section can be drawn of this exposure. The highest part of the exposure upstream consists of red and green interbedded slates. These are followed downstream by alternations of thin-bedded cherty sandstones in layers an inch thick, and thin dark,

carbonaceous sandy bands. These show several kinds of burrows, etc., but no direct fossils. They are followed in the middle part of the exposure by a development of thin and thick (up to 6 inches) beds of dark sandstone containing a miscellaneous debris of mica flakes, fragments of chitin, and recognizable fossils. The latter consist of incomplete valves of Botsfordia pretiosa, fragments of trilobites, and peculiar wire-like forms. Botsfordia pretiosa is an index fossil for the Charny formation as it is exposed around Lévis, and is considered to imply a Lower Cambrian age. Black shale and dark sandstone continue as far as the outcrop lasts. As the river bends back to its normal northwesterly course two more exposures are to be seen on the northern bank. The first consists of black and grey slate, the second of grey sandstone followed downstream by grey slate, and ultimately at the end of the outcrop by red slate. The attitude here is fairly constant, the beds strike N. 70° E., and dip 20° to 50° to the southeast.

About 1 1/2 miles above the bridge at St. Léonard two exposures of uncommon interest straddle the stream. The first consists almost entirely of gritty sandstone in thick well marked beds, with large quartz and feldspar grains up to 1/8 inch in diameter. There is no shale here. The beds strike N. 35° E., and dip 12° southeast. At the western end of the upstream exposure there is a bed of fairly fine-grained muddy sandstone, weathering yellowish green, with no apparent stratification though it splits easily parallel to the regional bedding. What appears to be ripple mark characterizes one surface; in one spot the rippled surface was subsequently channelled and a new set of 'ripples' seems superimposed at right angles to the earlier set. Other peculiar structures, arranged in curved radial lines that remind one of the fossil Spirophyton cauda-galli, look like, but are probably not, ripple marks. They stand up in relief probably because they are composed of purer quartz sand than is the rest of the rock. In fact, these curved radial structures, as also the 'ripples' described above, are the surface expressions of vertical plates of white quartz sand which may very well be the fillings of fractures in the greenish host rock (Plate VIII A, B). Much of this greenish rock is traversed by an irregular network of coarser and whiter sand than that which makes up the rest of the rock, and this network, as with the 'ripples' and the radial lines, may be fillings of a series of regular and irregular cracks developed in the greenish, slightly muddy sandstone. Of this network, some units are straight, some curved (Plate IX A, B), some angular, and some are branching. All of these quartz-sand cracks traverse the rock at right angles to the regional bedding, and they do not begin or end at any particular stratigraphic horizon. In one case the rock consists of the greenish host rock 'cut' by the white quartz 'veins', giving a striped effect at right angles to the bedding.

The second of this pair of exposures, large enough to have supported a dam in earlier times, consists of the same kind of gritty sandstone, with grains of quartz and feldspar up to 1/2 inch in diameter. Pebbles and flakes of slate up to 2 inches across are common. Small fragments of bluish fibrous, organic material, are interpreted as pieces of shells of inarticulate brachiopods, probably coloured by vivianite. The attitude of the bedding is fairly uniform, the strike being N. 35°-40° E. and the dip from 30°-40° to the east.

Dowstream, about one mile above St. Léonard, and just before the river turns sharply toward the west, heavy-bedded grey sandstone, with one 6-foot bed of the yellowish weathering greenish sandstone common in the exposures just described, occurs on the west bank of the river. The greenish sandstone has a few 'stringers' of white quartz sand perpendicular to the bedding. Near the downstream end of the exposure grey and red slates replace the sandstone. Small faults, striking about S. 25° E. shift the contact between the sandstone and the slate as indicated in the sketch on Figure 8a. An average attitude for this exposure is strike N. 40° E., dip 40° to 50° E.

The last exposure of the Sillery rocks is along the margin of an abandoned river channel north of the one currently used by Nicolet river. It is also about 1/4 mile upstream from the St. Léonard bridge. The rock here is entirely a coarse- to medium-grained sandstone, well deserving the name grit in its coarser parts. Clear quartz grains are common up to 1/8 inch across, and occur up to 1/4 inch across. No pebbles, or beds or flakes of slate were seen. The beds strike N. 55° E. and dip 45° S.E.

Pontgravé River Exposures

Fewer, though more extensive, exposures occur along this river than along the Nicolet. Beginning at the southern limit of the area, where the river enters at Notre Dame du Bon Conseil, and going downstream, Sillery sandstone can be seen at five localities. First, from just above the bridge at Notre Dame du Bon Conseil to a point about 1,000 feet downstream, there are discontinuous and poor exposures of dark, fairly fine-grained grit. Although the strike of these beds changes rapidly, the dips remain about 20° to the east, which probably indicates the presence of numerous shallow-plunging folds. In the vicinity of the mouth of a small stream entering from the north, dark basic rocks occur as dykes and probably as larger intrusive masses. For another half-mile nothing is exposed except irregularly contorted Sillery grits, fairly light grey, and dipping steeply to the east.

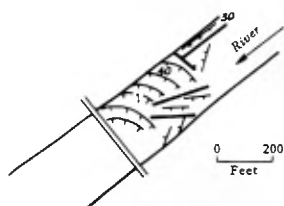


FIGURE 8B

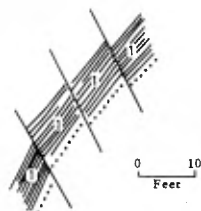


FIGURE 8A

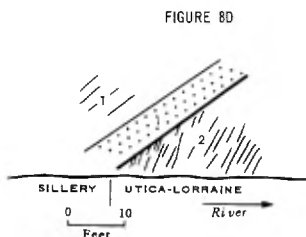


FIGURE 8D

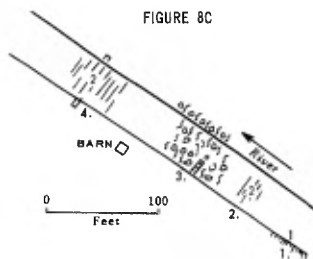


FIGURE 8C

LEGEND

2 St. Germain complex
(Utica-Lorraine)

1 Sillery sandstone, quartzite and slate

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Figures 8 a-d. Explanations

- 9a. Sillery shale and sandstone. Vertical face showing small-scale faults. Southwest bank of Nicolet river, one mile above St. Léonard.
- 9b. Sillery sandstone in bed of Pontgravé river 2½ miles east-northeast of Ste. Brigitte des Saults. At low water, resistant beds stand out above the river level in the pattern shown here. Heavy lines are faults. Strike lines are accompanied by short dip symbols.
- 9c. Exposures along Saults river ½ to ¾ mile above its confluence with Pontgravé river at Ste. Brigitte des Saults.
 - i. Black slates, fractured, cleaved, slickensided. No breccia.
 - ii. Evenly and regularly bedded Utica-Lorraine rocks. Nearly vertical.
 - iii. Breccia, slaty or shaly matrix, with large contained blocks. In middle of this mass there is a 10-foot block of Sillery sandstone above which there is a predominance of Sillery blocks in the breccia and below which the Utica-Lorraine types are the more numerous.
 - IV. Remains of an old dam. All the rocks immediately above and below here are Utica-Lorraine shales with grey and buff-weathering beds. There are some structural complications, but very little brecciation.
- 8d. Diagrammatic section looking southwest at southern bank of Bécancour river. This is very close to "Logan's Line". A 4-foot bed of Sillery sandstone overlies cleaved St. Germain slates.

Half a mile below the new bridge carrying Route 9, a long series of exposures occurs along both banks, consisting of quartzites and grits, with slates common toward the lower end. Many, strong, structural complications make attitude readings undiagnostic, though in general dips are very steep to the east. These exposures cease within a mile of Mitchell Station. Two and a half miles (straight line) downstream there is a small outcrop of grits, interesting chiefly because of the manner in which the folded strata show up in outcrop in the bed of the stream (see Figure 8b). All of the rocks here are much the same kind of grit, including some of the yellowish-weathering greenish rock described from Nicolet river; these carry traces of the quartz-rich 'veins' also. After a gap of about a mile the same kind of grit outcrops on both sides of the river, and continues to about a mile above the falls at Ste. Brigitte. Yellowish-weathering grit occurs here also, but lacks any of the crack-like structures. Most of the bedding planes strike N. 55° - 60° E. and the dip is 30° - 45° to the south.

Lastly, immediately above the falls at Ste. Brigitte, Sillery grits, greyish green and quartzitic, together with red and black slates, are in contact with brecciated Lorraine and possibly Utica rocks. Here is one of the few localities in Canada where the western boundary of the Appalachian mountain-built region can be seen. The attitude of the Sillery sandstone is approximately N. 55° E., and the dip is 55° to the east to vertical.

Half a mile due south, on the banks and in the bed of Saults river, essentially similar exposures can be seen. The Sillery rocks, which here are in indefinite contact with rocks of the St. Germain complex, consist, as usual, of green and grey grits, with black, dark grey, and red slates. The structural relationships both here and on Pontgravé river are treated below under Structural Geology (see Figure 8c).

Notre Dame du Bon Conseil Exposures

Four miles west of Notre Dame du Bon Conseil, coarse-grained grits, in places true conglomerates, outcrop as ridges in fields and in ditches. The beds strike N. 40° E. and dip 40° S.E.

Immediately northeast of Notre Dame du Bon Conseil there are splendid exposures of Sillery rocks, seen best in the large quarry developed by the Notre Dame Quarries Company, Ltd. Incipient metamorphism has transformed the sandstone into a quartzite; in the coarser-grained examples the original quartz and feldspar grains are plainly visible, but the rock breaks through, and never around, the grains. All original

porosity has been lost. Most of the rock is a fine- to very fine-grained dark grey quartzite. From that type it ranges upward to a fine-grained conglomerate, with grains averaging 5-10 mm. throughout beds of a foot or less in thickness. The finer-grained types are invariably black, and grade into a dense black shale. In the coarser-grained types feldspar is common, and shows bright cleavage faces on the broken rock surface. Bedding is well marked, but irregular, though a dip toward the north of less than 20° is everywhere apparent. A few faults are visible, one being accompanied by drag folding (Plate X). No red or green slates are seen here, nor is there any of the greenish grit so common elsewhere in the Sillery rocks.

Conclusions

From the descriptions of the many exposures of Sillery rocks in this area, a few generalizations can be made. The rocks grade from fine-grained conglomerate through sandstone to shale. In many places, particularly near igneous intrusions, they have been transformed into quartzites and slates. Because of their superior resistance to weathering and erosion sandstone and quartzite are the commonest types exposed, but it is unlikely that sandstone possessed any original depositional preponderance over shale. In fact, in the neighbourhood of Lévis and Sillery, shale is by far the commoner type. Hence there is a high degree of probability that the areas between exposures are underlain by shale. No arrangement of the exposures into an orderly structural pattern can be achieved. It is not known which of the green grits, red shales, etc., lies at the top and which at the bottom of the stratigraphic sequence. Any original stratigraphic succession may well have been practically obliterated during the shoving of these rocks westward during the Taconic orogenic period.

The presence in one locality of Botsfordia pretiosa definitely links the containing strata with the Charny formation of the Lévis region. Whether or not the rest of the Sillery series will eventually fall into the same, or related, formations must await the finding of additional critical data.

IGNEOUS ROCKS

No igneous rocks are known to cut, or to be in contact with, the rocks of the foreland. However, within a few miles of the front of the Appalachian folded terrane, the Sillery rocks have been invaded by basic rocks most of which are now exposed as intrusive bodies.

Elsewhere, as at St. Flavien (Portneuf area, Clark, MSS), and Drummondville, these rocks, also a short distance east of the frontal thrust, show extrusive characteristics, such as pillow structure and amygdaloidal texture.

St. Flavien Igneous Series

The most easily accessible exposures are on both sides of the road from Notre Dame du Bon Conseil to St. Léonard, 2 miles north-east of the former place and just north of the spot where the road makes a marked bend to the northwest. There, a great variety of rocks is exposed in small outcrops scattered over a quarter of a square mile. The commonest type is hornblende gabbro, carrying hornblende crystals up to 2 inches long. The exposures are all low, deeply weathered, and fresh samples for microscopic examination would be impossible to obtain except with blasting. Here and there small patches a few feet across of hornblende and biotite syenite occur, though no contacts between this lighter-coloured rock and the darker gabbro have been seen.

Half a mile due south of these exposures, an augite gabbro was exposed by digging into a gravel knoll. The rock consists almost entirely of inch-wide crystals of augite, with smears of rusty biotite between the augite crystals. Serpentine veins, most of which are slickensided, criss-cross the rock. The manner of exposure of the rock is remarkable. Spheroidal weathering has resulted in the formation of residual rounded masses (Pl. VII A,B), from around which the weathered rock has crumbled, and is today carted off without the necessity of blasting or crushing.

Two miles southeast of St. Wenceslas on Route 34 there is a group of exposures, locally known as Le Rocher. That part of the group nearest Route 34 is a fine-grained to aphanitic, dark green, basic rock, appearing in places to have been partly serpentized. Most of it is devoid of recognizable structures, but here and there marked pillow structures can be seen, the spaces between the pillows being occupied by radially developed quartz, probably a replacement of original zeolites. The attitude of the pillows is N. 50° E., dipping 45° S.E. Brecciated rock of the same type as the pillows occupies some of the inter-pillow spaces. Farther south, breccia is commoner, and is independent of pillows. Very little of this rock is obviously crystalline.

STRUCTURAL GEOLOGY

The two major structural units in this area are separated from each other by the Champlain fault, sometimes referred to as Logan's Line. West of this boundary lies a series of sedimentary rocks, which, in terms of the broad subdivisions of the North American continent, belongs to a northeastward extension (St. Lawrence Lowlands) of the Interior Basin. In terms of the Appalachian geosynclinal development they are part of the foreland. To the east of the Champlain fault there is a complex of sedimentary rocks grouped together as the Sillery series, which belongs to the Appalachian province of North America; these rocks were most probably deposited in the miogeosynclinal part of the Appalachian geosyncline. Associated with the Sillery sedimentary rocks is the St. Flavien series of basic igneous rocks.

Chambly-Fortierville Syncline

All of the exposures within the Yamaska area, and those in the northwestern half of the Aston area, are parts of the Chambly-Fortierville syncline, a structure which pervades the entire Lowlands between the St. Lawrence and the international border (Clark, 1947, p. 15). The axis of this fold enters the Yamaska area in the vicinity of Yamaska East, and leaves it very close to its northeastern corner. Hence, in the Yamaska area, approximately half of the land south of St. Lawrence river lies on the northwest limb and half on the southeast limb of the fold. All of the Aston area west of the Champlain fault (except the extreme northwest corner) lies on the southeastern limb. Almost all of the outcrops in this whole area lie to the southeast of the fold axis; in fact, northwest of the axis exposures are to be found only at La Baie and along the lower part of Pontgravé river.

Northwest Limb

The exposures are of red shales and sandstones belonging to the Bécancour River formation, and are exposed in the bed of a small stream near La Baie, and along Pontgravé river from 3 to 5 miles upstream from Nicolet. All beds dip 2° - 8° to the southeast. There are no local complications to the structure of the rocks at either of these two localities.

Southeast Limb

Exposures are confined to the banks of Bécancour, St. Wenceslas, Nicolet, Pontgravé, and St. Francis rivers. Along these streams the structural pattern is the same. Exposures close to the axis consist of flat or nearly flat beds, and thence upstream the beds show

dips of increasing magnitude (Plates I B; IV A, B, C). Rarely does one find vertical or near vertical dips, but inclinations of 50° and 60° , usually to the east, are common along the upper parts of the streams within the limits of the syncline.

The general northwesterly dip on the southeast limb is complicated by flexures and secondary folds (Plate VI A); however, no matter how strong the folding, nor how marked the faulting, there is a progression in a southeasterly direction from younger to older beds. This is very well marked on St. Francis and Pontgravé rivers, and has already been referred to under the description of the beds of the Nicolet River formation.

The regional strike is about N. 45° E. The many variations are an indication of minor irregularities due, for the most part, to the innumerable flexures and drag folds observed everywhere on the southeast limb of the fold. There is no such thing as a regional dip. On the northwest limb the dips are without exception to the southeast, and in places near the axis of the fold the beds are approximately horizontal. On the southeast limb, however, what would ordinarily be a series of beds dipping uniformly northwestward is complicated by faults and folds so that in places as much of the exposures dip to the southeast as to the northwest. On this limb, secondary folds, for the most part drag folds, of which some are closely associated with reverse faults, produce variance in the dips. Unfortunately, there is not sufficient evidence to connect these secondary structures across the spaces intervening from river section to river section, and, indeed, many folds, and more particularly faults, clearly seen on one bank of a river cannot be found on the opposite bank. The southeast limb is here interpreted as having been complicated by a maze of minor folds and cut up by an intricacy of minor faults, both of which increase in intensity and abundance toward the southeast. None of the complications can be shown to be through-going, or to give rise to a sufficiently large structure to be recommended as a possible reservoir for oil or gas.

On the areal map no attempt has been made to introduce all of the irregularities in the contacts between formations or members. This could be done effectively only upon a large-scale map, and would require far greater collections of correctly identified fossils than can be justified in the course of ordinary mapping. Before a campaign of drilling for oil or gas were to be undertaken, more extensive collections of fossils should be made so that the exact location of the zonal boundaries could be established, and the scope of the relatively minor folds worked out. The expense of such an undertaking would be amply justified as part of exploratory practice, but it has no place in this present work.

The strike of the Pontgravé River beds takes a marked bend away from the axis of the syncline as Nicolet river is approached from the southwest. From what is known of the distribution of the Pontgravé River and Nicolet River formations in the Trois-Rivières area, the northwestern belt of the Pontgravé River beds does not follow a parallel course, but diverges somewhat toward the north. In other words, the syncline broadens out in the northeastern corner of the Yamaska area, a condition which is in complete harmony with the hypothesis of a domal structure in the southwestern corner of the Bécancour area (north of Aston area). These two contiguous corners, together with the appropriate corners of the Trois-Rivières and the Aston areas, should be thoroughly prospected by geophysical means in order to verify the presence of the postulated domal structure and to outline its area with sufficient accuracy to allow wells to be located intelligently. The fact that two deep and dry wells (Canadian Seaboard St. Gregoire No. 1 and Canadian Seaboard Ste. Angèle No. 1) have been drilled on the Trois-Rivières and the Bécancour areas respectively, need not deter further exploration, for it is quite possible that the dome encompasses a secondary basin, in which, it may be, the dry wells were located.

St. Germain Complex

Along all four main rivers in this area, upstream from the fossiliferous sections already described, there lie other and more extensive exposures of Lorraine, probably Utica, and possible Trenton rocks whose attitudes are those of incompetent strata intensely folded, faulted, and contorted. Few fossils have been found in these contorted beds. Because it is in most places uncertain to which of the formations of the Middle or Upper Ordovician the exposures should be referred, they are included in the St. Germain complex (Clark, 1947, p. 15). This structural unit persists west of the Champlain fault with varying intensities and breadth of outcrop along the whole length of the syncline.

Bécancour River

Along Bécancour river the St. Germain complex occupies a belt about 4 miles wide measured across the strike. It consists mostly of shales, with a few sandstone beds, all much disturbed by faults and folds. Fossils are scarce and do not help everywhere in determining the formation to which these disturbed beds belong. East of the present area, and northeast of Aston Junction, the trace of the Champlain fault cuts across the winding Bécancour river in three places. Adjacent to and west of the fault, the complications and distortions of the rocks are extreme, though, save for the development of cleavage in some of the shales, and the transformation of some of the sandstones to quartzites, none of the rocks should be called metamorphic (Plate XII A, B).

Nicolet River

Starting at the anticline marking the base of the measured section (Plate IV C) exposures continue for 2 miles upstream. The structures typical of the rocks along this stretch are shown in Figure 6. The rocks consist of shales with thin sandstone beds, and shale with buff-weathering magnesian limestone bands. For the first half mile or so, folds and faults are prominent; the dips of both bedding and faults gradually change from steep eastwards to steep westwards, but the strikes remain fairly constant at about N. 50° E. Following a gap on both sides of the river, exposures begin again on the right bank and, with one gap, extend for more than a mile. Throughout this stretch, folds are very rare; strikes are constant at about N. 45° E., and dips are steep to the west.

No fossils were found in these rocks. Lithologically they resemble the Breault formation, and may include that part of the Lower Lorraine (elsewhere known as Leclercville shale, Clark, 1947, p.8) occurring below the anticline at the base of Foerste's section. That internal and unrecognized complications must exist here is shown by the calculation that over a breadth of outcrop of 1.3 miles (6,964 feet), using an average dip of 50°, the thickness of the strata concerned would be a supposedly impossible 5,336 feet. There are no outcrops for the last 3 miles below St. Léonard, where the Champlain fault crosses the river.

Pontgravé River

Upstream from the section already described, beds readily referable to the Breault member of the Nicolet River formation can be followed to within 200 feet of Sullivan's dam. Beyond this point highly contorted shales persist for half a mile or so, and are the only representatives of the St. Germain complex on this river within the Yamaska area. In the Aston area, the St. Germain complex is very well exposed on both this river and its tributary, Saults river, at Ste. Brigitte des Saults. Here shale, sandstone, and magnesian limestone beds have been intricately folded, faulted, brecciated, and jammed together within a few hundred feet of the Champlain fault (Figure 8c; Plates X B, XI A, B).

St. Francis River

The regular succession of beds developed along the banks of this river, and described above, ends one mile from the map margin on the south bank and 2 miles from the map margin on the north bank. There are no further exposures within this area upstream along the south bank,

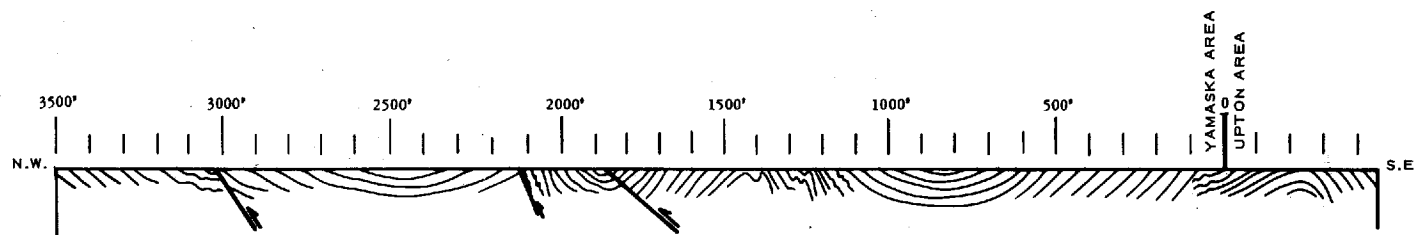


FIGURE 9A

Section along right (northeast) bank of St. Francis river downstream (northwest) from map boundary. Exposures continue for 950 feet beyond northwest end of sketch, with little change in attitude. St. Germain complex.

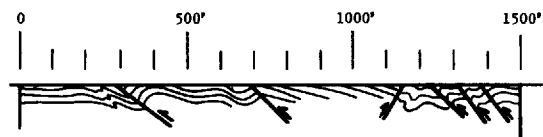


FIGURE 9B

Section along left (southwest) bank of St. Francis river from mouth of small tributary stream $\frac{1}{2}$ mile southeast of house of L.G. Biron. Poor exposures continue upstream for about half a mile. Probably Chambly member from 0' to 300', Breault member from 300' to 1500'.

but outcrops begin at the map margin on the north bank and persist downstream for about a mile. The structure of the shales found here is shown in Figure 9a. Here and there Cryptolithus, Sowerbyella, Geisonoceras, and a few other fossils occur, all indicating a Lower Lorraine age for the containing beds, and there are also exposures of black shales with buff-weathering limestone beds, surely belonging in the Utica formation. No continuous stratigraphic section can be worked out. Such mingling of formations with complicated structures relegates these outcrops to the St. Germain complex.

The Champlain Fault

The boundary between the rocks of the foreland and the complex terrane of the Appalachian mountain-built belt is known as the Champlain fault. It is customary to refer to this structural feature as a thrust, but there is yet some doubt as to its precise nature. Although the break is shown on the maps as a single line there is reason to believe that it is in reality a fault zone. Only at Philipsburg (Lacolle area) can this fault be seen as a clean-cut surface. Elsewhere its presence is necessitated by distributional anomalies, or, as at Ste. Brigitte des Saults, by wide brecciated zones. Similar brecciated zones can be well seen along Bécancour river northeast of Aston Junction.

Pontgravé River, Ste. Brigitte des Saults.

Pontgravé river divides just before plunging over the crest of the falls at this locality. A very small part of the water takes the northern route, and passes through a narrow, artificial-looking channel about 40 feet wide. At the upper entrance to this channel there is a prominent exposure of normal greenish grey Sillery sandstone striking N. 55° E., and dipping 55° E. to vertical. This is followed downstream for about 200 feet by red and black Sillery shales with no regularity of attitude, except that a steep dip to the east is the rule. The remainder of the narrow channel is occupied by a breccia consisting of blocks of buff-weathering limestone, possibly of Utica age, set in a groundmass of distorted shales which might be of either Utica or Lorraine age, or both (Plates X B; XI A, B). Some of the shales have a marked brown streak, a characteristic of the Utica formation elsewhere. The breccia continues to the limit of the exposures downstream, about 500 feet below the falls. At the lower end of the outcrop there are, associated with the buff-weathering types, brecciated beds of grey limestone, which may possibly indicate the presence of Trenton rocks here.

The actual contact between the Sillery and the more extensive St. Germain complex is obscured, but its position can be fixed within 3 feet, and it appears to be nearly vertical. Within a few tens of feet of this contact, no general structural pattern of the brecciated St. Germain rocks can be determined, other than a fairly uniform strike of N. 20° E. The whole exposure downstream from the contact fits well into the St. Germain complex.

On the south shore of Pontgravé river, along a path that ascends the shore from the mill, the same relationships can be seen, and the contact can be located here within 4 feet. The line joining the two contacts runs at N. 20° E. The exposures are not so extensive as on the north bank but the structural details are in accord with what can be seen there.

Saults River

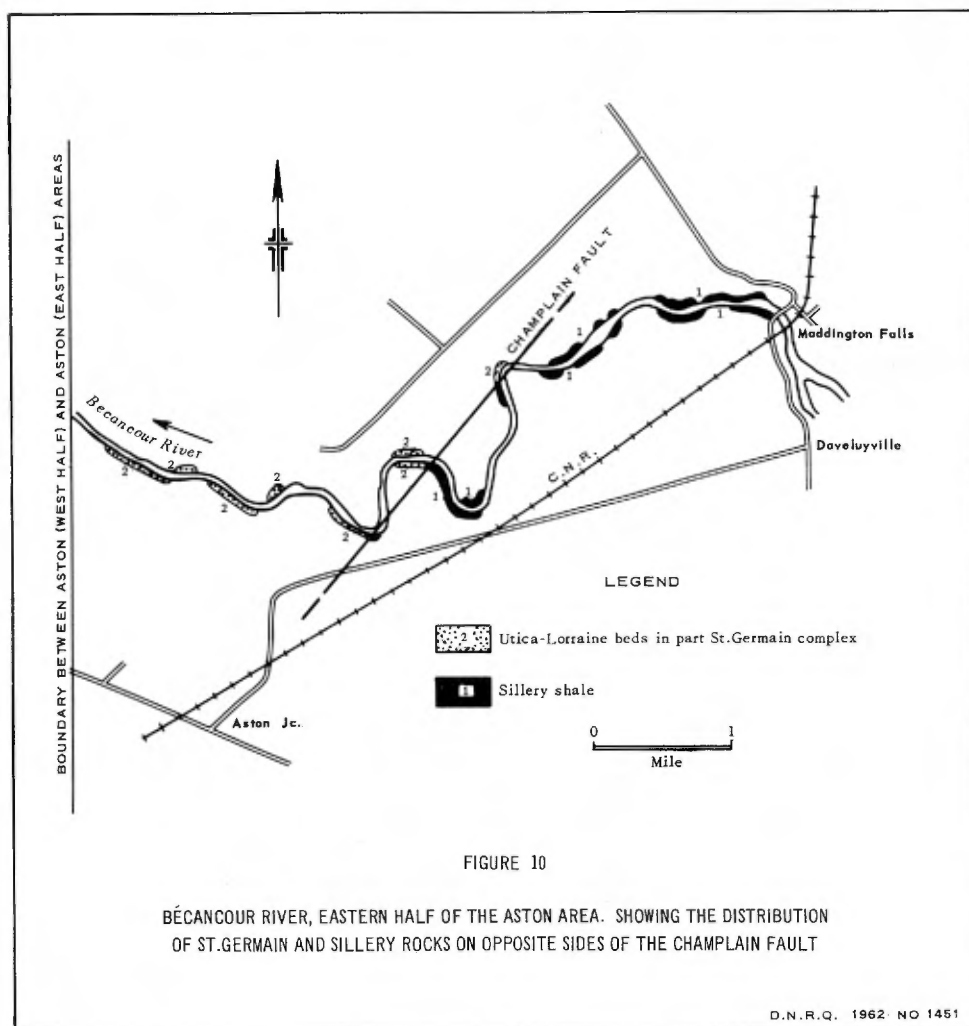
This is a small tributary stream which enters the Pontgravé just below the falls at Ste. Brigitte des Saults. Exposures here reveal essentially the same relationships as those along Pontgravé river (Figure 8c). They begin below the old mill 1/4 mile upstream from the mouth of the river, and consist, for several hundred feet, of normal St. Germain rocks, contorted shales with both buff- and grey-weathering limestone, and sandstone beds. All of these strata are brecciated into blocks less than 6 feet long. There is no apparent trend within this brecciated zone, which continues upstream beyond the remains of an old dam as far as an obstruction on the south bank consisting of two very large glacial erratics resting on an exposure of Sillery sandstone. The latter, which does not reach the middle of the stream, is certainly in place, and is merely a fragment in the breccia. At this point the St. Germain complex yields to Sillery black slates, intensely contorted, and containing blocks and small fragments of Sillery sandstone. This breccia can be seen to better advantage on the cliff along the north bank. The contact between the St. Germain and the Sillery is approximately perpendicular to the course of the stream, and trends N. 20°-40° E. The shales and slates of the two formations are sufficiently alike so that, where jammed together, their mutual boundary becomes an indefinite zone about 20 feet wide. Farther upstream the St. Germain appears as blocks and as areas of a hundred square feet or so within the crumpled Sillery slates. The blocks here are more rounded than are those farther downstream. There follow black Sillery slates intensely folded and cleaved, but without blocks of either Sillery sandstone or of St. Germain rocks. At the end of the continuous exposures upstream these black slates are

strongly cleaved and slickensided as seen on the south bank. 300 feet farther upstream red Sillery slates occur on the north bank. The red slates strike N. 55° E., and form the last exposure within this area on Saults river. Just beyond the map limits it cuts through a fine section of relatively undisturbed Sillery sandstone.

The complications and brecciation seem to be somewhat more pronounced here than along the Pontgravé. The trend of the structures involved, wherever visible, is from N. 20° - 50° E. Because the regional trace of the fault zone over the whole area is N. 45° E. more or less, the north-south relationship between its intersections of the Pontgravé and of the Saults rivers is anomalous. This difficulty is best resolved by the introduction of a tear fault breaking the boundary as indicated on the map. This and other dislocations of the Champlain fault have already been described by the writer (Clark, 1951).

Bécancour River

From the bridge which crosses Bécancour river northwest of Aston Station, rocks of the St. Germain complex are exposed upstream in several places on both sides of the river as far as the prominent bends about 2 miles northeast of Aston Junction. Though this location lies beyond the limit of this area, it seems best to give a brief description of the occurrences. From Aston Junction a road follows the Nicolet-Arthabaska counties boundary northward. Half a mile south of the river it turns sharply to the east toward Daveluyville. One mile east of this corner the road is within 1/4 mile of the southernmost part of a wide swing of the river (Figure 10). A rude path zigzags down the cliff to the water level. The rocks exposed along the southwestern part of the bend belong to the St. Germain complex (Plate XII B). In one or two places, shales with buff-weathering magnesian limestone bands, elsewhere characteristic of the Utica, and thin-bedded grey limestones with a Trenton aspect are associated with the shales. Contortions and brecciation are common. Fossils are almost completely absent, only a few obscure trails and a specimen or two of Dalmanella have been seen. However, near the upstream end of these St. Germain rocks there is a conspicuous exposure of black shale, bearing Utica graptolites in great profusion, and stained bright yellow by the mineral glockerite (Clark, 1951). Less than 1/4 mile upstream, and 400-500 feet from the end of the exposure, the contact between the Sillery and the St. Germain complex can be approximately located. The lowest (actual position) Sillery is a 4-foot bed of sandstone resting directly upon the soft St. Germain shales. Were it not for this heavy bed of sandstone (Figure 8d) the contact might pass unnoticed because of the similarity between the shales and slates of the two contiguous formations. The attitude of the base of the Sillery



sandstone bed, and therefore presumably of the thrust plane, is N. 35° E., dip 45° east. Not too much significance should be attributed to this reading, however, although it does correspond to the axial planes of many of the minor folds in the Sillery shales, and the strike is the same as the strike of the fault as it cuts across the curves of the river upstream. There are no exposures along the northern portion of this river bend.

Going upstream, and rounding the big complementary bend to the north, St. Germain rocks are exposed for 1/3 mile along the east-west stretch of the stream. Just before the valley turns to the south-east, the contact is again reached. Though it cannot actually be seen, probably because of the absence of hard, prominent, Sillery sandstone beds, its approximate position can be placed somewhere in a zone about 250 feet wide, in which the St. Germain beds can be identified by their sandy stratification planes, flow rolls, and buff-weathering limestone beds, and the Sillery slates by the virtual absence of mica on the bedding surfaces, their black splintery nature, and a tendency to weather rusty (Plate XII A). Red Sillery slate occurs only at the extreme upstream end of this exposure, where the river comes close to the road for the last time before meeting it at Maddington Falls.

Thence, following the river upstream for a mile or so toward the north, Sillery slates again appear just before the river begins to make its big bend toward the east. The basal 20 feet (structurally considered) of the Sillery is a breccia of grit blocks set in a jumbled mass of slate beds, in which no continuous or mappable structures could be seen. These are followed, at the climax of the curve, by St. Germain shales, with their characteristic buff- and orange-weathering beds, flow rolls, micaceous bedding surfaces, etc. Strangely enough, although the overlying Sillery is intensely contorted, the St. Germain is, over long stretches on both sides of the river, scarcely disturbed, except for small-scale folding and faulting. No contact with the Sillery occurs at the upstream end of this exposure, but around the bend Sillery rocks again occur on the south bank. On the north bank the contact can be located within a few feet. Although the structural relationships are not clear it appears that the contact is nearly vertical.

The three contact zones described above line up almost perfectly at about N. 40° E. This trend cannot be continued far to the southwest, for the igneous rocks near St. Wenceslas Station, presumably associated exclusively with the Sillery series, would lie to the west of such an extension. An outcrop of Sillery sandstone close to the mouth of the tributary entering Nicolet river immediately above St. Léonard must also lie to the east of the fault trace. There is no controlling

exposure along the Nicolet for 3 miles below St. Léonard, but samples of rock from shallow wells midway between St. Léonard and St. Perpétue are of Lorraine types. Further, though not convincing, support of the assumed position of the fault trace between the calcareous Lorraine and the non-calcareous Sillery lies in the reputation borne by the wells northwest of the road leading southwest from St. Léonard for yielding hard water, whereas those southeast of the road yield soft water. No further offset need be invoked before the Pontgravé exposures are reached, but a slight adjustment is necessary between Pontgravé and Saults rivers (see above).

The Sillery Series

Although the Sillery rocks occupy nearly half of the Aston area, nowhere are they exposed sufficiently widely or continuously to give a comprehensive picture of their structure. Discontinuous exposures can be followed along the Pontgravé from Notre Dame du Bon Conseil to Ste. Brigitte, and in limited localities the structure of the beds can be made out. Along Nicolet river downstream to St. Léonard, exposures are more numerous, but shorter, and nowhere does an outcrop betray more than a hint as to the regional structural pattern.

The slates, red, grey, and black, have yielded so readily to distortion that, in the few places where they are exposed, no general structural attitude can be recorded. Although the sandstones have also yielded to the deforming forces their greater competence has allowed the preservation of their original lithological characteristics and stratal identities.

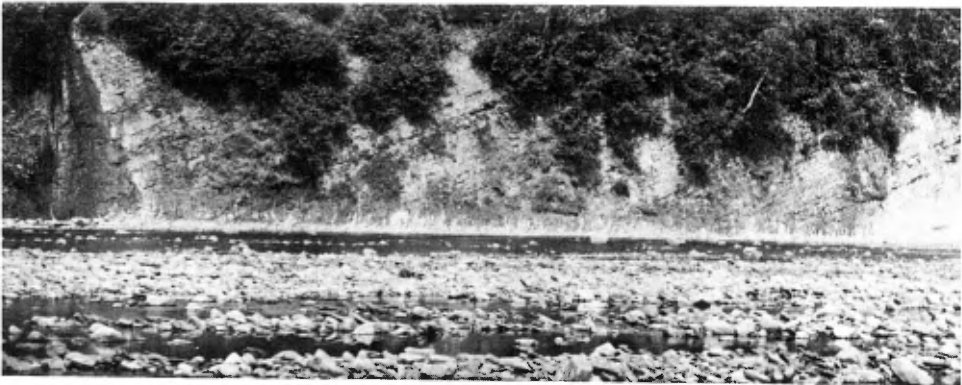
Pontgravé River

A mile or more along Pontgravé river downstream from Notre Dame du Bon Conseil, the exposures are almost entirely of sandstone. For the first 1,000 feet the attitudes make it possible to interpret the structure as a broad anticline plunging to the northeast. About where the basic dyke occurs, near the small tributary entering from the north, the rocks are slaty, and complications are rife, disallowing any discernment of a structural pattern. In the mile-long exposure just below the bridge carrying Route 9, complications and irregularities in the exposures make it impossible to record more than mere impressions of the attitudes. Strikes range from N. to N. 15° E., and the dips from 85° E. to vertical. Two miles below Mitchell Station the sandstones are distributed across the river bed displaying the pattern shown in Figure 8b.

Plate I



A- The characteristically quiet Bécancour river. Looking downstream from bridge 3 miles northeast of St-Wenceslas.



B- Boulder-strewn bed of Nicolet river, looking across to Chambly beds on right bank. One mile east of western boundary of Aston area.



C- Rapids-infested St-François river. Looking across at left bank 6 miles above Pierre-ville. Rapids are caused by harder Pontgravé River beds.

Plate II

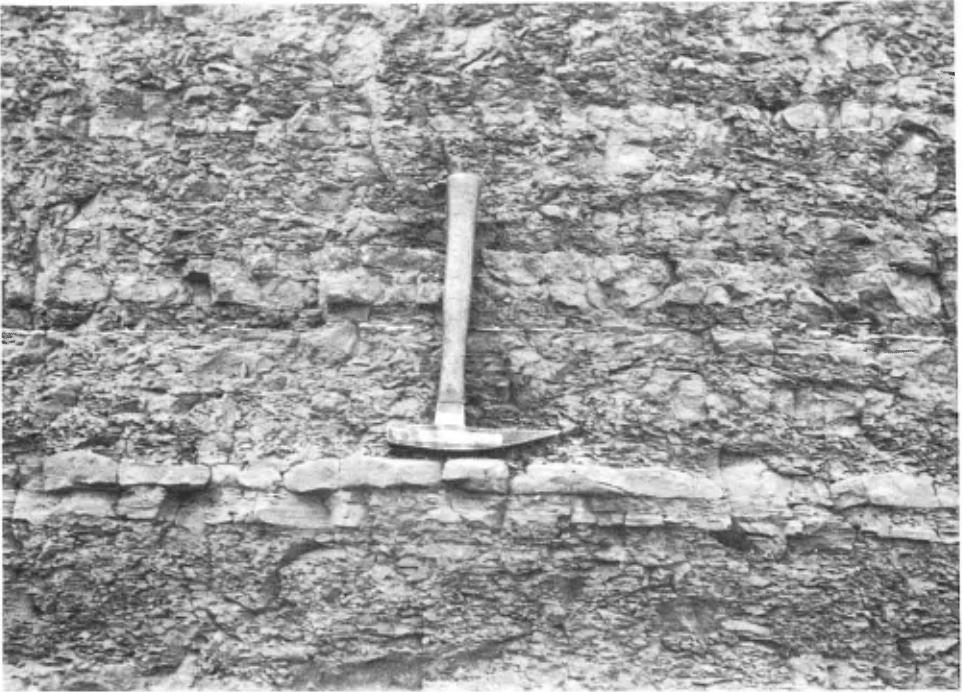


A- Upper beds of Pontgravé River formation. South bank of Nicolet river at lower end of horseshoe bend.



B- Detail of A. above.

Plate III



A- Pontgravé River formation. South bank of Pontgravé river, immediately below dam at La Visitation. Note calcite bedding vein.



B- Fault within Pontgravé River formation, 500 feet above dam at La Visitation. South bank of Pontgravé river.

Plate IV



A- Nicolet river, north bank, at beginning of horseshoe bend. St-Hilaire member shale with resistant sandstone beds.



B- Nicolet river, north bank, 1000 feet upstream from IV A. Lower part of St-Hilaire beds.



C- Nicolet river, north bank. Arrow points to anticline at base of the measured section. Folded structures upstream.

Plate V



A- Flow rolls on underside of sandstone bed in St-Hilaire beds. Talus from beds shown in Plate IV A.



B- Light grey sandstone in Bécancour River formation. South bank of St-François river, 3½ miles above Pierreville.

Plate VI



A- Drag fold in sandstone beds, Breault member of Nicolet River formation. North bank, Bécancour river. Breault.



B- Same locality as VI A. Note erosion of beds covered by hammer handle.

Plate VII



A- Residual "boulders" of pyroxenite. Hammer rests on weathered debris made up largely of one-inch pyroxene crystals. One mile northeast of bridge at Notre-Dame-du-Bon-Conseil.

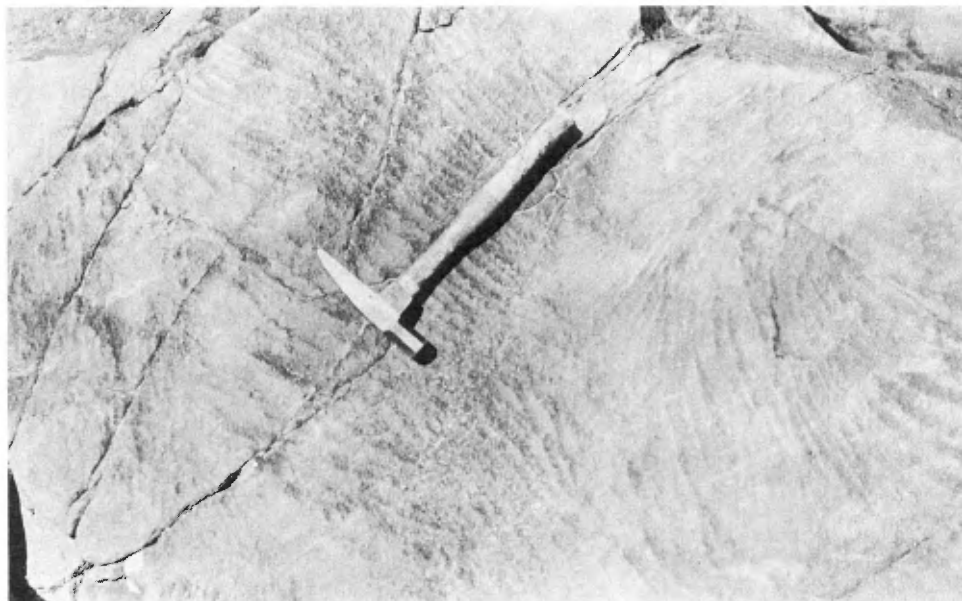


B- Several "boulders" in process of being uncovered by quarrying. Same locality as Plate VII A.

Plate VIII



A- Approximately vertical quartz sand "veins" cutting Sillery sandstone. Nicolet river, south bank, $1\frac{1}{4}$ miles above St-Léonard.

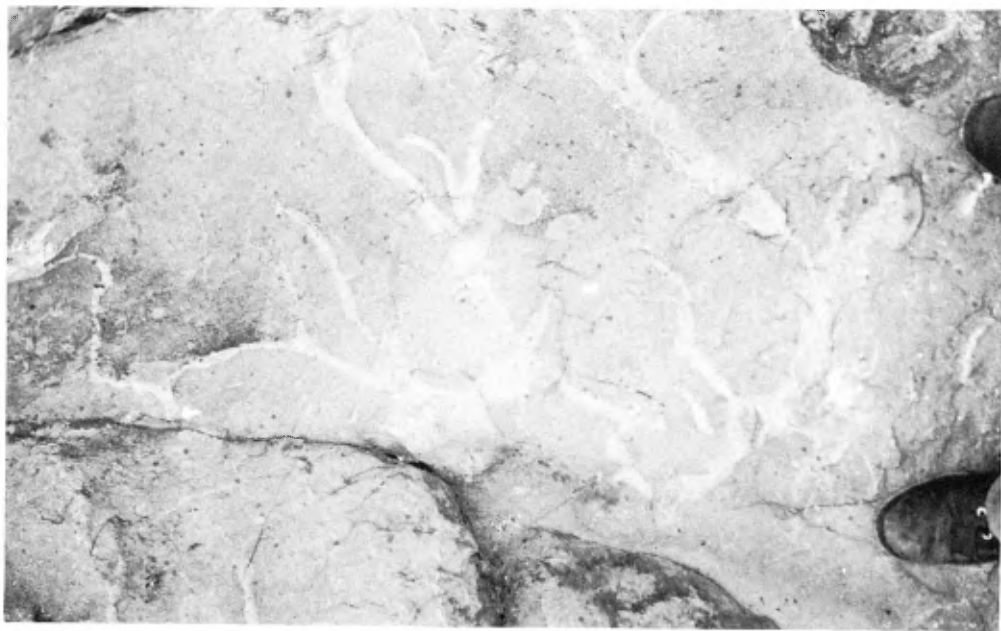


B- Detail of "veined" structure shown in VIII A. Same locality. Looking straight downwards. Each of the ridges is the "outcrop" of a more or less vertical "vein".

Plate IX



A- Irregular "veins" in Sillery sandstone. Horizontal view, showing vertical component of veins. Same locality as for Plate VIII A.



B- Vertical view of "veins" to left of hammer in Plate IX A.

Plate X



A- Fault in Sillery quartzite, Notre Dame Quarries Company quarry at Notre-Dame-du-Bon-Conseil. The steeply inclined, well-lighted body is a fault breccia. Beds dip gently to right (northwest), with sharp but local folding just beyond photograph.



B- Horizontal faulting of cleaved St-Germain rocks immediately below falls at Ste-Brigitte. North bank of Pontgravé river.

Plate XI



A- St-Germain complex. Right bank of Pontgravé river, immediately below falls at Ste-Brigitte des Saules. Looking N. 50 E.



B- Detail of Plate XI A.

Plate XII



A- "Logan's Line". Low angle thrust, with Sillery slates above and below. Hammer rests against block of St-Germain rock within Sillery formation. South bank, Bécancour river, Looking N. 110 W.



B- "Logan's Line". St-Germain complex. Note low angle thrusts diverging upward toward the right from pile of papers. Looking about S.W. south bank Bécancour river.

About one mile above Ste. Brigitte des Saults, sandstone outcrops maintain a fairly constant strike of about N. 60° E., and dip 30°-45° S.E. Immediately above the falls, the sandstone has the same strike as at the last exposure, but the dips are steeper to the east, and in places are vertical.

It is obvious that along Pontgravé river no generalization can be made with regard to the structural pattern except that the Sillery sandstones are everywhere folded, dip to the east, and are in places faulted.

Nicolet River

Along Nicolet river the story is much the same, though there is more shale and slate, which, when independent of sandstone beds, shows marked complexities. Both slates and sandstones are complicatedly deformed except between St. Léonard bridge and a point 1 1/2 miles upstream. At the latter place, wide exposures of sandstone span the river, and show a surprisingly uniform attitude, striking N. 35°-40° E., and dipping 30°-40° E. Close to St. Léonard the sandstones have much the same attitude, and are broken by small-scale faults (Figure 8a).

In general, structural complications are prevalent. Strangely enough, complications seem to diminish in intensity toward the southeast as the Champlain fault is approached, a condition also noted along Pontgravé river. This is probably due as much to a fortuitous exposure of a large amount of competent sandstone as to any relationship to the Champlain fault itself.

ECONOMIC GEOLOGY

Building Stone

The Sillery sandstone could be quarried and trimmed for building stone, though it would probably be far too expensive for any local need. The light grey Bécancour River sandstone on St. Francis river 4 miles above Pierreville is in readily separating beds 6-8 inches thick. Moreover, it is weakly jointed and breaks into roughly rectangular blocks (Plate V B). One house has been built of this rock. It is not known how much is available. Unless a large amount could be located free, or nearly so, from overburden, it will probably remain too expensive a material for building. For modest local uses, this resource is probably sufficient.

Road Material

The Sillery sandstone, locally transformed into a quartzite, has been quarried and crushed at Notre Dame du Bon Conseil for many years. Elsewhere in this area this sandstone, though not as hard or as tough as the quartzite at Notre Dame du Bon Conseil, could serve as road material or concrete aggregate. None of the sedimentary rock accompanying the Sillery sandstone is resistant enough to weathering or abrasion to make a satisfactory road or aggregate stone. The foreland rocks are everywhere too argillaceous to stand up against weathering.

Road material is for the most part obtained from post-glacial sand and gravel deposits. These occur in fair abundance in the eastern part of the area, and from here came much of the gravel used in the construction of Route 9. An apparent esker, about a mile long, stretches southwestward from Grand St. Esprit, and has been dug into, though nowhere does it appear to have good usable gravel. Where the roads cut through the "esker" at Grand St. Esprit it contains too many large blocks to make its use profitable, and in its southwestern extension it is composed chiefly of sand. Sand is widespread in some parts of this area, but over many square miles it may be only 2 or 3 feet thick. It is mostly well-washed and quartz-rich. It is not satisfactory in road construction, and its quartz content is too low to allow its use as a raw material for glass manufacture.

Oil and Natural Gas

No oil has been reported from this region, but natural gas has been found in many wells drilled for water (see Appendix C). This has led to the drilling of deep wells expressly for the purpose of finding oil or natural gas. The first of these was the Trudel Well (DeBlois, 1959, p. 158), put down in 1885 with the encouragement of J. Obalski of the Quebec Bureau of Mines. For local use the well was a success, although commercial production was not achieved. At first 8 houses were supplied with gas from this well; today only one house draws upon it, and uses the gas for cooking and heating. Other wells with depths ranging down to 4,000 feet have been drilled since, but in all cases without encouraging results. It is possible that the lack of success is but a natural result of poor emplacement of the wells with regard to geological structure. It should not be assumed that this area stands condemned because of the lack of success hitherto (see Structural Geology).

Information concerning deep wells drilled in this area is given in Appendix D.

APPENDIX A

Table of dips and strikes measured at 100-foot intervals along the north bank of Nicolet river from the anticline 3 1/2 miles south-southeast of Grand St. Esprit and going northwestward or downstream (see Figure 4). Distances in feet. Dips and strikes in degrees.

<u>Distance</u>	<u>Dip</u>	<u>Strike</u>	<u>Distance</u>	<u>Dip</u>	<u>Strike</u>
0	(Anticline)		2800	26	
0 - 75	(High dips)		2900	22	
100	36		3000	28	
200	38		3100	26	55
300	35	55	3200	23	58
400	32		3300	22	
500	32		3400	25	55
600	35		3500	30	
700	36		3600	27	
800	41		3700	28	55
900	37		3800	33	
1000	37	50	3900	31	
1100	34		4000	19	
1200	38		4100	25	
1300	25		4200	19	55
1400	30		4300	24	
1500	29		4400	25	
1600	29		4500	26	
1700	31	58	4600	18	
1800	32	53	4700	17	55
1900	32	53	4800	21	45
2000	31		4900	15	55
2100	25	55	5000		
2200	33		5050	19	
2300	33		5125	16-19	
2400	27		5175)		
2500	34		)	16	
2600	29	58	6400)		
2700	40		6500	16	

APPENDIX B

Surveying data used in constructing map of north bank of Nicolet river shown in Figure 4. Brunton and 100-foot steel tape were used.

Start of surveyed line is at anticline, Station O, of Figure 4.

<u>Direction</u>	<u>Distance in Feet</u>	<u>Total Distance in Feet</u>	
312°	725	725	
288°	250	975	
309°	325	1300	
300°	150	1450	
303°	325	1775	
323°	525	2300	
333°	500	2800	
321°	400	3200	
316°	575	3775	
290°	225	4000	
303°	500	4500	
284°	425	4925	
281°	100	5025	
263°	275	5300	
251°	250	5550	
234°	250	5800	
219°	750	6550	
225°	125	6675	
250°	25	6700	
241°	200	6900	
2°	1460	8360	Across pasture
337°	885	9245	North bank, beyond field

APPENDIX C

Water Wells Yielding Natural Gas

1. BOISCLAIR, AMADE

Côte St. François, Village of St. Zéphirin

Depth of overburden = 90' - 100' Depth in rock = ?

Gas probably struck between overburden and rock.
Continuous bubbles. Never used. Occasionally
burned at end of pipe merely as demonstration.
Elsewhere in St. Zéphirin village there are a few
wells with unimportant bubblings of gas, and with
salty water.

2. CÔTÉ, GERARD

Rang St. François, St. Zéphirin de Courval,
Yamaska County.

Depth of overburden = 80' - 90' Depth in rock = ?

Gas probably struck between overburden and rock.
Bubbles only. Used in 1 house prior to 1930.
House bought from Mr. Boisvert, who bought it from
Ovide Marcotte about 1920.

At top of pipe there is a cistern 7' x 9' by 20' deep.
Water ordinarily keeps at about 6' level above base
of cistern. Pipe goes down 60' to 70' below cistern,
diameter unknown. Cistern has a wooden cover.

The well had been plugged prior to about 1930 because of
gas. About that time Mr. Marcotte removed the cover and entered the
cistern to unplug the pipe. He was instantly asphyxiated. His son, not
seeing his father return, also entered the cistern and died. A second
son followed and died in turn. A neighbour, investigating this, descended
and died at once. The parish priest forbade any others to enter the
cistern; instead, they lowered a cat, and brought it up dead. The bodies
were recovered after some improvised gas-masks made the descent possible,
by which time, also, circulation may have cleared the gas from the cistern
to some extent.

The present owner (1944) does not know if there is any gas in the cistern or not. In a year or so he must replace the wooden cover, and will test the cistern with a cat.

3. FRECHETTE, MAURICE (July, 1943)

Rang St. Pierre, St. Zéphirin de Courval, Yamaska.

Depth of overburden = 90' Depth in rock = 2'.
Hard sandstone. Took 2 days to drill through
2 feet.

Owner denied presence of gas, but local storekeeper said that this house and others all had bubbles of gas in wells. 1/2 to 1/3 mile across the road from house a well in the fields yields gas by infrequent bubbles.

4. GAUTHIER, ARTHUR

Lot 226, Concession St. Joseph, St. Thomas de Pierreville,
Yamaska County.

Drilled about 1911. Probably not more than 2' in rock. Gas probably struck between overburden and rock. When first dug, enormous quantities of gas issued, subsiding in a few months, and finally failing. An attempt to clean out the pipe started another violent surge of gas, which soon subsided. This was repeated, and on the third failure of the gas, in 1915, nothing more was done. The well supplies the house with water. The owner at the time was Joseph Côté, St. Amable, Que. There is doubt as to the ownership of subsurface rights, and of the property itself. This information was obtained from Notaire Fréchette, La Baie, Yamaska Co.

APPENDIX D

REGISTER OF DEEP WELLS

Information concerning the following wells is given in this Appendix; the numbers of the wells listed and reported on are as given on Quebec Department of Mines Map 1288 (DeBlois, 1959):-

<u>Number</u>	<u>Name of well</u>
11	Bald Mountain No. 1 Louiseville (1)
12	Bald Mountain No. 2 Louiseville (1) (2)
51	Laduboro No. 1 La Baie Yamaska (1) (2)
51a	Laduboro No. 2 La Baie Yamaska (1) (2)
	Laduboro No. 3 La Baie Yamaska (1) (2)
	Laduboro No. 4 La Baie Yamaska (1) (2)
66	Imperial Lowlands No. 6 Nicolet (1) (2)
115	South Shore No. 1
116	South Shore No. 2
117	No. 1 Nicolet
118	Quebec Fuel No. 1
505	Forest well
511	Guillemette well
518	Collège de Nicolet well
526	Trudel well

Bald Mountain-Louiseville No. 1 well

Bald Mountain Oil Company (DeBlois, 1959, p.11)

Location

Lot: 375

Concession: De la Petite Rivière

Parish: St. Antoine de la Rivière du Loup de Louiseville

County: Maskinongé

Coords: 100' from W. LL., 100' from S. LL.

-
- (1) Under heading ACID there is given the reaction with 5% HCL
- (2) All figures in charts headed STATISTICAL SUMMARY refer to percentages of whole formation.

Ground Elevation: 24'

RF Elevation: 26'

Spudded: May 22, 1957

Completed: June 22, 1957

Driller: Logan Brothers

Type of Rig: Diamond Drill

Result: Gas Well

Reported flow: 850 Mcf./day. Closed-in pressure: 384 psi.

Water

371', 670'-700'

Gas at: 269'-279', 371', 511'-521', 785'-818', 819'

Log by T.H. Clark:

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 205
Utica	205 - 261
Trenton (Upper)	261 - 377
" (Middle)	377 - 471
L. " (Deschambault)	471 - 696
L. " (Rockland)	696 - 711
Black River	711 - 775
Chazy	775 - 795
Beekmantown (Beauharnois)....	795 - 819

Additional information given in The Mining Industry of the Province of Quebec in 1957, page 52, is as follows:- Salt water at 371 and 670-700 feet. An important gas flow occurred at 819 feet. On June 10, the closed-in pressure was 384 lbs. psi. and the flow was 850,000 cfd. The well was cemented from bottom to top.

LOUISEVILLE NO. 1

BALD MOUNTAIN OIL CO.

T.H. Clark, January, 1959

DESCRIPTION OF FORMATIONS

UTICA: Dark grey to black, finely banded shale, oily odour, brown streak, calcareous.

UPPER TRENTON: Largely limestone, dark grey, dense; interbeds of brownish grey shale, in places with oily odour.

MIDDLE TRENTON: Limestone, mostly dense, lesser amounts of fine-grained crystalline, very irregularly bedded; shaly partings and thin interbeds common.

LOWER TRENTON:

DESCHAMBAULT FORMATION: Almost all medium grey crystalline limestone, very little shale. Bryozoan mats throughout lower 92'.

ROCKLAND FORMATION: Dark grey, dense limestone, a few crystalline beds, irregular shaly partings. Probably the Ouareau formation.

BLACK RIVER: Largely dark grey dense limestone, but a little fine-grained crystalline, and some semi-lithographic. Irregular shaly partings and thin interbeds.

CHAZY: Mostly medium grey, fine-grained dolomite and dolomitic limestone; a little limestone, and a little sandstone.

BEAUHARNOIS: Dolomite, light to medium grey, very fine grained.

SUMMARY

O - 205 feet		overburden
205 - 261	"	Utica shale
261 - 711	"	Trenton limestone
711 - 775	"	Black River limestone
775 - 795	"	Chazy limestone
795 - 819	"	Beauharnois dolomite

Log of Louiseville Well No. 1

Depth in feet	Description	Diamond Drill Core	
		Streak	Acid
0 - 205	Overburden		
205 - 225	Dense dark shale. Oily odour	Brown	Good
225 - 245	Dense, dark, variegated shale. Oily odour <u>Leptobolus</u>	do.	do.
245 - 260	Dark grey, banded, slightly siliceous shale <u>Leptobolus</u> Graptolites	Brown/lt.br.do.	
260 - 261 1/4	Ditto, but paper-thin sandy bands common		
261 1/4 - 265	Dark grey shale and dark grey limestone irregularly interbedded. Contacts sharp to cloudy, horizontal to 40°. Some of the shale is brownish, with an oily odour. All shales effervesce		
265 - 285	Ditto in all respects. Percentage shales: limest. (30:70) Shale in beds of 2"-3", limestone 3"-6"		
285 - 305	285-286 as above; 286-305 as above but bedding tends to be more regular. Shale very fissile. sh. 1"-2"; ls. 2"-4" (35:65)		
305 - 325	Like 286 - 305 above sh. 1"-2"; ls. 1"-5" (30:70)		
325 - 345	As above sh. 1"-2"; ls. 1"-5" (33:67)		
345 - 365	As above. Contacts typically horizontal, but cloudy to sharp. <u>Leptobolus insignis</u> in shale sh. < 3"; ls. < 6" (25:75)		
365 - 366	As above		
366 - 377	Black shale with abundance of crinoidal fragments. Limestone in very irregular blobby masses. Contacts horizontal to 50°. A few slickensides (30:70)		
377 - 378	Limestone and shale with very irregular bedding (30:70)		
378 - 385	Dark grey limestone and dark grey shale with very irregular contacts, probably the core expression of nodular limestone in outcrop.		
385 - 405	Dark grey limestone, in part dense, in part fine to medium grained, crystalline. Shale, dark grey, in part filled with white fossil specks, and fragments of limestone Bedding very irregular		
405 - 427	As above, but grey crystalline limestone as follows: 410-410 1/2; 412'6"-412'10"		
427 - 429	Fine-grained crystalline limestone and 1/2" shale beds interbedded		
429 - 431	Like 385-405		
431 - 445	Like 427-429		
445 - 454	Dark grey limestone, dense to fine-grained crystalline. Black shale, light streak, strong effervescence. Fairly irregular bedding.		

454	- 457	MIDDLE TRENTON	Limestone and shale as above, but bedding irregular. Wispy shaly partings common, enveloping limestone making latter look like pebbles.
457	- 464 1/2		Limestone, dark grey, medium grained crystalline, with abundance of crinoidal fossils and crinoidal shale. Bedding extremely irregular and indistinct
464 1/2	- 465		Like 454-457 above
465	- 471		Limestone and shale as above. Bedding contacts range from horizontal to vertical. Shale surrounds limestone 'pebbles'. Probably 'nodular' limestone in outcrop
471	- 485	LOWER TRENTON	Limestone, medium grey, fine, medium, and coarse grained. A little light; a little dark. Bedding 1/16" to 1/8", up to 1/4". Shale 1%, apx.
485	- 505		Limestone as above. Bedding mostly shown by thin wispy shaly partings, approximately horizontal. Shale 1%, apx.
505	- 525		Limestone as above, but mostly medium and coarse grained. A few shale bands 1/4" thick. Shale 2%, apx.
525	- 545		Limestone as above. Shaly layers as above. At 539 1" of shale with white limestone ovals of coarse-grained crystalline limestone. Shale 3%, apx.
545	- 551 1/2		Limestone as above. Dark grey chert at 546.
551 1/2	- 565		Dark grey, very fine-grained limestone. Wispy shaly partings
565	- 585		As above. Bedding not well shown. Grain approaches dense. Shale here and there in 1/4" beds. Shale 3%, apx.
			<u>Dalmanella</u> , <u>Rafinesquina</u> Strap-like bryozoa
585	- 593		As above, but somewhat more shale, probably 5%
593	- 593 1/2		Light grey, medium-grained limestone
593 1/2	- 604	LOWER TRENTON	Like 585 - 593 above
604	-		Half-inch bryozoan mat in black shale
604	- 605		Light grey, coarse-grained limestone. Bryozoan mats. <u>Rafinesquina</u> , <u>Dalmanella</u>
605	- 610		Light grey, coarse-grained limestone, shaly bands up to 1/4". Bryozoan mat 1" thick at 607 1/2. Vugs present.
610	- 615		Limestone as above. Bryozoan mats and irregular shaly beds common.
615	- 620		Limestone as above, and bryozoan mats, 50:50
620	- 623		Limestone, light grey, coarse grained, with shaly bryozoan mats.
623	- 625		Limestone, light grey, medium and coarse grained. Faint shale interbeds. Faint oily odour.

625	- 645	T R E N T O N	Alternations of light grey, medium- to coarse-grained limestone and dense limestone with shaly interbeds. Bryozoan mats scarce. A few open vugs present. One or two breccia zones. Oily odour.
645	- 651 1/2		Alternations of same two types of rock. Bedding obscure
651 1/2	- 651 1/4		Almost wholly shale, irregular bedding.
651 1/4	- 664 1/2		Alternations as in 625-645
664 1/2	- 665	L O W E R	Medium grey medium-grained limestone with 30% black chert
665	- 685		Alternations of "impure" crystalline limestone with dark grey dense limestone. Shaly partings and interbeds throughout. Bryozoan mats common, but nowhere thick.
685	- 687		Light grey, coarse- to medium-grained limestone
687	- 696		Alternations as in 665-685
696	- 705	L. TRENTON ROCKLAND	Poorly bedded dark grey dense limestone, in part very finely crystalline.
705	- 711		Ditto, with very fine irregular shaly partings. Crystalline beds up to 2".
711	- 714		Dark dense to fine-grained crystalline limestone with lmm. thick wavy shaly partings.
714	- 723		Coarse-grained, dark grey, crystalline limestone, with network of shaly partings in lower 3 feet.
723	- 726 1/4	R I V E R	Dense, semi-lithographic medium dark grey limestone, with irregular shaly partings.
726 1/4	- 730		Ditto, shaly partings rare. Smooth ostracods common
730	- 735		Dark grey, semi-lithographic limestone with irregular shaly partings, and shale interbeds up to 6" thick
735	- 737		Dense, medium grey, semi-lithographic limestone
737	- 738 1/2	B L A C K	Like 730-735
738 1/2	- 740		Like 735-737, but with <u>Phytopsis</u> -like tubes
740	- 743		Limestone and shale as above, very irregularly intermixed
743	- 746 1/2		Dark grey, fine-grained limestone and dark grey shaly interbeds up to 1".
746 1/2	- 748		Like 740-743
748	- 750 1/4		Dark grey, dense to fine-grained limestone
750 1/4	- 755		Dark grey, dense limestone with network of black shaly seams.

755	- 771 1/2	BLACK RIVER	Dark grey, dense limestone with dark shaly seams and interbeds, very irregular, 'blobby' bedding. Lower 6 feet pseudo-conglomeratic.
			Dark dense limestone in beds up to 2", and shaly interbeds up to 1". Very irregularly bedded.
771 1/2	- 774 1/2	CHAZY	Dark grey sandy limestone
774 1/2	- 775		Dark grey limestone, with abundance of small white fossil spots, ?bryozoa.
775	- 779 1/2	CHAZY	Dark friable sandstone, with abundant white specks, as above
779 1/2	- 780		Medium grey, fine-grained dolomite and dolomitic limestone. No fossils visible. Very fine-scale bedding
780	- 782		Ditto, but poorly bedded
782	- 783		Ditto, well and evenly bedded, with shaly partings
783	- 784		Ditto, very little bedding apparent
784	- 789 1/2		Dark grey shale
789 1/2	- 790		Like 780-782, bedding fair
790	- 791		Ditto, with open network of small dark streaks
791	- 793		Ditto, but light and light medium grey. Well bedded
793	- 795		Core missing
795	- 799	BEAUFORT	Dolomite, light grey, very fine grained, very irregularly bedded, irregular shaly bands in lower part
799	- 802		Dolomite, light and medium grey interbedded, fine grained, fairly well bedded
802	- 805		Dolomite, light and medium light grey, fine grained, Poorly bedded. 1" shale at base.
805	- 807 1/2		Ditto, well bedded, Dip 15° at top; horizontal at base
807 1/2	- 810		Dolomite, medium grey, fine grained, massive, with irregular flaky markings.
810	- 815		Dolomite, medium grey, very fine grained, partings and bedding present but obscure. Dark shale at base.
815	- 817 1/2		Dolomite, medium dark grey masses in medium grey matrix. ?Pseudobreccia.
817 1/2	- 818 1/4		No core
818 1/4	- 819		
819			Bottom of Hole.

Bald Mountain-Louiseville No. 2 well

Bald Mountain Oil Company

(DeBlois, 1959, p. 12)

Location

Lot: 375

Concession: De la Petite Rivière

Parish: St-Antoine de la Rivière du Loup de Louiseville

County: Maskinongé

Coords: 100' from E. LL., 150' from S. LL.

Ground Elevation: 25'

RF Elevation: 27'

Spudded: Sept. 30, 1957

Completed: May 23, 1958

Drillers: Company's rig to 1115', A. Dubé's rig to 1218'

Type of Rig: Cable

Result: Dry hole

Water

Salty at: 250', 705', 975', 993'-995', 1000'-1006', 1015'-1020'

Gas at: 202'-203', 705', 814', 832'-834', 975', 992'

Log by T.H. Clark:

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 205
Utica	205 - 261
Upper Trenton	261 - 385
Middle Trenton	385 - 495
Lower Trenton	495 - 680
Black River	680 - 758
Chazy	758 - 800
Beekmantown (Beauharnois)	800 - 975
Beekmantown (March)	975 - 1075
Potsdam	1075 - 1218

Additional information given in The Mining Industry of the Province of Quebec in 1957, page 52, is as follows: - All water zones were isolated by means of strings of casing. Small gas pockets were encountered between 202 and 203 and at 705, 814, 832 to 834, 975, and 992 feet. This well was suspended at a depth of 1,115 feet. It is kept under control by a master gate valve. Drilling operations will be resumed in 1958.

The Mining Industry for the Province of Quebec for 1958, p. 38, adds that this well was deepened by cable tool from 1,115 to 1,218 feet, and that the well was plugged with crushed stone and cement.

LOUISEVILLE NO. 2

BALD MOUNTAIN OIL CO.

T.H. Clark, December, 1958

Summary

0	-	205 feet		Overburden
205	-	261	"	 Utica shale
261	-	680	"	 Trenton limestone
680	-	758	"	 Black River limestone
758	-	800	"	 Chazy limestone
800	-	975	"	 Beauharnois dolomite
975	-	1075	"	 March dolomite and sandstone
1075	-	1218	"	 Potsdam sandstone

DESCRIPTION OF FORMATIONS

UTICA: Black shale, medium brown streak, calcareous

UPPER TRENTON: Dominantly medium to dark grey limestone, very fine-grained; dark shale 10%

MIDDLE TRENTON: Dark grey shaly, dense to medium-grained crystalline limestone; dark shale 8%

LOWER TRENTON: Light grey limestone, crystalline; chert; shale 2%

BLACK RIVER: Mostly dark dense limestone, a little cryst. ls; shale 4%

CHAZY: Limestone, shale, sandstone, and dolomite; shale 6%

BEAUHARNOIS: Almost wholly dolomite, grey to buff grey, very fine-grained. A little limestone at top, and less shale.

MARCH: Alternating quartz sandstone and fine-grained dolomite.

POTSDAM: Fine-grained quartz sandstone.

LOUISEVILLE NO. 2

STATISTICAL SUMMARY

	Sandstone	Siltstone	Shale	Limestone	Dolomite
UTICA	-	2	98	-	-
UPPER TRENTON	-	-	14	86	-
MIDDLE TRENTON	-	-	9	91	-
LOWER TRENTON	-	-	2	98	-
BLACK RIVER	-	-	4	96	-
CHAZY	14	-	6	20	60
BEAUHARNOIS	-	present	present	present	100
MARCH	86	-	-	-	14
POTSDAM	100	-	-	-	-

<u>Depth in feet</u>		<u>Description</u>	<u>Cable Rig Cuttings</u>	
0 - 205		Overburden		
205 - 210	UTICA	Black shale Pyrite	<u>Streak</u> Medium brown	<u>Acid</u> weak
210 - 215		Black shale Pyrite	do.	do.
215 - 222		Black shale	do.	Fair
222 - 229		Black shale	do.	do.
229 - 234		Black shale 95%:Siltstone 5%	do.	do.
234 - 240		Black shale 90%:Siltstone 10%	do.	do.
240 - 246		Black shale	do.	do.
246 - 251		Black shale Pyrite	do.	Fairly good
251 - 256		Black shale Slickensides	do.	do.
256 - 262		Black shale 95% Dense, medium-grained limestone 5% Pyrite	do.	do.
	UPPER TRENTON	Black to dark grey shale		
		1 Limestone, dark grey, shaly		
		1 Limestone, medium to dark grey, very fine grained		
262 - 266		30% -- 70%		
266 - 271		5 -- 95		
271 - 278		10 -- 90		
278 - 282		15 20 65		
282 - 290		5 5 90		
290 - 299		5 5 90		

			Shale, black to dark grey			
			Limestone, dark grey, shaly			
			Limestone med. to dark grey, dense to very fine grained			
299 - 303	TRENTON		5%	5%	90%	
303 - 308	TRENTON		5	5	90	
308 - 314	TRENTON		5	5	90	
314 - 321	TRENTON		5	5	90	A few pieces of brown fissile shaly metabentonite
321 - 325	TRENTON		5	5	90	
325 - 332	TRENTON		10	5	85	
332 - 337	TRENTON		15	10	75	Poor graptolites present
337 - 343	TRENTON		10	5	85	A few pieces medium-grained cryst. ls.
343 - 350	TRENTON		10	5	85	
350 - 355	TRENTON		10	5	85	do.
355 - 361	TRENTON		10	10	80	
361 - 368	TRENTON		10	5	85	slickensides
368 - 375	TRENTON		5	20	45	30% fine- to medium-grained ls. crystalline crinoids, ostracods
375 - 385	TRENTON		15	35	25	25 crinoids, ostracods, <u>Ceraurus</u>
385 - 391	TRENTON		15	45	15	25 <u>Conotreta</u> : ostracods, crinoids
391 - 398	TRENTON		10	50	10	30 <u>Ceraurus</u> ; ostracods
398 - 407	TRENTON		10	55	15	20 Crinoids
			Shale, black to dark grey			
			Limestone, dark grey, shaly			
			Ls., dense to very fine grained, dark grey			
			Ls., fine to medium grained, dark grey to medium grey			
407 - 413	TRENTON		20%	40%	10%	30%
413 - 420	TRENTON		10	30	30	30
420 - 427	TRENTON		10	20	20	50
427 - 434	TRENTON		5	20	45	30
434 - 442	TRENTON		10	15	50	25
442 - 451	TRENTON		10	15	50	25
451 - 459	TRENTON		5	15	15	65
459 - 467	TRENTON		5	35	20	40
467 - 475	TRENTON		5	10	30	55 <u>Sowerbyella sericea</u>
475 - 482	TRENTON		5	-	65	30
482 - 490	TRENTON		5	-	70	25
490 - 495	TRENTON	pr	-	-	10	90x xlight grey
495 - 502	TRENTON	-	-	-	5	95x xlight grey
502 - 508	TRENTON	-	-	-	-	100x xlight grey
508 - 515	TRENTON	-	-	-	-	100x xlight grey. Light brown chert
515 - 522	TRENTON	pr	-	-	10	90x xlight to med. grey. Do.
522 - 529	TRENTON	pr	-	-	15	85x xdo. do.
529 - 534	TRENTON	pr	-	-	5	95x xdo. do.
534 - 545	TRENTON	pr	-	-	10	90x xdo. do.

				Shale, black to dark grey
				Limestone, dense to very fine grained, med. to dark grey
				Ls., light grey, fine to medium grained
545 - 551	pr	20%	80%	Buff-grey chert abundant
551 - 560	pr	15	85	do. present
560 - 567	5	15	80	do. rare
567 - 574	5	15	80	
574 - 583	5	20	75	do. common
583 - 594	pr	10	90	do. present
594 - 605	5	25	70	<u>Prasopora</u>
605 - 615	5	20	75	<u>Prasopora</u>
615 - 626	pr	10	90	<u>Prasopora</u>
626 - 634	pr	10	90	
634 - 643	pr	10	90	Dark grey chert
643 - 650	pr	10	90	do.
650 - 659	pr	50	50	Dark grey and black chert
659 - 668	5	30	65	
668 - 674	10	60	30	Brown chert
674 - 683	5	75	20	Grey chert
683 - 696	5	55	30	10% shaly limestone, dark grey
696 - 705	5x	30	10	5 do. x brown flaky shale, with fragments of plicated brachiopods
705 - 715	-	10x	90	x light grey
				Shale, dark grey
				Limestone, dense to very fine grained, medium to dark grey.
				Ls. medium to dark grey, fine grained
715 - 723	Prx	80%	20%	x brown flaky shale
723 - 731	5	70	25	A little dense brown limestone
731 - 740	5	75x	20	x sandy limestone
740 - 748	5	90	5	
748 - 758	10	20	70	
758 - 766	20	-	80	Sandy limestone. <u>Camarotoechia plena</u>
766 - 776	10	10	10	30% light grey calcareous sandstone 40% dark grey calcareous sandstone All grains about .2mm. maximum in dark grey rock 2mm.
776 - 785				Dolomite, light to light-medium grey, very fine grained, 100%
785 - 792				Ditto
792 - 800				Ditto, dark grey only. Pyrite
800 - 810				Dolomite, medium grey, fine grained 50%: light grey, dense Shale 5% 25%: medium grey dense, 10%: dark grey, fine grained 10%: Pyrite
810 - 814				Dolomite, light grey, very fine grained 50%: medium grey very fine grained 50%: Pyrite
814 - 815				Dolomite, probably as above, but poor sample. 5% brown dense limestone
815 - 815.6				Dolomite, probably as above. Poor sample

815.6 - 816		Dolomite, light grey, very fine grained 50%; medium grey, very fine grained 50%. Poor sample. A few pieces buff crystalline limestone. Sand abundant in fine fragments
816 - 819		Dolomite as above, sand abundant in fine fragments
819 - 820		Dolomite, mostly blue grey, very fine grained. A little buff crystalline limestone. Sand grains present.
820 - 822		Dolomite do.; limestone do.; sand do.
822 - 827		Dolomite as above, 20%; light and dark grey buff dol. 80%
827 - 832		Dolomite as above, 5%: light grey, very fine grained 60%; medium grey-buff. v.f. g. 35%
832 - 834		Dolomite as above 85%; lt. grey, v.f. gr. 10% med. grey, fine grained 5%
834 - 840		Very light grey, very fine grained to fine grained dolomite 100%
840 - 848		Ditto
848 - 858		Ditto
858 - 863		Dolomite, grain as above, light 50%; dark 50%
863 - 868		Dolomite. do. 5 95
868 - 877		Dolomite. do. 30 70
877 - 887		Dolomite. do. 40 60
887 - 895		Dolomite. do. 80 20 A few quartz grains present
895 - 902		Dolomite. do. 60 40 do.
902 - 912		Dolomite very light grey, a) very fine grained to b) fine grained 100% a) 90% b) 10% A few quartz grains present
912 - 921		Dolomite, do. 90 10 do.
921 - 930		Dolomite, do. 95 5 do. Some dol. almost white
930 - 939		Dolomite, do. 10 90* do. * medium light
939 - 946		Dolomite, do. 20 80* do. * do.
		Dolomite, very fine grained to fine grained, a) light (a) (b) b) dark grey
946 - 956		5/95%
956 - 963		50/50
963 - 970		95/5
970 - 975		80/20
975 - 977		70/10 20% Sandstone, white, fine grained, average grain .2mm.
977 - 982		20/10 70
982 - 985		100
985 - 987		100
987 - 991		100 grains up to .3mm.
991 - 995		100 do.
995 - 998		100 do.
998 - 1006		100 do.
1006 - 1010		100 grains range from .2 to .5mm.

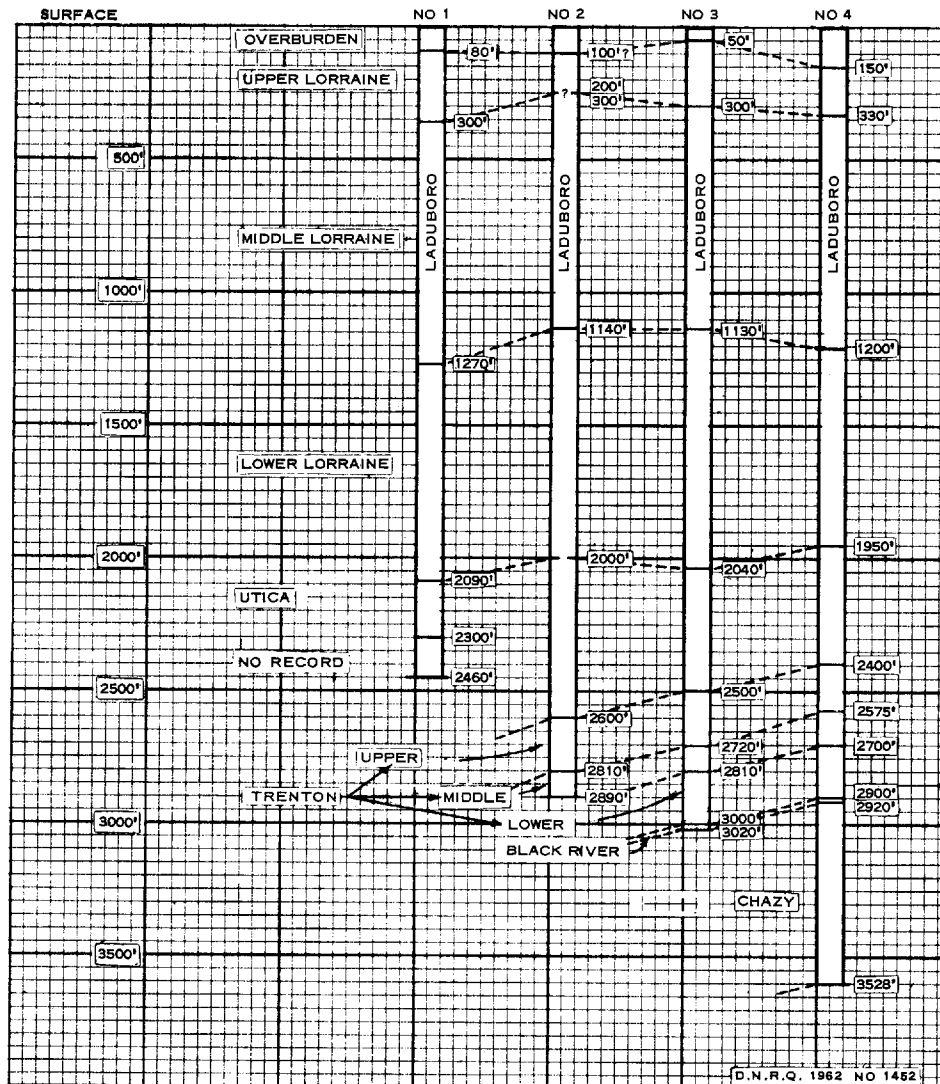
BEAUFORT

MARCH

			Sandstone, white, fine grained, average grain .2mm.
1010 - 1013			100% grains range from .2 to .5mm.
1013 - 1015			100 do. a little grey ss.
1015 - 1020			100 do. All grains rounded and frosted
1020 - 1023			100 do. do.
1023 - 1026			100 do. do. Black shale abundant. A little brown ls.
1026 - 1030			100 grains range from .2 to .3mm. rounded, frosted
1030 - 1035			100 grains average .4mm., rounded, frosted
			Sandstone, white, fine grained
1035 - 1038			100% grains average .4mm.
1038 - 1047			100 do. Black shale present
1047 - 1051			100 do. do.
1051 - 1056			100 do. do.
1056 - 1059			100 do. do.
1059 - 1063			80 (white 20%; medium grey 60%) Dolomite 20%
1063 - 1067			80 do 20
1067 - 1071			- 100, light and medium grey
1071 - 1075			- 100 do.
1075 - 1079			100 grains .2 to .3 mm.
1079 - 1084			100 .1 to .5 mm., a few grains feldspar
1084 - 1087			100 do. do.
1087 - 1091			100 .1 to .3mm. do.
1091 - 1096			100 do. do.
1096 - 1100			100 do. do.
1100 - 1104			100 .1 to .4mm., a few grains feldspar
1104 - 1108			100 do. do.
1108 - 1111			100 do. do.
1111 - 1115			100 do. do. A little grey sandstone
1115 - 1120			100 .1 to .2mm. One grain amethyst, one dark mica
			Sandstone, white, very fine grained
1120 - 1125			100% grains from .1 to .2mm., several black grains
1125 - 1130			100 do. grey matrix
1130 - 1135			100 do. do.
1135 - 1140			100 do. do.
1140 - 1145			100 do. do.
1145 - 1150			100 do. do.
1150 - 1155			100 do. do.
1155 - 1160			100 grains from .2 to .4mm., all rounded, frosted
1160 - 1165			100 grains from .2 to .3mm., all rounded, frosted
1165 - 1218			95 do. do. 5% black shale
1218			Bottom of hole

FIGURE 11
CORRELATION CHART
LADUBORO OIL LIMITED

HOLES NOS 1, 2, 3, 4, LABAIE - YAMASKA



Laduboro No. 1 La Baie-Yamaska
Laduboro Oil Limited
(DeBlois, 1959, p.57)

Location:

Lot: 349
Range: I
Parish: Baie-du-Febvre
County: Yamaska
Coords: 50' from E. LL., 700' from S. LL.

Ground Elevation: 17'

RF Elevation: 22'

Spudded: Jan. 7, 1958

Completed: July 21, 1958

Driller: Heath and Sherwood

Type of Rig: Diamond Drill

Result: Dry hole

Gas at: 80', 2339', 2370'--- (Small shows)

Log by T.H. Clark (1)

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 80
Lower Lorraine	80 - 1130
Utica	1130 - 2300
No record	2300 - 2460

This hole was plugged with cement (Mining Industry for 1958, page 41).

T.H. Clark, December, 1959

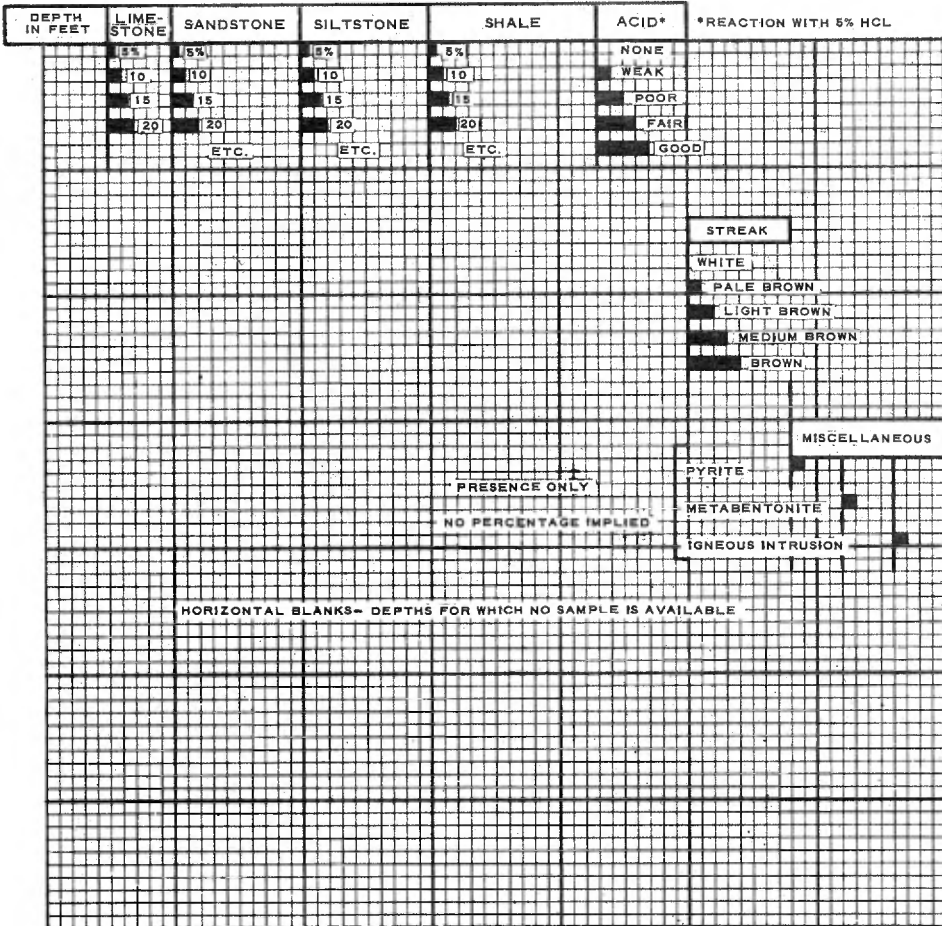
LADUBORO NO. 1

STATISTICAL SUMMARY

	SANDSTONE	SILTSTONE	SHALE	LIMESTONE	DOLOMITE
Upper Lorraine 80 - 360	3.1	5.6	75.2	16.1	-
Middle Lorraine 360 - 1100	25.3	16.9	57.8	--	-
Lower Lorraine 1100 - 1700	.6	7.7	91.7	-	-
Utica 1700 - 2300	.5	3.6	95.9	-	-

(1) See Clark's revised log, given in following pages.

FIGURE 12
LEGEND FOR DIAGRAMMATIC LOGS GIVEN BELOW



LADUBORO NO.1

DIAGRAMMATIC LOG

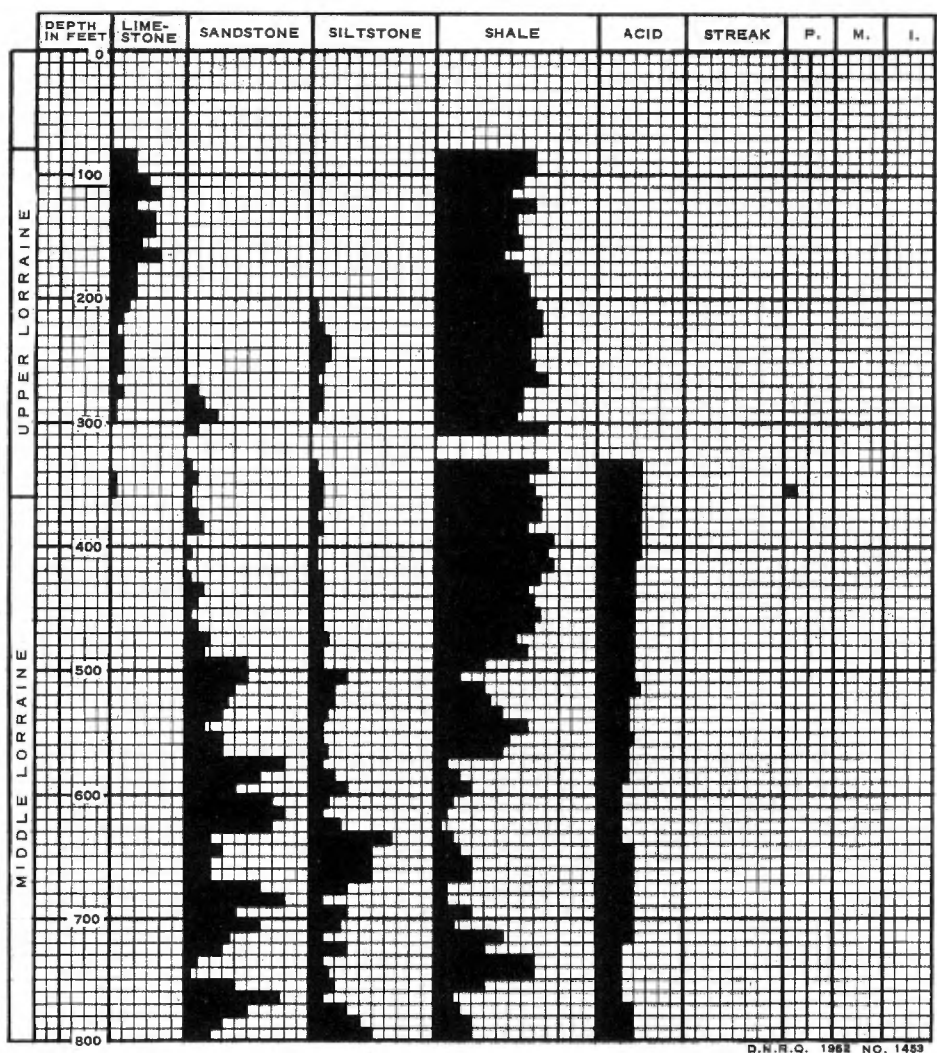
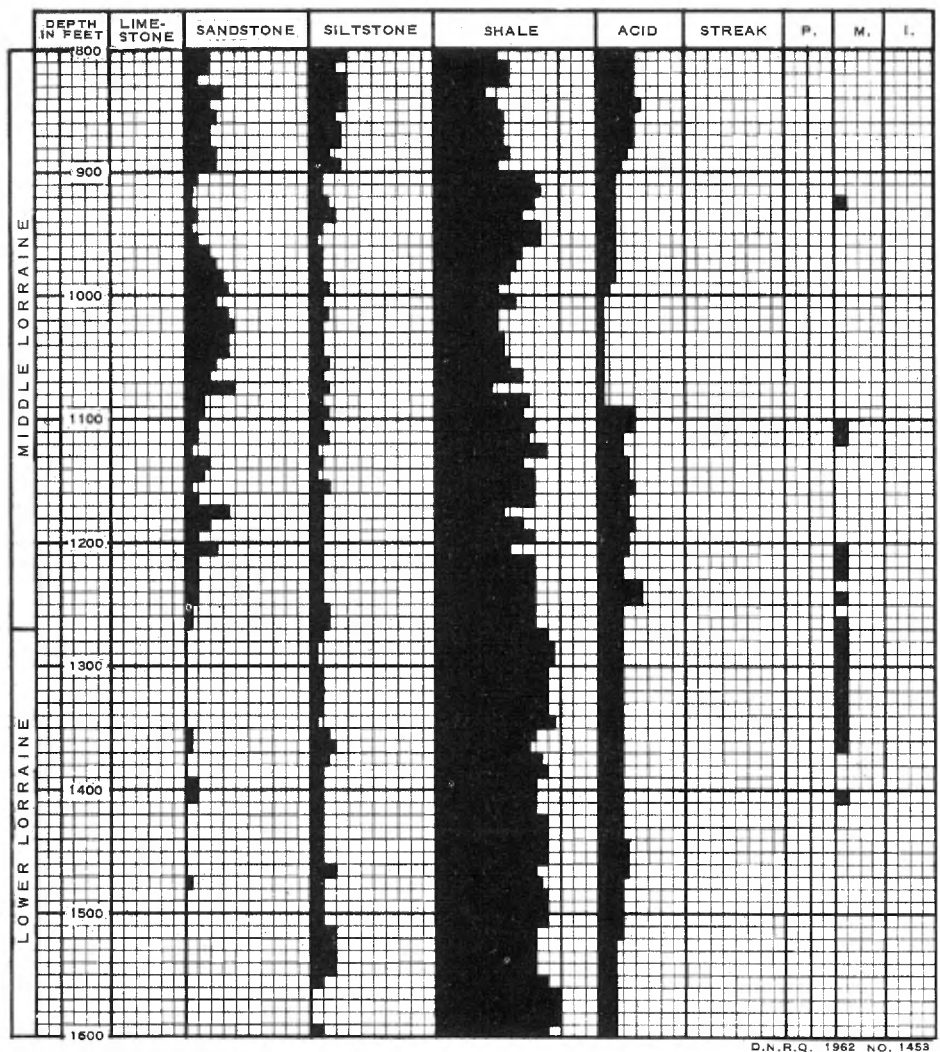


FIGURE 12

D.N.R.Q. 1962 NO. 1453

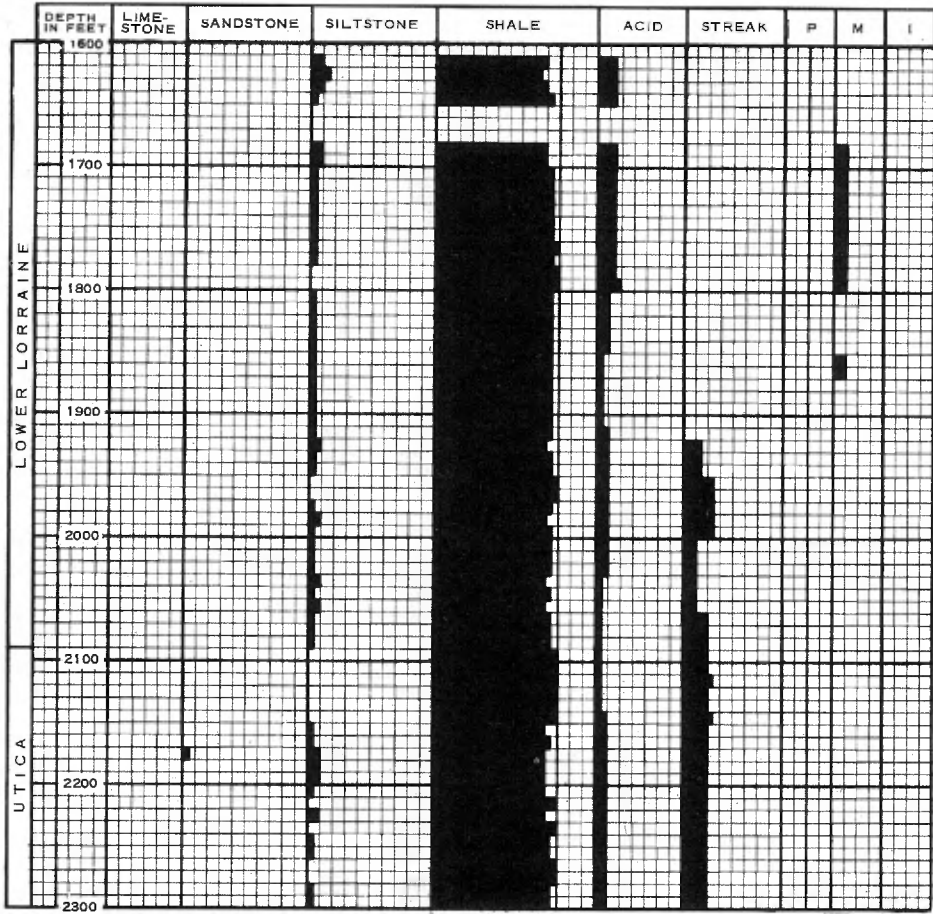
LADUBORO NO. 1

DIAGRAMMATIC LOG



LADUBORO NO. 1

DIAGRAMMATIC LOG



LADUBORO NO. 1 LA BAIE - YAMASKA

Depth in feet		Description	<u>Diamond Drill Cuttings</u>	
0 - 10	OVERBURDEN	Clay		
10 - 20		Clay		
20 - 30		Clay, with fragments of shells		
30 - 40		Clay, with fragments of shells "Sphaerium"		
40 - 50		Clay, with fragments of shells		
50 - 60		Sand, quartz rich, fine grained		
60 - 70		Sand, quartz rich, fine grained		
70 - 80		Sand, quartz rich, fine grained, with a little clay		
	LORRAINE	Sandstone, light grey, fine to very fine grained		
		Siltstone, light to medium grey		
		Shale, medium grey		
		Limestone, grey to grey-buff, dense		
80 - 90		- - 80% 20%	With diminishing amounts of sand	
90 - 100		- - 80 20	do.	
100 - 110		- - 70 30	do.	
110 - 120		- - 60 40	do.	
120 - 130		- - 80 20	do.	
130 - 140		- - 65 35	Practically no sand. Smooth ostracods	
140 - 150		- - 65 35	<u>Prasopora</u> -type bryozoa	
150 - 160		pr 5% 70 25	Fragments of brachiopods	
160 - 170		- 5 55 40	Fragments of brachiopods. Smooth ostracods	
170 - 180		pr 10 70 20		
180 - 190		pr 5 75 20		
190 - 200		pr 5 75 20		
	UPPER	Sandstone, light grey, fine to very fine grained, calcareous		
		Siltstone, medium grey		
		Shale, medium grey		
		Limestone, grey to grey-buff, dense		
200 - 210		pr 5% 80% 15%		
210 - 220		pr 5 85 10		
220 - 230		pr 10 85 5	Fragments of brachiopods	
230 - 240		pr 15 75 10	Fragments of brachiopods	
240 - 250		pr 15 75 10	Fragments of brachiopods	
250 - 260		pr 10 80 10	Fragments of brachiopods. Smooth ostracods	
260 - 270		pr 5 90 5		
270 - 280		10% 10 70 10		
280 - 290		15 10 70 5		

—

			Sandstone, light grey, fine to very fine grained	
			Siltstone, medium grey	
			Shale, medium grey	Acid
690 - 700		40% 30% 30%		Fair
700 - 710		60 25 15		do.
710 - 720		35 10 55		do.
720 - 730		30 30 40		Poor
730 - 740		10 10 80		do.
740 - 750		5 15 80		do.
750 - 760		40 20 40		do.
760 - 770		75 10 15		Poor
770 - 780		50 30 20		Fair
780 - 790		30 40 30		do.
790 - 800		20 50 30		do.
800 - 810		20 30 50		do.
810 - 820		20 20 60		do.
820 - 830		10 30 60		do.
830 - 840		30 30 40		do.
840 - 850		20 30 50		Fair to good
850 - 860		25 20 55		Fair
860 - 870		20 25 55		do.
870 - 880		20 25 55		do.
880 - 890		25 15 60		Fair to poor
890 - 900		25 25 50		Poor
900 - 910		10 10 80		Very poor
910 - 920		5 10 85		do.
920 - 930		5 15 80	One piece metabentonite	do.
930 - 940		10 20 70		do.
940 - 950		5 10 85		Very poor
			All grains a little darker below this	
950 - 960		10% 5% 85%		do.
960 - 970		20 10 70		do.
970 - 980		25 10 65	Shale is dark and splintery	do.
980 - 990		30 10 60	do.	do.
990 - 1000		35 15 50	do.	Weak
			Sandstone, light to light medium grey, fine to very fine grained	
			Siltstone, medium grey	
			Shale, medium to medium dark grey	Acid
1000 - 1010		25% 10% 65%	Shale is dark and splintery	Weak
1010 - 1020		35 15 50	do.	Very weak
1020 - 1030		40 10 50	do.	do.
1030 - 1040		35 10 55		do.
1040 - 1050		35 10 55		do.
1050 - 1060		25 15 60		do.
1060 - 1070		20 10 70		do.
1070 - 1080		40 15 45		do.
1080 - 1090		15 10 75	Shale is dark grey	do.

				Sandstone, light to light medium grey, fine to very fine grained	
				Siltstone, medium grey	
				Shale, medium to medium dark grey	<u>Acid</u>
1090 - 1100	15%	15%	70%	Shale is dark grey	Fair
1100 - 1110	10	10	80	do. Several pieces metabentonite	do.
1110 - 1120	10	15	75	do. Metabentonite pr.	Poor
1120 - 1130	5	5	90	do. do.	do.
1130 - 1140	20	10	70	do. do.	Fair/poor
1140 - 1150	15	5	80	do. do.	do.
1150 - 1160	5	15	80	do.	Fair
1160 - 1170	10	10	80	do.	Fair/poor
1170 - 1180	35	10	55	do.	do.
1180 - 1190	20	10	70	do.	Fair
1190 - 1200	10	10	80	do.	Fair/poor
				Shale, medium dark grey to dark grey	
1200 - 1210	35	5	60%		do.
1210 - 1220	10	10	80	Metabentonite pr.	Poor
1220 - 1230	10	10	80	do. Sample ground very fine	do.
1230 - 1240	10	10	80	do.	Fair/good
1240 - 1250	10	10	80	do. do.	do.
1250 - 1260	5	15	80	Poor sample	Poor
1260 - 1270	5	15	80	do. do.	do.
1270 - 1280	pr	10	90	do. do.	do.
				Sandstone, light to light medium grey, fine to very fine grained	
				Siltstone, medium grey	
				Shale, medium dark grey to dark grey	<u>Acid</u>
1280 - 1290	pr	5%	95%	Metabentonite pr	Poor
1290 - 1300	pr	5	95	do.	do.
1300 - 1310	pr	10	90	do.	do.
1310 - 1320	pr	10	90	do.	do.
1320 - 1330	pr	10	90	do. Poor sample	do.
1330 - 1340	-	10	90	do.	do.
1340 - 1350	-	5	95	do.	do.
1350 - 1360	5	15	80	do.	do.
1360 - 1370	5	20	75	do.	do.
1370 - 1380	-	15	85	pr	do.
1380 - 1390	-	10	90	pr	do.
1390 - 1400	10	10	80	-	do.
				Sandstone, light to light medium grey, fine to very fine grained	
				Siltstone, medium grey	
				Shale, dark grey	<u>Acid</u>
1400 - 1410	10%	10%	80%	Metabentonite pr	Poor
1410 - 1420				Poor sample, probably as above	do.
1420 - 1430	pr	10%	90%	do.	do.

				Sandstone, light to light medium grey, fine to very fine grained	
				Siltstone, medium grey	
				Shale, dark grey	Acid
1430 - 1440				Poor sample, probably as above	Poor
1440 - 1450				Poor sample, probably as above	Fair/poor
1450 - 1460				Poor sample, probably as above	do.
1460 - 1470	pr	20%	30%	do. Poor sample	do.
1470 - 1480	5%	10	85	do.	Poor
1480 - 1490	pr	10	90	do.	do.
1490 - 1500	pr	10	90	do.	do.
1500 - 1510	-	10	90	do.	do.
1510 - 1520	-	20	80	do. Poor sample	do.
1520 - 1530	-	20	80	do.	Very poor
1530 - 1540				Poor sample, probably as above	do.
1540 - 1550	-	20	30	Poor sample	do.
1550 - 1560	-	10	90		do.
1560 - 1570	-	pr	100	silty	do.
1570 - 1580	-	pr	100	do.	do.
1580 - 1590	-	pr	100	do.	do.
1590 - 1600	-	10	90	do.	do.
1600 - 1610				No sample retained	
1610 - 1620	-	10	90		Very poor
1620 - 1630	pr	15	85	Sandstone pr.	do.
1630 - 1640	-	10	90		do.
1640 - 1650	-	5	95		do.
1650 - 1660				No sample received	
1660 - 1670				No sample received	
1670 - 1680				No sample received	
1680 - 1690	-	10	90	Shale medium grey Metabentonite	do.
1690 - 1700	-	10	90	do.	do.
1700 - 1710	-	5	95	do.	do.
1710 - 1720	-	5	95	do.	do.
1720 - 1730	-	5	95	do.	do.
1730 - 1740				Poor sample, 5% Metabentonite probably as above	
1740 - 1750				do. 5% "	
1750 - 1760				do. Metabentonite	do.
1760 - 1770	-	-	100	"	do.
1770 - 1780	-	5	95	pr	Very poor
1780 - 1790	-	-	100	Shale medium grey pr	Poor
1790 - 1800	-	-	100	do. pr	do.
				Shale, medium to medium dark grey	
1800 - 1810	-	-	100	Poor sample	Poor
1810 - 1820	-	5	95	do.	do.
1820 - 1830	-	5	95	do. Determination approximate	do.

				Siltstone, medium grey		
				Shale, dark grey	<u>Acid</u>	
1830 - 1840		5%	95%	do. do.		do.
1840 - 1850		5	95			do.
1850 - 1860		5	95	Metabentonite pr		do.
1860 - 1870		5	95	do.	Very	poor
1870 - 1880		5	95	Poor sample, determinations approximate		do.
1880 - 1890		5	95	do. do.		do.
1890 - 1900		5	95	do. do.		do.
1900 - 1910		5	95	do. do.		do.
1910 - 1920		5	95	do. do.		do.
1920 - 1930		10	90	Poor graptolites	<u>Streak</u> Faint/light	Poor
				Sandstone, light grey to light medium grey, fine to very fine grained		
				Siltstone, medium grey		
				Shale, medium to medium dark grey		
					<u>Streak</u>	<u>Acid</u>
1930 - 1940		-	5%	95% Poor graptolites	Faint/light	Poor
1940 - 1950		-	5	95	do.	do.
1950 - 1960		-	-	100	Light/Lt.Med.	do.
1960 - 1970		-	-	100	do.	do.
1970 - 1980		-	5	95	do.	do.
1980 - 1990	pr	10	90		do.	do.
1990 - 2000	pr	5	95		do.	do.
				Sandstone, light to medium grey, fine to very fine grained		
				Siltstone, medium grey		
				Shale, medium dark to dark grey, mostly flaky breaking		
					<u>Streak</u>	<u>Acid</u>
2000 - 2010	pr	5%	95%	Poor graptolites	Pale	Poor
2010 - 2020	pr	5	95	do.	do.	do.
2020 - 2030	-	5	95	do.	do.	do.
2030 - 2040	pr	10	90		do.	Very poor
2040 - 2050	-	5	95		do.	do.
2050 - 2060	pr	10	90		do.	do.

	LOWER LORRAINE				Streak	Acid
	pr	%				
				Sandstone, light to medium grey, fine to very fine grained		
				Siltstone, medium grey		
				Shale, medium dark to dark grey mostly flaky breaking		
2060 - 2070	pr	5%	95%		Light	Very poor
2070 - 2080	pr	5	95		do.	do.
2080 - 2090	pr	5	95		do.	do.
2090 - 2100	-	pr	100		do.	do.
2100 - 2110	pr	pr	100		do.	do.
2110 - 2120	-	-	100		Light/Lt.med.	do.
2120 - 2130	pr	pr	100		light	do.
2130 - 2140	pr	pr	100	Shale dark grey from here down	do.	do.
2140 - 2150	pr	pr	100		Light/lt.med.	Poor
2150 - 2160	5	5	90		Light	do.
2160 - 2170	pr	5	95		Light	do.
2170 - 2180	pr	10	90		do.	do.
2180 - 2190				Poor sample, probably same as above		
2190 - 2200				Poor sample, probably same as above		
	UTICA			Sandstone, light to medium grey, fine to very fine grained		
				Siltstone, medium grey		
				Shale, medium dark grey, flaky breaking		
					Streak	Acid
2200 - 2210	5%	5%	90%		Light	Poor
2210 - 2220	pr	pr	100		do.	do.
2220 - 2230	-	10	90		do.	do.
2230 - 2240	pr	pr	100		do.	do.
2240 - 2250	ab	5	95	one slickenside	do.	do.
2250 - 2260	pr	5	95		do.	do.
2260 - 2270	pr	pr	100		do.	do.
2270 - 2280	pr	pr	100		do.	do.
2280 - 2290	ab	5	95		do.	do.
2290 - 2300	pr	5	95		do.	do.
2300 - 2460	No record					
2460	Bottom of hole					

LADUBORO NO. 2 WELL

LADUBORO OIL LIMITED

Laduboro No. 2 La Baie-Yamaska well is located in Lot 349, Range I, Baie-du-Febvre parish, Yamaska electoral district, at about 200 feet south of Laduboro No. 1. It was diamond drilled to a depth of 2,890 feet. Elevation, 17 feet. Small gas shows were encountered at 650, 2,130, 2,690, 2,780 and 2,880 feet. The geological log (T.H. Clark) is as follows:

0 - 72 feet Overburden
 72 - 1,200 Lower Lorraine
 1,200 - 2,600 Utica
 2,600 - 2,810 Trenton (Tétreauville)
 2,810 - 2,890 Trenton (Montreal) (Quebec
 Dep't of Mines Mining Industry in 1958, p. 41. See
 also the revised log given by Clark below).

LADUBORO NO. 2

T.H. Clark, January, 1960

STATISTICAL SUMMARY

	SANDSTONE	SILTSTONE	SHALE	LIMESTONE	DOLOMITE
U. Lorraine St. Hilaire mem.	12.5	7.5	77.5	2.5	-
M. Lorraine Chambly mem.	27.9	7.1	65.	-	-
L. Lorraine Breault mem.	4.	11.	85.	-	-
Utica	5.3	12.8	81.9	-	-
U. Trenton Tetreauville	-	-	74.	26.	-
M. Trenton Montreal	-	-	65.7	34.3	-

LADUBORO NO 2

DIAGRAMMATIC LOG

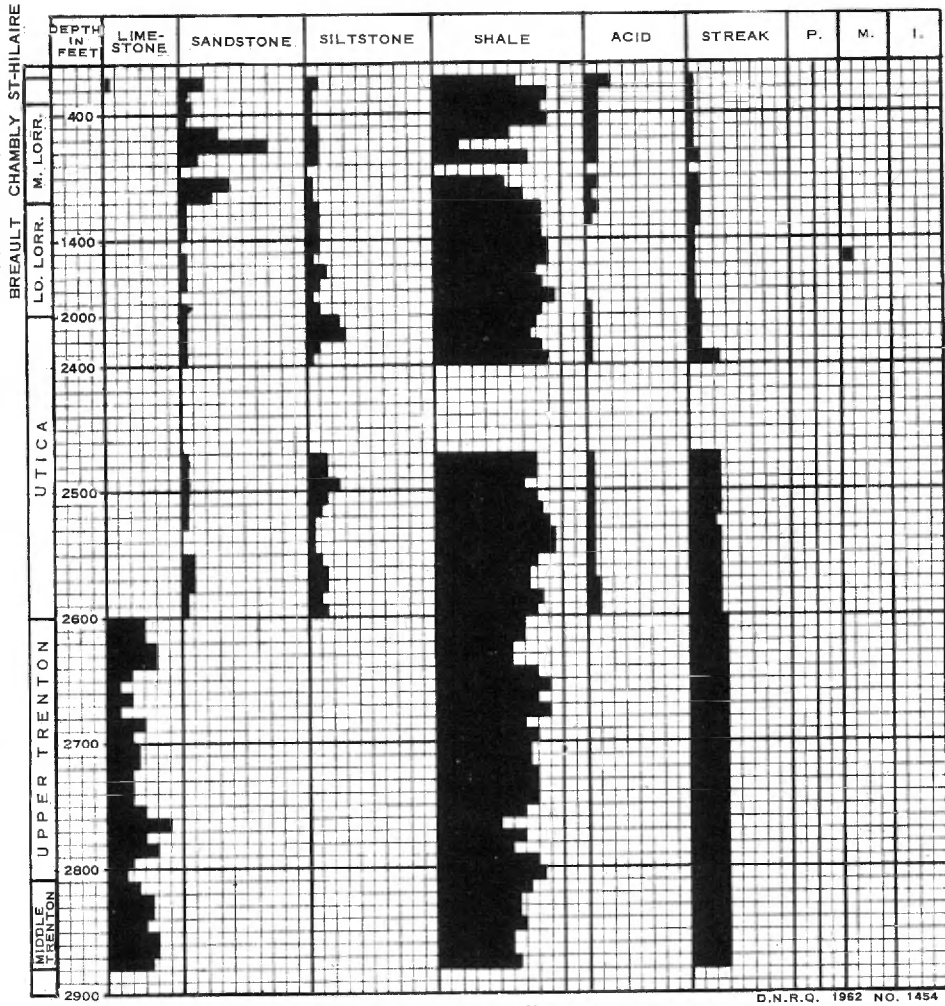


FIGURE 13

LOG OF LADUBORO 2 LA BAIE-YAMASKA

LADUBORO OIL COMPANY

Depth in feet		Description	Diamond drill cuttings	
0 - 72		Overburden		
	NICOLET RIVER ST-HILAIRE MEM.	Sandstone, light grey, very fine grained		
		Siltstone, medium grey		
		Shale, medium grey	<u>Streak</u>	<u>Acid</u>
72 - 200	NICOLET RIVER CHAMBLEY MEMBER	20% 10% 65% 5% limestone massive bryozoa	Very pale	Fair
200 - 330		5 5 90	do.	Poor
330 - 400		10 5 85	do.	do.
400 - 500		5 5 90	do.	do.
500 - 600		30 10 60 Crinoids	do.	do.
600 - 700		70 10 20	do.	do.
700 - 800		15 10 75 Slickensides	Pale	do.
800 - 900		No sample		
900 - 1000		40 5 55 Slickensides	do.	do.
1000 - 1140		25 5 70 Massive bryozoa	do.	Very poor
	NICOLET RIVER BREAUULT MEMBER	Shale dark grey, micaceous		
1140 - 1200		5 10 85 Massive bryozoa	do.	Poor
1200 - 1300		5 10 85	do.	Very poor
1300 - 1400		5 10 85	Very pale	do.
1400 - 1500		pr 10 90	do.	do.
1500 - 1600		5 5 90 White metabentonite	do.	None
1600 - 1700		5 15 80	do.	do.
1700 - 1800		5 10 85	do.	do.
	UTICA	Sandstone, medium grey, very fine grained		
		Siltstone, medium grey		
		Shale, dark grey to black	<u>Streak</u>	<u>Acid</u>
1800 - 1900		5% 95%	Very pale	None
1900 - 2000		5% 10 85	Pale	Very poor
2000 - 2150		5 25 70	do.	do.
2150 - 2200		5 30 65	do.	do.
2200 - 2300		5 10 85 Few pc. buff qztic. sltst.	do.	do.
2300 - 2400		5 5 90	Lt./med.	Very poor

				Sandstone, medium grey, very fine grained		
				Siltstone, medium grey		
				Medium to dark grey shale, finely silty		
					<u>Streak</u>	<u>Acid</u>
2400 - 2470						
2470 - 2480		5%	15%	80%	do.	do.
2480 - 2490		5	15	80	do.	do.
2490 - 2500		5	25	70 Few pc. buff qzte. Buff dol. pr.	do.	do.
2500 - 2510		5	15	80	do.	do.
2510 - 2520		5	10	85 Sh. finely banded, 1-2mm. do.	do.	do.
2520 - 2530		5	5	90 Fine-gr. dol. pr.	Light	do.
2530 - 2540		pr.	5	95	Lt/med.	do.
2540 - 2550		pr.	5	95	do.	do.
2550 - 2560		10	10	80	do.	do.
2560 - 2570		10	15	75 1 pc. drab dol. slickenside	do.	do.
2570 - 2580		10	15	75	do.	Very poor
2580 - 2590		5	10	85	do.	do.
2590 - 2600		5	15	80	do.	do.
				(Sandstone and siltstone as above present to bottom of hole, probably as cavings)		
				Shale, dark grey, massive, medium brown streak		
				Shale, medium grey, slabby. Lt. brown streak		
				Limestone, buff grey, very fine grained		
				Both shales non-calcareous		
2600 - 2610		60%	10%	30%		
2610 - 2620		50	20	30		
2620 - 2630		40	20	40		
2630 - 2640		20	40	40		
2640 - 2650		20	60	20		
2650 - 2660		40	50	10		
2660 - 2670		20	60	20		
2670 - 2680		60	30	10		
2680 - 2690		50	20	30		
2690 - 2700		30	50	20		
2700 - 2710		40	35	25		
2710 - 2720		50	25	25		
2720 - 2730		40	40	20		
2730 - 2740		50	30	20		
2740 - 2750		70	10	20		
2750 - 2760		60	10	30		
2760 - 2770		20	30	50		
2770 - 2780		20	50	30		
2780 - 2790		25	35	40	1 smooth ostracod. Trilobite fragment	
2790 - 2800		60	20	20	Fossils as above. Most limestone dense	
2800 - 2810		15	70	15	Fossils as above. Most limestone dense	
				(Sandstone and siltstone as above continue to bottom of hole, probably as cavings).		
				Shale, dark grey, massive		
				Shale, medium grey, fissile		
				Limestone, buff grey, dense		
				Limestone, light buff grey, fine grained		
2810 - 2820		15%	60%	15%	10%	
2820 - 2830		25	40	10	25	
2830 - 2840		35	30	5	30	A little medium grained ls. pr.
2840 - 2850		10	60	10	20	
2850 - 2860		10	30	pr	40	
2860 - 2870		10	50	pr	40	Medium grey shale is silty
2870 - 2880		15	50x	pr	35	* Medium to dark grey.
2890				Bottom of hole		

Laduboro No. 3 La Baie-Yamaska Well

LADUBORO OIL LIMITED

This well is in lot 350, range I, Baie-du-Febvre parish, Yamaska county. Elevation, 18 feet. It was drilled by rotary to 3,020 feet in 1959. Gas showed at 2,650-2,708 feet. Acidizing and waterfrac operations were unsuccessful. The 10 3/4-inch and 5 1/2-inch casings were left in the hole. Three cement plugs were set: 3,020-2,800 feet, 2,708-2,600 feet, and 128-0 feet. (Mining Ind., Quebec, in 1959, p. 36). The summary of the geological log given in this reference is the writer's and is the same as given below.

LADUBORO NO. 3

T.H. Clark, December, 1959

STATISTICAL SUMMARY

	SANDSTONE	SILTSTONE	SHALE	LIMESTONE	DOLOMITE
Upper Lorraine 50 - 300	.3	9.	74.7	16.	
Middle Lorraine 300 - 1130	23.3	28.3	48.4	-	
Lower Lorraine 1130 - 2040	5.9	17.7	76.4	-	
Utica 2040 - 2500	.3	5.5	94.2	-	
Upper Trenton 2500 - 2720	-	.3	80.2	19.5	
Middle Trenton 2720 - 2810	-	-	48.9	51.1	
Lower Trenton 2810 - 3000	-	-	57.9	42.1	
Black River 3000 - 3020	-	-	62.5	37.5	

LADUBORO NO.3

DIAGRAMMATIC LOG

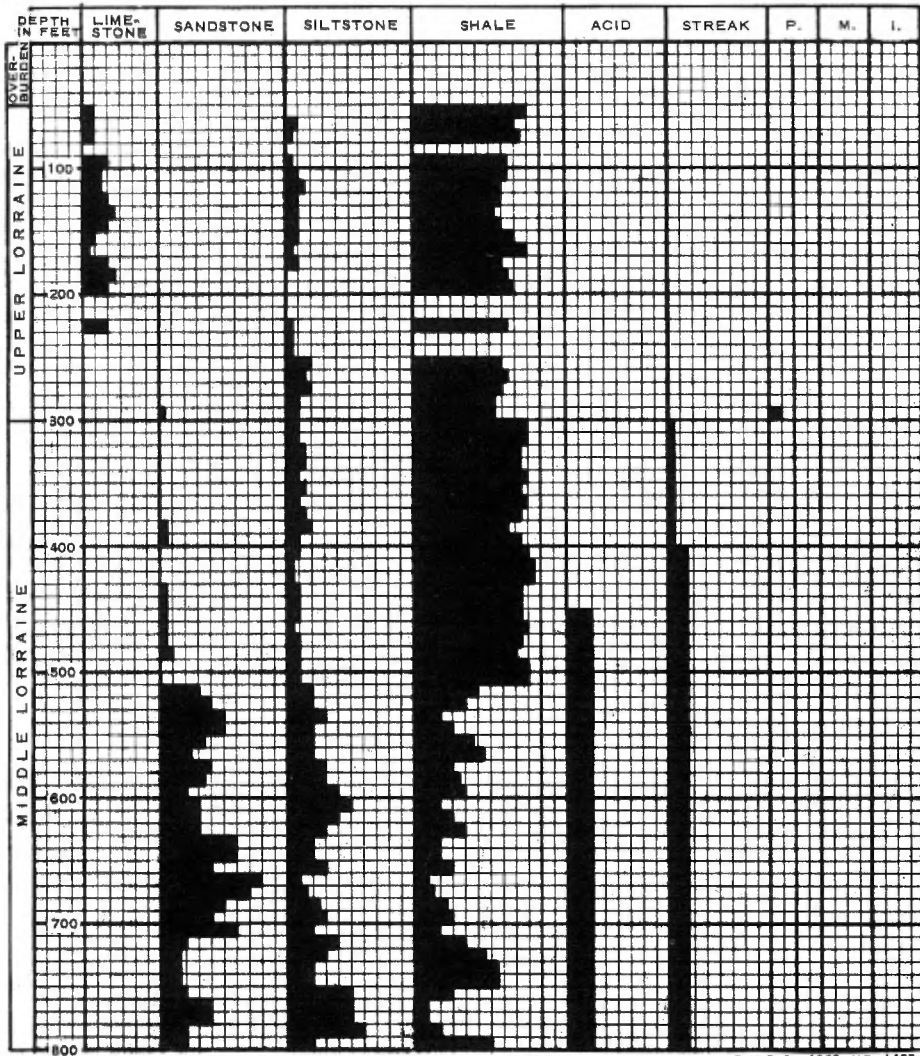
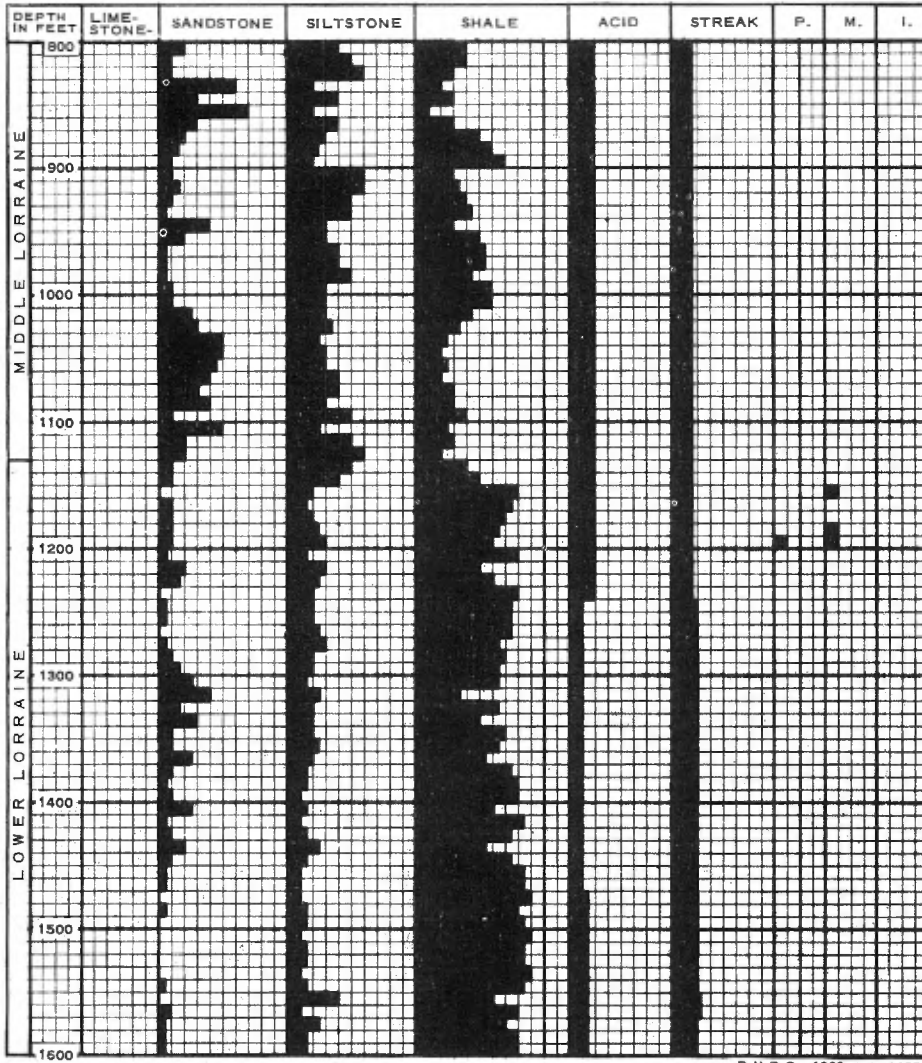


FIGURE 14

D.N.R.Q. 1962 NO. 1455

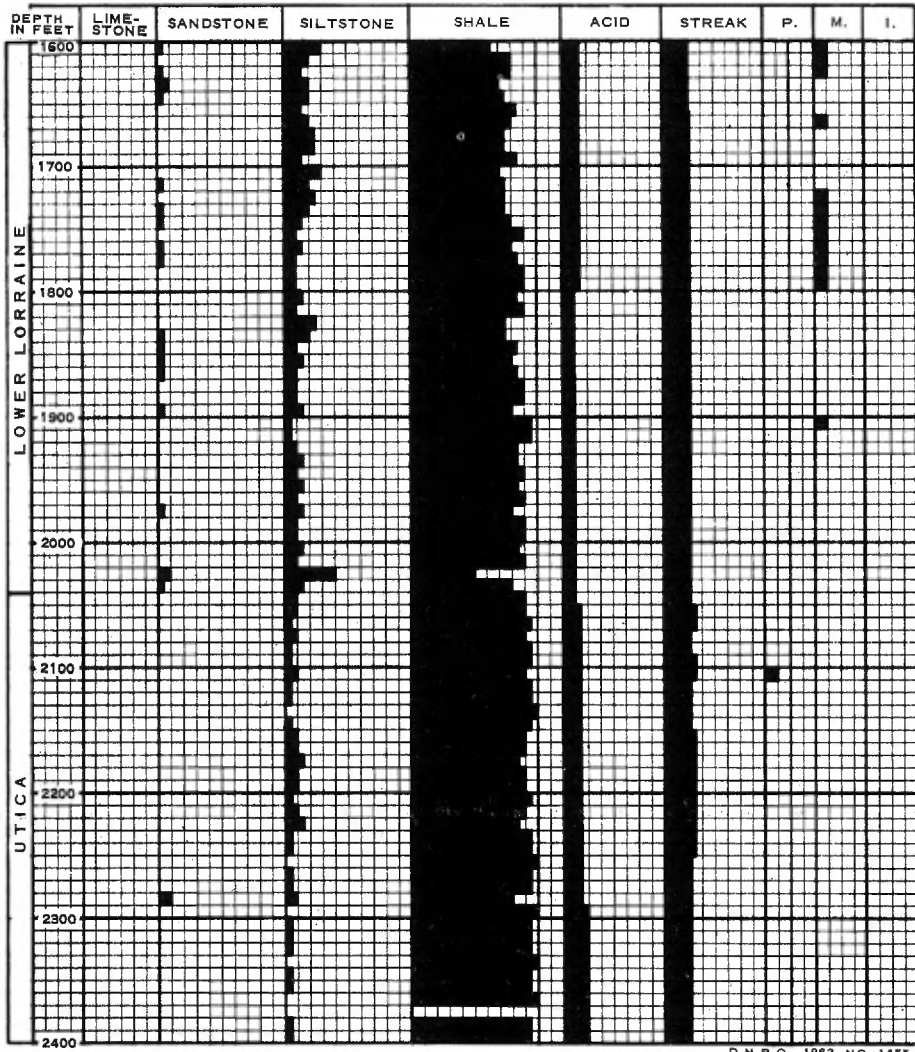
LADUBORO NO. 3

DIAGRAMMATIC LOG



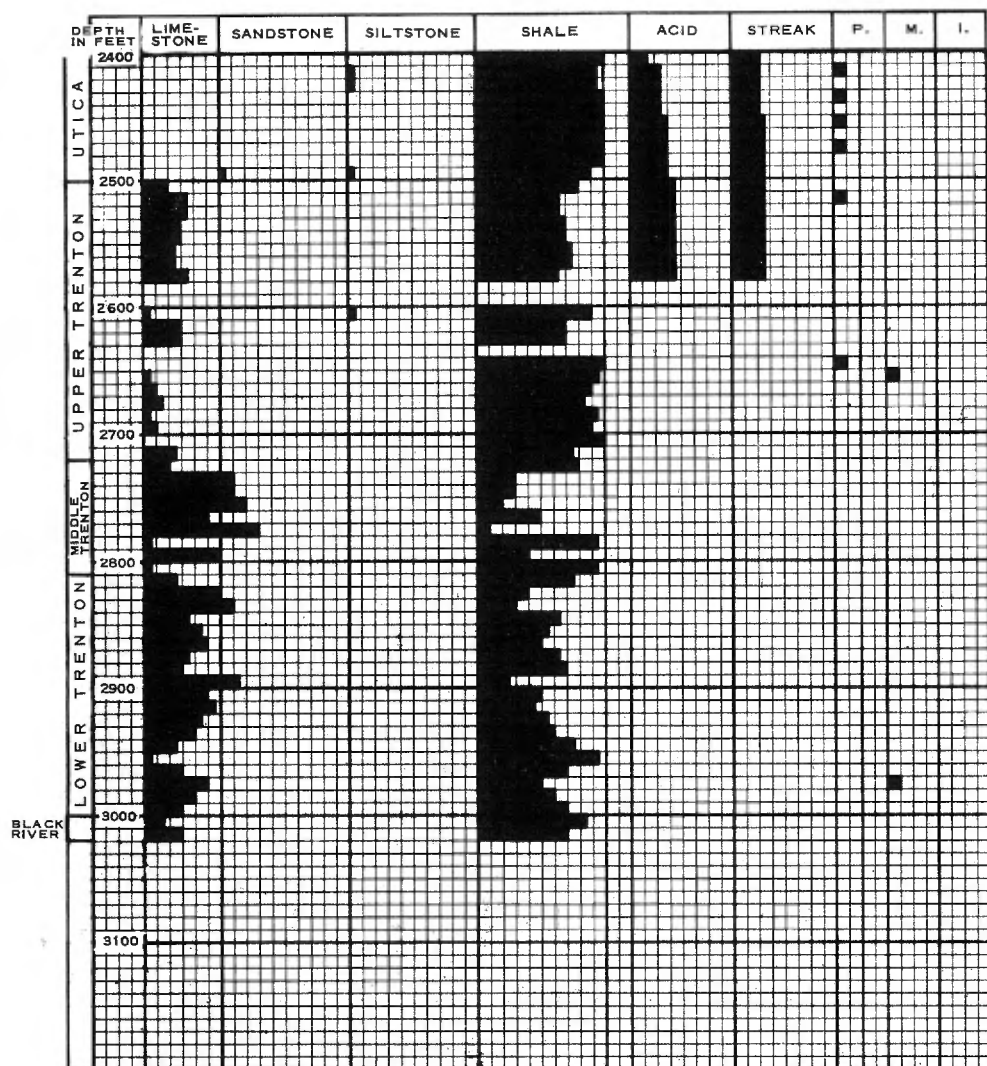
LADUBORO NO. 3

DIAGRAMMATIC LOG



LADUBORO NO. 3

DIAGRAMMATIC LOG



LOG OF LADUBORO 3 LA BATE-YAMASKA

LADUBORO OIL COMPANY

Depth in feet		Description	Rotary Rig Cuttings	
0 - 10	OVERBURDEN	Pale grey clay		
10 - 20		Pale grey clay		
20 - 30		Pale grey clay		
30 - 40		Pale grey clay. A few quartz grains		
40 - 50		Pale grey clay. A few quartz grains		
	LORRAINE UPPER	Sandstone, light medium grey, fine to very fine grained		
		Siltstone, medium grey		
		Shale, medium grey, slightly calcareous		
		Limestone, buff grey, dense to very fine grained		
50 - 60		pr 90% 10%	<u>Rafinesquina Catazyga</u>	
60 - 70		10% 80 10		
70 - 80		5 85 10		
80 - 90			Poor sample, probably out of place	
90 - 100		5 75 20		
100 - 110		pr 10 75 15	<u>Rafinesquina</u>	
110 - 120		pr 15 70 15		
120 - 130		10 70 20	<u>Sowerbyella</u> , smooth ostracods	
130 - 140		10 65 25	<u>Rafinesquina Dalmanella</u>	
140 - 150		10 70 20	<u>Rafinesquina</u> Smooth ostracods	
150 - 160		10 80 10	Smooth ostracods	
160 - 170		5 90 5	Branching bryozoa	
170 - 180		10 70 20	<u>Catazyga</u>	
180 - 190		pr 75 25		
190 - 200		pr 80 20		
		Sandstone, light to medium grey, fine to very fine grained		
		Siltstone medium grey		
		Shale medium grey, faintly calcareous		
		Limestone, grey and buff, dense to fine grained		
200 - 210		No sample		
210 - 220		No sample		
220 - 230		5% 75% 20%	<u>Catazyga</u>	
230 - 240		No sample		
240 - 250		No sample		
250 - 260		pr 20 70 10		
260 - 270		pr 15 75 10	<u>Prasopora</u> -like bryozoa	
270 - 280		ab 20 70 10		

					Sandstone, light to medium grey, fine to very fine grained		
					Siltstone medium grey		
					Shale medium grey, faintly calcareous		
					Limestone, grey and buff, dense to fine grained		
280 - 290	pr	10%	65%	25%	Branching and <u>Prasopora</u> -like bryozoa		
290 - 300	5%	10	65	20	Pyrite	<u>Streak</u>	
300 - 310	-	10	90	pr		Very faint brown	
310 - 320	pr	10	90	-		do.	
320 - 330	-	15	85	pr		do.	
330 - 340	pr	15	85	-		do.	
340 - 350	ab	10	90	ab		do.	
						<u>Streak</u>	<u>Acid</u>
350 - 360	-	15	85	-		Very faint brown	
360 - 370	-	10	90	pr		do.	
370 - 380	-	15	85	-		do.	
380 - 390	5	20	75	-		do.	
390 - 400	5	10	85	pr		do.	
					Sandstone, light to medium grey, fine to medium fine grained		
					Siltstone, medium grey		
					Shale medium grey, faintly calcareous		
					Limestone, grey and buff, dense to fine grained		
						<u>Streak</u>	<u>Acid</u>
400 - 410	pr	10%	90%	-		Very light	
410 - 420	-	5	95	-		do.	
420 - 430	pr	5	95	-		do.	
430 - 440	5%	10	85	pr		do.	
440 - 450	5	10	85	pr		do.	
					Sandstone very fine grained		
450 - 460	5%	10	85	-		do.	Poor
460 - 470	5	5	90			do.	do.
470 - 480	5	10	85	pr		do.	do.
					Sandstone, light to medium grey, very fine grained		
					Siltstone, medium grey		
					Shale, medium grey, faintly calcareous		
					Limestone, grey to buff, dense to very fine grained		
						<u>Streak</u>	<u>Acid</u>
480 - 490	10%	10%	80%	-		Very light	Poor
490 - 500	-	10	90	-		do.	do.
500 - 510	pr	10	90	pr		do.	do.
510 - 520	30	20	50	-		do.	do.
520 - 530	40	20	40	-		do.	do.
530 - 540	50	30	20	-		do.	do.

540 - 550	5%	20%	30%	-	Sandstone, light to medium grey, very fine grained	do.	do.
550 - 560	35	20	45	-	Siltstone, medium grey	do.	do.
560 - 570	25	20	55	-	Shale, medium grey, faintly calcareous	do.	do.
570 - 580	40	30	30	-	Limestone, grey to buff, dense to very fine grained	do.	do.
580 - 590	35	30	35	-		do.	do.
590 - 600	20	40	40	-		do.	do.
600 - 610	30	50	20		Sandstone, medium light grey, very fine grained	do.	do.
610 - 620	30	40	30			do.	do.
620 - 630	30	30	40			do.	do.
630 - 640	60	20	20		<u>Dalmanella</u> . Smooth ostracods	do.	do.
640 - 650	60	20	20		<u>Dalmanella</u>	do.	do.
650 - 660	40	30	30			do.	do.
660 - 670	80%	10%	10%		Sandstone, medium light grey, very fine grained	do.	do.
670 - 680	70	15	15		Siltstone, medium grey	do.	do.
680 - 690	50	25	25		Shale, medium grey, slightly calcareous	do.	do.
680 - 700	40	30	30			do.	do.
700 - 710	60	20	20		<u>Dalmanella</u>	do.	do.
710 - 720	20	40	40			do.	do.
720 - 730	15	30	55			do.	do.
730 - 740	15x	20	65	x a few pc. buff quartzite	do.	do.	do.
740 - 750	15x	20	65	x do.	do.	do.	do.
750 - 760	20x	50	30	x do.	Very light to light	do.	do.
760 - 770	40	50	10		do.	do.	do.
770 - 780	40	50	10		do.	do.	do.
780 - 790	20	60	20		<u>Dalmanella</u>	do.	do.
790 - 800	20	20	60			do.	do.
800 - 810	20%	40%	40%	1 pc. buff quartzite	Sandstone, medium grey, very fine grained	do.	do.
810 - 820	10	50	40		Siltstone, medium grey	do.	do.
820 - 830	10	60	30		Shale, medium to medium dark grey	do.	do.
830 - 840	60	20	20			do.	do.

MIDDLE LORRAINE

		Sandstone, medium grey, very fine grained						
		Siltstone, medium grey						
		Shale, medium to medium dark grey						
					<u>Streak</u>	<u>Acid</u>		
840 - 850	MIDDLE LORRAINE	30%	40%	30%	do.	do.		
850 - 860		70	20	10	do.	do.		
860 - 870		30	40	30	do.	do.		
870 - 880		20	30	50	do.	do.		
880 - 890		15	25	60	do.	do.		
890 - 900		10	20	70	do.	do.		
900 - 910		10	60	30	do.	do.		
910 - 920		15	60	35	do.	do.		
920 - 930		10	50	40	do.	do.		
930 - 940		5	50	45	do.	do.		
940 - 950		40	30	30	do.	do.		
950 - 960		20	30	50	do.	do.		
960 - 970		5	40	55	do.	do.		
970 - 980		5	40	55	do.	do.		
980 - 990		5	50	45	V.lt/lt	Poor		
990 - 1000		10	30*	60 *A few pc. buff quartzite	do.	do.		
		Sandstone, light to med. grey, very fine grained						
1000 - 1010	MIDDLE LORRAINE	10	30	60 Siltstone has a few	do.	do.		
1010 - 1020		25	30	pieces buff quartzite	do.	do.		
1020 - 1030		30	35	35 do.	do.	do.		
1030 - 1040		50	25	25 do.	do.	do.		
1040 - 1050		50	30	20 do.	do.	do.		
1050 - 1060		45	30	25 do.	do.	do.		
1060 - 1070		40	40	20 do. interbedded with	do.	do.		
		siltstone, 2mm. beds						
1070 - 1080		30	40	30 do. do.	do.	do.		
1080 - 1090		40	30	30 do. do.	do.	do.		
1090 - 1100		10	50	40	do.	do.		
1100 - 1110		50	25	25	do.	do.		
1110 - 1120	20	50	30 do.	do.	do.			
1120 - 1130	20	60	20 do. ab	do.	do.			
		Sandstone, light to med. grey, very fine grained						
		Siltstone, medium grey						
		Shale, medium to medium dark grey						
					<u>Streak</u>	<u>Acid</u>		
1130 - 1140	LOWER LORRAINE	10%	50%	40% Siltstone has a few	Very light	Poor		
		pieces buff quartzite						
1140 - 1150		10	40	50 do.	do.	do.		
1150 - 1160		pr	20	80 A few pieces white,	do.	do.		
		wax-like metabentonite						
1160 - 1170		10	15	75	do.	do.		

				Sandstone, light to med. grey, very fine grained		
				Siltstone, medium grey		
				Shale, medium to medium dark grey		
					<u>Streak</u>	<u>Acid</u>
1170 - 1180	10%	20%	70%	do.	do.	
1180 - 1190	10	25	65	do. but grey	do.	do.
1190 - 1200	10	30	60	do. ab grey Pyrite replaces fossils in small fragment of limestone in place		
				Shale, medium to dark grey		
1200 - 1210	5%	15%	80%	Lt/lt. med.	do.	
1210 - 1220	20	30	50	do.	do.	
1220 - 1230	15	25	60	do.	do.	
1230 - 1240	pr	20	80	do.	do.	
1240 - 1250	5	20	75	Light	Weak	
1250 - 1260	5	20	75	do.	do.	
				Sandstone, light to medium grey, very fine grained		
				Siltstone, medium grey		
				Shale, medium to dark grey		
					<u>Streak</u>	<u>Acid</u>
1260 - 1270	pr	25%	75%	Light to med. light	Weak	
1270 - 1280	5%	30	65	do.	do.	
1280 - 1290	10	20	70			
1290 - 1300	15	20	65	do.	do.	
1300 - 1310	25	15	65			
1310 - 1320	40	25	35	do.	do.	
1320 - 1330	15	20	65			
1330 - 1340	30	20	50	do.	do.	
1340 - 1350	10	20	70			
1350 - 1360	10	25	65	do.	do.	
1360 - 1370	25	20	55			
1370 - 1380	10	15	75	do.	do.	
1380 - 1390	5	15	80			
1390 - 1400	10	10	80	do.	do.	
1400 - 1410	25	15	60			
1410 - 1420	5	10	85	Light	do.	
1420 - 1430	10	15	75	Light	Weak	
1430 - 1440	20	25	55	do.	do.	
1440 - 1450	10	15	75			
1450 - 1460	5	10	85	do.	do.	
1460 - 1470	5	10	85	3 pc. white metabentonite		
1470 - 1480	pr	10	90	do.	Weak/poor	
1480 - 1490	5	15	80			

LOWER LORRAINE

1

			Sandstone, light to medium grey, very fine grained		
			Siltstone, medium grey		
			Shale, medium to medium dark grey		
				<u>Streak</u>	<u>Acid</u>
2160 - 2170	pr	10% 90%			
2170 - 2180	pr	15 85		do.	do.
2180 - 2190	-	10 90			
2190 - 2200	-	10 90 do.		do.	do.
			Shale, medium to dark grey		
2200 - 2210	-	5 95% Buff quartzitic siltstone pr.			
2210 - 2220	-	10 90 do.		Lt/med. Weak/poor	
2220 - 2230	-	15 35 do.		do.	do.
2230 - 2240	-	5 95		do.	do.
2240 - 2250	-	5 95			
2250 - 2260	pr	5 95		Lt/lt. med.	do.
2260 - 2270	-	5 95			
2270 - 2280	pr	5 95		do.	do.
2280 - 2290		10% 10 80 do.			
			Sandstone, siltstone and shale a little darker		
2290 - 2300	- pr	100		do.	Poor
2300 - 2310	-	5 95			
2310 - 2320	-	5 95		do.	do.
			Siltstone and shale black		
2320 - 2330	-	5% 95			
2330 - 2340	- pr	100		do.	do.
			Sandstone, a little darker grey, very fine grained		
			Siltstone, black		
			Shale, black	<u>Streak</u>	<u>Acid</u>
2340 - 2350	-	5% 95% Buff quartzitic siltstone pr.			
2350 - 2360	-	5 95		Lt/lt. med.	Poor
2360 - 2370	-	- 100			
2370 - 2380		No sample			
2380 - 2390	-	5 95 All siltstone is buff and quartzitic			
2390 - 2400	-	5 95 <u>Diplograptus</u>		do.	do.
			Siltstone, dark grey to black		
2400 - 2410	- pr	100% do. Pyrite			
2410 - 2420	-	5% 95 Pyrite		do.	Poor/fair
2420 - 2430	-	5 95			
2430 - 2440	-	- 100 Pyrite		do.	do.
2440 - 2450	-	- 100		do.	

U T I C A

		UTICA					
		Sandstone, a little darker grey, very fine grained					
		Siltstone, dark grey to black					
		Shale, black		<u>Streak</u>		<u>Acid</u>	
2450 - 2460	pr	100%	Pyrite	Lt/med.	Fair		
2460 - 2470	-	100		do.			
2470 - 2480	-	100	Pyrite	do.	do.		
2480 - 2490	No sample						
2490 - 2500	5%	5%	90	do.	do.		
		Siltstone, dark grey to black					
		Shale, black					
		Shale, medium to medium light grey, dense					
		Limestone buff, dense to very fine grained					
				<u>Streak</u>		<u>Acid</u>	
2500 - 2510	pr	80%	5%	15%	Lt/med	Fair/good	
2510 - 2520	pr	65	20	15	do.	do.	
2520 - 2530	pr	65	15	20	Pyrite	do.	do.
2530 - 2540	pr	70	15	15	do.	do.	
2540 - 2550	pr	70	10	20	do.	do.	
2550 - 2560	pr	75	5	20	do.	do.	
2560 - 2570	pr	75	pr	25	do.	do.	
2570 - 2580	pr	65	15	20	do.	do.	
2580 - 2590	No sample						
2590 - 2600	No sample						
		Shale, dark grey					
		Limestone, buff grey, dense to very fine grained with fine sandy residue					
2600 - 2610	90%	5%	5%	Siltstone.	Light blue grey metabentonite	pr.	
2610 - 2620	70	30		<u>Leptobolus</u>			
2620 - 2630	70	30		<u>Leptobolus</u> ,	plicated brachiopods		
2630 - 2640	No sample						
2640 - 2650	100	pr		Pyrite			
2650 - 2660	95	5		Metabentonite	pr, light blue grey		
2660 - 2670	90	10					
2670 - 2680	85	15					
2680 - 2690	95	5					
2690 - 2700	90	10					
2700 - 2710	100	pr					
2710 - 2720	75	25		Limestone	in part fine grained		

				Shale, dark grey
				Limestone buff grey, dense
				Limestone, do., fine grained
				Limestone., do., medium grained
2720 - 2730		80%	5% 15%	-
2730 - 2740		30	10 50	10
2740 - 2750		30	5 60	5
2750 - 2760		20	45 30	5
2760 - 2770		50	5 40	5 15% of shale is greenish grey
2770 - 2780		10	70 20	- 5% do.
2780 - 2790		95	- 5	-
2790 - 2800		40	- 60	-
	MIDDLE TRENTON			
				Shale, dark grey
				Limestone, medium grey, dense
				Limestone, fine grained, light grey
2800 - 2810		85%	- 5%	10% is sandstone, very fine grained effervesces feebly, possibly caving
2810 - 2820		75	- 25	
2820 - 2830		40	- 60	
2830 - 2840		30	- 70	<u>Rafinesquina</u>
2840 - 2850		65	- 35	
2850 - 2860		55	- 45	
2860 - 2870		50	5 45	
2870 - 2880		65	5 30	
2880 - 2890		70	5 25	<u>Rafinesquina</u>
2890 - 2900		25	10 65	
2900 - 2910		50	- 50	<u>Dalmanella</u> , branching and spreading bryozoa
2910 - 2920		45	- 55	<u>Dalmanella</u> , <u>Zygospira</u> , <u>Rafinesquina</u> Black chert
2920 - 2930		55	- 45	<u>Dalmanella</u> , <u>Rafinesquina</u> , <u>Prasopora</u> Dark brown chert
2930 - 2940		60	- 40	
2940 - 2950		75	- 25	Light brown chert
2950 - 2960		95	- 5	Light brown chert
2960 - 2970		70	- 30	<u>Prasopora</u>
2970 - 2980		50	- 50	<u>Dalmanella</u> (Brown chert (Dark buff calcareous metabentonite
2980 - 2990		60	- 40	
2990 - 3000		70	- 30	
3000 - 3010		65	20 15	
3010 - 3020		60*	10 30	* 10% is greenish grey
3020	BLACK RIVER			Bottom of hole

LADUBORO NO. 4 LA BAIE-YAMASKA WELL

LADUBORO OIL LIMITED

This well is in lot I-west, range of Corporation de la Commune, Baie-du-Febvre parish, Yamaska county. Elevation 14 feet. It was drilled by rotary to 3,528 feet in 1959. Gas show at about 2,500 feet. The 10 3/4-inch casing, cemented at 305 feet, was left in the hole. The well was plugged with cement, gravel, and wood. (Mining Ind., Quebec, in 1959, p. 37). The summary of the geological log given in this reference is the writer's and is the same as given below.

LADUBORO NO. 4

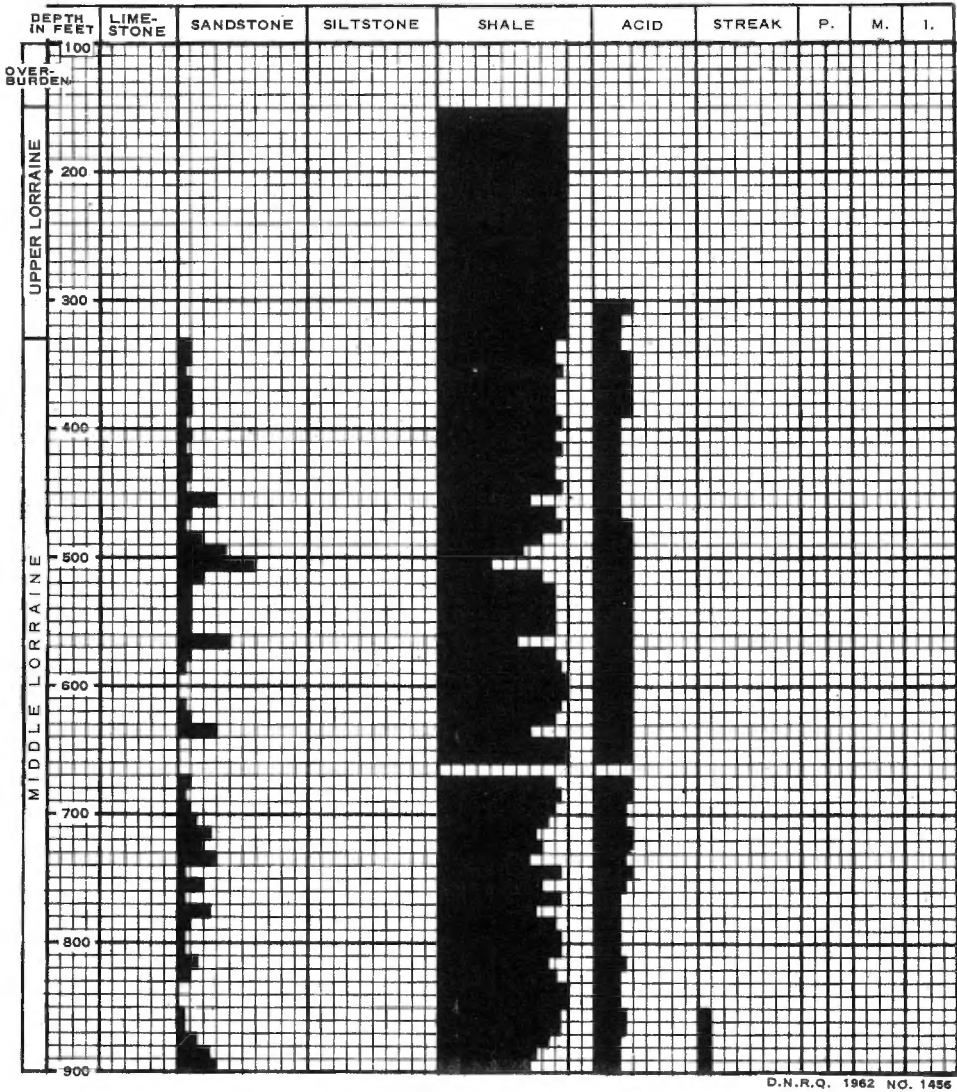
T.H. CLARK, FEBRUARY, 1960

STATISTICAL SUMMARY

	SANDSTONE	SILTSTONE	SHALE	LIMESTONE	DOLOMITE
Upper Lorraine St.Hilaire member	-	-	100.	-	-
Middle Lorraine Chambly member	17.5	8.	74.3	.2	-
Lower Lorraine Breault member	3.2	10.9	85.9	-	-
Utica	-	3.1	95.9	1.	-
Upper Trenton	-	-	75.	25.	-
Middle Trenton	-	-	38.3	61.7	-
Lower Trenton	-	-	41.8	58.2	-
Black River	-	-	25.	75.	-
Chazy	-	-	25.4	74.6	-

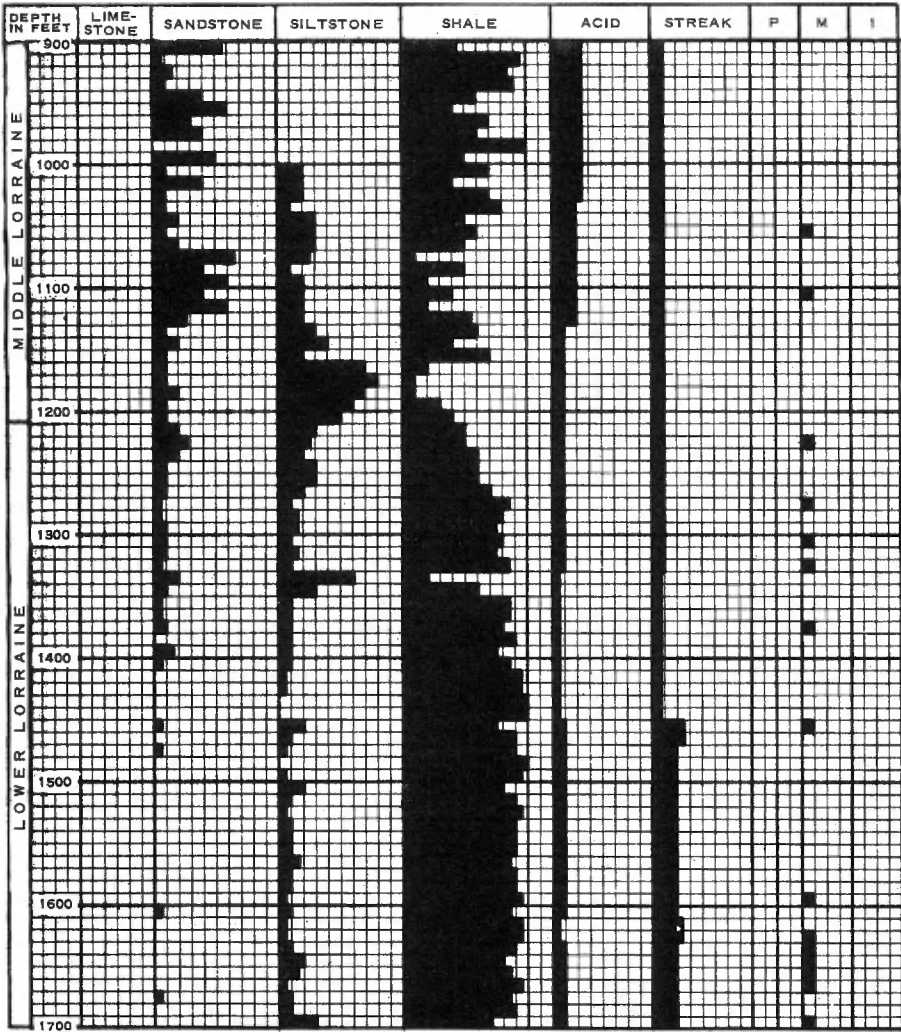
LADUBORO NO. 4.

DIAGRAMMATIC LOG



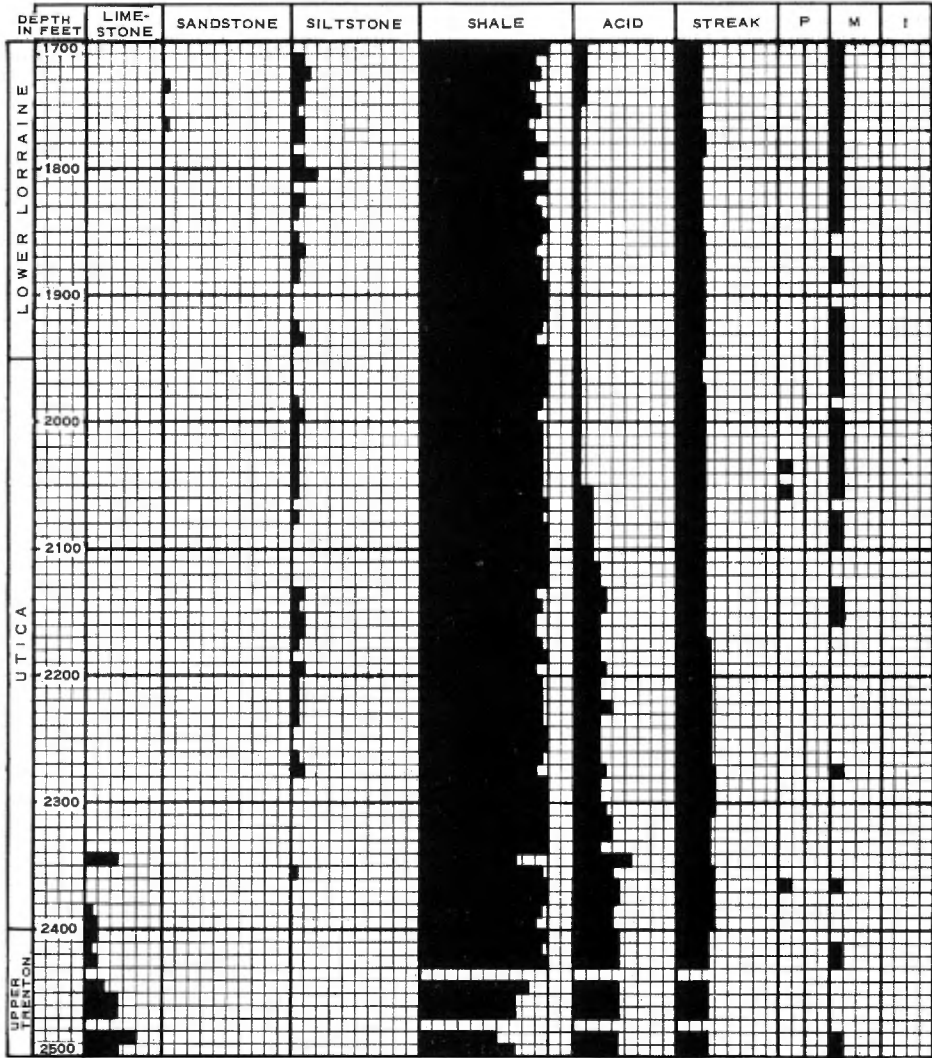
LADUBORO NO. 4

DIAGRAMMATIC LOG



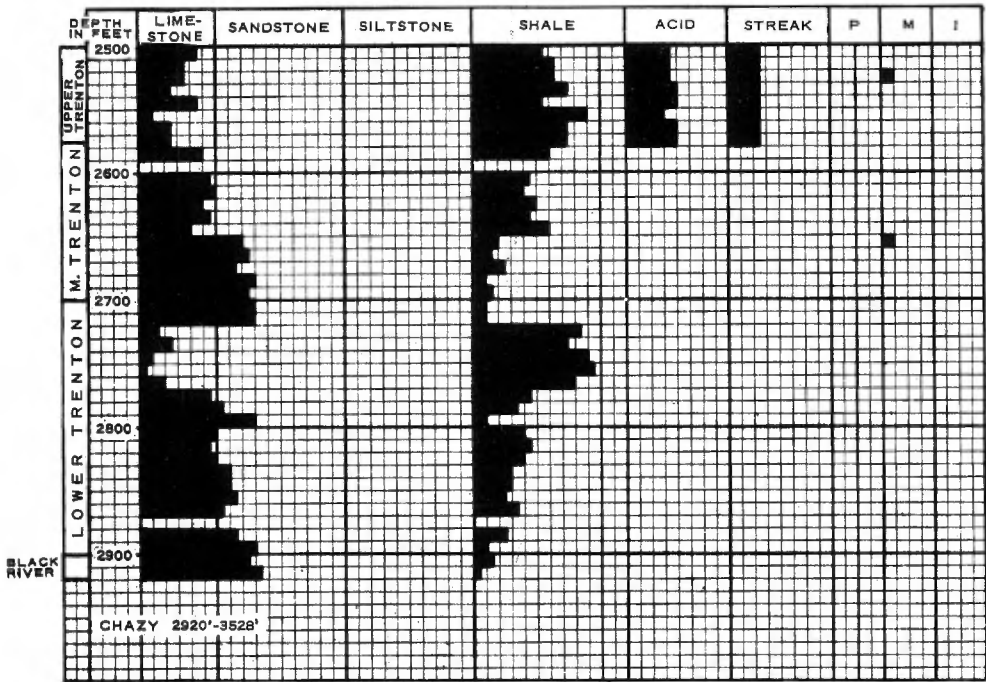
LADUBORO NO. 4

DIAGRAMMATIC LOG



LADUBORO NO. 4

DIAGRAMMATIC LOG



LOG OF LADUBORO NO. 4 LA BAIE-YAMASKA WELL

LADUBORO OIL COMPANY

Depth in feet		Description	Rotary Rig Cuttings	
0 - 150		Overburden		
	UPPER LORRAINE	Sandstone, light grey, very fine grained		
		Shale, light to medium grey, silty		
		Limestone		
			<u>Streak</u>	<u>Acid</u>
150 - 180	UPPER LORRAINE	pr 100% -		
180 - 210		pr 100 -		
210 - 240		pr 100 -		
240 - 270		pr 100 - Fragments of brachiopods and crinoids		Poor
270 - 300	UPPER LORRAINE	pr 100 pr 1 pc. fossiliferous ls		do.
300 - 310		pr 100 -		Fair
310 - 320		pr 100 - <u>Dalmanella</u>		Poor
320 - 330		pr 100 pr <u>Catazyga</u> Branching bryozoa		do.
330 - 340	MIDDLE LORRAINE	10% 90 pr Crinoids Brachiopods		do.
340 - 350		10 90 - Branching bryozoa		Fair
350 - 360		5 95 -		do.
360 - 370		10 90 pr <u>Sowerbyella</u> Crinoids		do.
370 - 380	MIDDLE LORRAINE	5 90 5% Crinoids		do.
380 - 390		5 90 5 Crinoids		do.
390 - 400		- 95 5 Crinoids		do.
		Sandstone, light grey, very fine grained		
	MIDDLE LORRAINE	Shale, light to medium grey, silty		
400 - 410		10% 90% <u>Sowerbyella</u>		Poor
410 - 420		5 95 Crinoids		do.
420 - 430		10 90 <u>Dalmanella</u> pelecypods		do.
430 - 440	MIDDLE LORRAINE	10 90 Crinoids		do.
440 - 450		5 95 Crinoids		do.
450 - 460		30 70		
460 - 470		10 90 Crinoids <u>Calymene</u> branching bryozoa		do.
470 - 480	MIDDLE LORRAINE	5 95 ls. pr. crinoids, branching bryozoa		Fair
480 - 490		20 80		do.
490 - 500		35 65 Crinoids		do.
500 - 510		60 40 Crinoids <u>Leptaena</u>		do.
510 - 520		20 80 Poor sample, largely cement		

			Sandstone, light grey, very fine grained		
			Shale, light to medium grey, silty		
				<u>Streak</u>	<u>Acid</u>
520 - 530	10%	90%	do.		
530 - 540	10	90	do.		
540 - 550	10	90	do. Crinoids		Fair
550 - 560	10	90	Poor sample, largely cement		
560 - 570	40	60	do.		
570 - 580	10	90	do.		
580 - 590	5	95	do.		
590 - 600	No sample				
			Shale, light to medium grey		
600 - 610	pr	100%	Poor sample, mostly cement		
610 - 620	pr	100	do.		
620 - 630	5	95	do.		
630 - 640	10	90	do. <u>Sowerbyella</u>		
640 - 650	30	70	do.		
650 - 660	-	100	do. ls. pr.		
660 - 670	-	100	do.		
670 - 680	10	90	do.		
680 - 690	5	95	do.		
690 - 700	10	90			Fair/poor
700 - 710	15	85			do.
710 - 720	25	75			Fair
720 - 730	20	80			do.
730 - 740	30	70			Fair/poor
740 - 750	5	95			Poor
750 - 760	20	80			Fair/poor
760 - 770	5	95			Poor
770 - 780	25	75		White/light	do.
780 - 790	10	90	Crinoids	do.	do.
790 - 800	5	95	Crinoids	do.	do.
800 - 810	5	95	Massive bryozoa	do.	do.
810 - 820	15	85		do.	Poor/fair
820 - 830	10	90	Crinoids	do.	Poor
830 - 840	-	100		do.	do.
840 - 850	-	100	Metabentonite yellow grey-green	do.	do.
850 - 860	5	95		do.	do.
860 - 870	5	95		do.	do.
870 - 880	15	85		do.	Poor

				Sandstone, light grey, very fine grained		
				Shale, light to medium grey		
					<u>Streak</u>	<u>Acid</u>
880 - 890	25%	75%	Crinoids	White/light	Poor	
890 - 900	30	70		do.	do.	
900 - 910	55	45	Sandstone and shale medium to medium dark grey	do.	do.	
910 - 920	5	95	do.	do.	Poor/fair	
920 - 930	15	85	do.	do.	do.	
930 - 940	10	90	do.	do.	do.	
940 - 950	40	60	do.	do.	do.	
950 - 960	60	40	do.	do.	do.	
960 - 970	30	70	do.	do.	do.	
970 - 980	40	60	do.	do.	do.	
980 - 990	-	100	Poor sample			
990 - 1000	50	50	Shale, dark grey	do.	do.	
				Sandstone, medium grey, very fine grained		
				Siltstone, medium grey		
				Shale, dark grey		
1000 - 1010	10%	20%	70%	do.	do.	
1010 - 1020	40	20	40	do.	do.	
1020 - 1030	10	20	70	do.	do.	
1030 - 1040	10	10	30	White/light	Poor	
				Shale, medium grey		
1040 - 1050	20	30	50%	do.	do.	
1050 - 1060	10	30	60 1 piece lt. grey metabentonite	do.	do.	
1060 - 1070	20	30	50	do.	do.	
1070 - 1080	65	25	10	do.	do.	
1080 - 1090	40	10	50	do.	do.	
1090 - 1100	60	20	20	do.	do.	
1100 - 1110	60	20	20 1 piece metabentonite	do.	do.	
1110 - 1120	40	20	40	do.	do.	
1120 - 1130	25	20	55			
1130 - 1140	10	30	60	do.	do.	
1140 - 1150	20	40	40			
1150 - 1160	10	20	70	do.	Weak	
1160 - 1170	10	70	20			
1170 - 1180	10	80	10	do.	do.	
1180 - 1190	5	15	80			
1190 - 1200	10	60	30	do.	do.	

				Sandstone, medium grey, very fine grained		
				Siltstone, medium grey		
				Shale, medium grey		
					<u>Streak</u>	<u>Acid</u>
1200 - 1210	20%	30%	50%		White/light	Weak
1210 - 1220	20	30	50		do.	do.
1220 - 1230	25	25	50	Light grey metabentonite		
1230 - 1240	20	20	60		do.	do.
1240 - 1250	10	30	60			
1250 - 1260	10	30	60		do.	do.
1260 - 1270	10	20	70			
1270 - 1280	5	10	85	Light grey metabentonite	do.	do.
1280 - 1290	5	15	80			
1290 - 1300	10	15	75		do.	do.
1300 - 1310	10	10	80			
1310 - 1320	10	15	75		do.	do.
1320 - 1330	5	10	85	2 pieces metabentonite		
1330 - 1340	20	60	20		do.	do.
1340 - 1350	10	30	60			
1350 - 1360	5	10	85		do.	do.
1360 - 1370	5	10	85			
1370 - 1380	10	10	80	1 piece light grey metabentonite	do.	do.
1380 - 1390	pr	10	90			
1390 - 1400	15	10	75		White/light	Weak
				Shale, dark grey		
1400 - 1410	5	10	85%		do.	do.
1410 - 1420	pr	5	95		do.	do.
1420 - 1430	pr	5	95			
1430 - 1440	-	-	100		do.	do.
1440 - 1450	-	pr	100			
1450 - 1460	5	20	75		Light/medium	do.
1460 - 1470	pr	10	90			
1470 - 1480	5	5	90		Light	do.
1480 - 1490	-	pr	100			
1490 - 1500	pr	5	95		do.	do.
1500 - 1510	-	20	80			
1510 - 1520	-	10	90		do.	do.
1520 - 1530	-	5	95			
1530 - 1540	-	10	90		do.	do.
1540 - 1550	-	10	90			

				Sandstone, medium grey, very fine grained		
				Siltstone, medium grey		
				Shale, dark grey		
					<u>Streak</u>	<u>Acid</u>
1550 - 1560	-	10%	90%		Light/medium	Weak
1560 - 1570	pr	10	90		do.	do.
1570 - 1580	pr	10	90			
1580 - 1590	-	10	90			
1590 - 1600	pr	5	95	light buff metabentonite	do.	do.
1600 - 1610		5%	10	85	do.	do.
1610 - 1620	-	5	95		do.	do.
1620 - 1630	-	5	95	light buff metabentonite		
1630 - 1640	pr	10	90	do.	do.	do.
1640 - 1650	-	20	80	do.		
1650 - 1660	-	15	85	do.	Light	do.
1660 - 1670	-	5	95	do.		
1670 - 1680	5	10	85		do.	do.
1680 - 1690	-	10	90			
1690 - 1700	-	30	70	do., abund.	do.	do.
1700 - 1710	-	-	100	do., pr		
1710 - 1720	-	10	90	do., pr	do.	do.
1720 - 1730	-	5	95	do., pr		
1730 - 1740	5	10	85	Light buff metabentonite pr.	Light/medium	Weak
1740 - 1750	-	10	90	do., pr.; buff quartzite abund.		
1750 - 1760	-	5	95	do.	do.	do.
1760 - 1770	5	10	85	do.		
1770 - 1780	5	10	85	do. do.	Light/light medium	do.
1780 - 1790	-	pr	100			
1790 - 1800	-	10	90	do. do.	do.	do.
1800 - 1810	-	20	80	buff quartzite light grey metabentonite	abund. Light	do.
1810 - 1820	-	pr	100	do. do.	do.	do.
1820 - 1830	pr	10	90	do. do.		
1830 - 1840	-	5	95	do. do.	do.	do.
1840 - 1850	-	-	100	do. do., nearly white		
1850 - 1860	-	5	95		Light/light medium	do.
1860 - 1870	-	10	90			
1870 - 1880	-	5	95	do., pr. do.	do.	do.
1880 - 1890	-	5	95	do., pr. do.		
1890 - 1900	-	-	100		do.	do.
1900 - 1910	-	-	100	1 branching bryozoan		
1910 - 1920	-	-	100	light grey metabentonite	do.	do.

	LOWER LORRAINE	Siltstone, medium grey					
				Shale, dark grey	<u>Streak</u>	<u>Acid</u>	
1920 - 1930		5%	95%	light grey metabentonite			
1930 - 1940		10	90	do. buff quartzite pr	Light/light medium	Weak	
1940 - 1950		-	100	do.			
1950 - 1960		-	100	do.	do.	do.	
1960 - 1970		-	100	do., ab.			
1970 - 1980		pr	100	do. do. do. sandstone pr.		do.	
1980 - 1990		5	95				
1990 - 2000		10	90	do. do. do.		do.	
2000 - 2010		5	95	do. do. do.		do.	
2010 - 2020		5	95	do. do. do.		do.	
2020 - 2030		5	95	do. do.			
2030 - 2040		5	95	do. do. Pyrite	do.	do.	
2040 - 2050		5	95				
2050 - 2060		5	95	1 pc. brown metabentonite Pyrite	do.	Weak/poor	
2060 - 2070		-	100				
				Black shale			
2070 - 2080		5	95%	light grey metabentonite	do.	do.	
	U T I C A	Sandstone, medium grey, very fine grained					
				Siltstone, medium grey			
				Shale, black			
2080 - 2090		-	-	100% Lt. grey metabentonite	Lt./lt. med.	Weak/poor	
2090 - 2100		-	-	100 do.	Lt./lt. med.	Weak/poor	
2100 - 2110		-	-	100 do.			
2110 - 2120		-	-	100	do.	do.	
2120 - 2130		Sample missing					
				Shale, medium dark grey			
2130 - 2140		pr	10%	90% White metabentonite	do.	Fair/poor	
2140 - 2150		pr	5	95 1 pc. do.			
2150 - 2160		pr	10	90 1 pc. do. do.		Poor	
2160 - 2170		pr	10	Shale medium lt. dense: medium dark, (30:60) coarse			
2170 - 2180		pr	5	95 (30:65)	do.	do.	
2180 - 2190		pr	pr	100 (10:90)			
2190 - 2200		pr	10	90 (10:80)	do.	Poor	
		Siltstone, medium dark grey, buff quartzitic type pr.					
		Shale (a) dense, medium light: (b) coarse, medium dark					
				a) b)			
2200 - 2210		-	5%	95% (20:75)	Lt./med med.	do.	

				Siltstone, medium dark grey, buff quartzitic type pr.		
				Shale (a) dense, medium light: (b) coarse, medium dark		
					<u>Streak</u>	<u>Acid</u>
				a) b)		
2210 - 2220	5%	95%	(20:75)		Lt.med./med.	Poor
2220 - 2230	5	95	(20:75)			
2230 - 2240	5	95	(30:65)		do.	do.
2240 - 2250	ab	100	(40:60)			
2250 - 2260	-	100	(40:60)		Lt.med./brown	do.
2260 - 2270	5	95	(30:65)			
2270 - 2280	10	90	(20:70)	White metabentonite pr.		
				Sandstone pr.	do.	do.
2280 - 2290	pr	100	(40:60)			
2290 - 2300	pr	100	(30:70)		do.	do.
2300 - 2310	-	100	(40:60)			Fair/poor
2310 - 2320	-	100	(40:60)		Lt.med/med.	Fair
2320 - 2340	pr	100	(50:50)		do.	Poor
2340 - 2350	-	75	(25:50)	25% dense buff ls. or dolomitic ls.	do.	Very good
2350 - 2360	5	95	(20:75)		Lt.med/brown	Fair
2360 - 2370	-	100	(30:70)	Lt. grey metabentonite Pyrite	do.	Fair/good
2370 - 2380	pr	100	(20:80)	Shale very dark grey	Lt.med./ brown	Fair/good
2380 - 2390	pr	95	(40:55)	5% dense dol. ls	do.	Good
2390 - 2400	-	90	(20:70)	10% do.	do.	do.
				Shale, light to medium grey, dense		
				Shale, dark grey, coarse		
				Limestone, buff grey, dense		
				Limestone, buff, very fine grained crystalline		
2400 - 2410	30%	60%	10%	-		
2410 - 2420	40	55	5	-	White and greenish grey metabentonite pr.	
2420 - 2430	20	70	5	0%	White metabentonite pr.	
2430 - 2440	Missing					
2440 - 2450	20	65	10	5		
2450 - 2460	10x	65	15	10	x greenish grey	
2460 - 2470	10	65	15	10		
2470 - 2480	Missing					
2480 - 2490	10	50	25	15	White metabentonite pr.	
2490 - 2500	15	60	20	5	do.	
2500 - 2510	10	45	15	30		
2510 - 2520	10	55	15	20		
2520 - 2530	10	55	25	10	do., also pale grey-green metabentonite	

[illegible]

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				Shale, mostly dark grey
				Limestone, light buff, fine grained
				Calcareous dolomite, light grey, sugary, very fine grained
				Calcareous dolomite, dark grey, fine grained
3110 - 3120	40%	-	30% 30%	
3120 - 3130	45	5%	15 35	<u>Prasopora</u> <u>Camarotoechia</u>
3130 - 3140	30	10	20 40	Plicated brachiopods Dark brown Crinoids chert
3140 - 3150	30	10	25 35	
3150 - 3160	15	5	10 70	<u>Rafinesquina</u>
				Limestone, dark buff, semi-lithographic to dense
3160 - 3170	15	5%	15 65	
3170 - 3180	30	5	25 40	Plicated brachiopods. Quartz grains to Imm.
3180 - 3190	40	10	20 30	
3190 - 3200	50	10	10 30	
				Shale, mostly dark
				Limestone, medium grey, to light buff, medium grained
3200 - 3210	25%	pr	45% 30%	
3210 - 3220	20	5%	35 40	Crinoids <u>Rafinesquina</u> , plicated brachiopods
3220 - 3230	No sample			
3230 - 3240	30	-	20 50	Olive-green metabentonite
3240 - 3250	45	-	20 35	
				<u>Rafinesquina</u>
3250 - 3260	40	5	10 45	<u>Lingula</u> poor graptolites <u>Serpulites</u>
3260 - 3270	40	-	10 50	
3270 - 3280	50	-	35 15	
3280 - 3290	15	5	15 65	
3290 - 3300	10	-	40 50	<u>Prasopora</u> <u>Rafinesquina</u> plicated brachiopods
3300 - 3310	20	-	40 40	
3310 - 3320	15	5	20 60	<u>Prasopora</u>
3320 - 3330	No sample			
3330 - 3340	15	-	15 70	Crinoids <u>Camarotoechia</u>
3340 - 3350	25	5	35 35	
3350 - 3360	No sample			
3360 - 3370	50	-	5 45	Pyrite <u>Prasopora</u> plicated brach.
3370 - 3380	30	-	5 65	
3380 - 3390	35	-	10 55	
3390 - 3400	40	-	5 55	
				Shale, mostly dark grey
				Dolomite, dense and very fine grained, brownish
				Dolomite fine grained and medium grained, light
3400 - 3410	40%	5%	55%	
3410 - 3420	35	5	60	
3420 - 3430	No sample			
3430 - 3440	30	10	60	Obscure fossils
3440 - 3450	No sample			
3450 - 3460	40	10	50	<u>Prasopora</u> <u>Rafinesquina</u> Crinoids
3460 - 3470	30	15	55	2 pieces sandstone pr.
3470 - 3480	30	20	50	ss. pr.
3480 - 3490	45	10	45	ss. pr.
3490 - 3500	45	10	40	ss. 5%
3500 - 3510	35	15	45	ss. 5%
3510 - 3520	30	10	50	ss. 10% Pyrite
3528				Bottom of hole

IMPERIAL LOWLANDS NO. 6 NICOLET WELL

Lowlands Exploration Limited

(DeBlois, 1959, p. 72)

Location

Lot: 11

Range: St. Joseph de l'Isle à la Fourche

Parish: Ste. Perpétue

County: Nicolet

Coords.: 200' from E. LL., 200' from N. LL.

Ground Elevation: 202'

KB Elevation: 215'

Spudded: Oct. 5, 1957

Completed: Dec. 26, 1957

Driller: Union Rotary

Type of Rig: Rotary

Result: Dry Hole

Log by T.H. Clark: (See revised log by T.H. Clark, below)

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 50
Lorraine	50 - 5046

The report on the Mining Industry in 1957, p. 59, adds:
"Cement plugs were set at 590 to 532 feet and 5 to 0 feet. A plate was welded to a collar which was screwed on the surface casing."

Imperial Lowlands No. 6 Nicolet

T.H. Clark, February, 1959

Summary Log

0 - 50 feet Overburden

Upper Lorraine 50 - 709 " Medium grey, fine-grained
sandstone (40%)
Medium grey shale, weakly cal-
careous, pale brown streak.
Medium grey siltstone.

709 - 1310 " Missing

Middle Lorraine 1310 - 2380 " Rock types as above, but
dominantly shale.

Lower Lorraine 2380 - 4180 " Rock types as above, shale even
more common.

Utica 4180 - 5046 " Shale, dark grey, calcareous,
pale brown streak.
Medium grey siltstone
Light grey, fine grained
sandstone.

- - - - -

Statistical Summary

	SANDSTONE	SILTSTONE	SHALE	LIMESTONE	DOLOMITE
U. Lorraine St. Hilaire member	40.1	27.4	32.5	-	-
M. Lorraine Chambly member	25.7	16.5	57.7	-	-
L. Lorraine Breault member	13.7	18.5	67.8	-	-
Utica	4.2	11.0	84.8	-	-

CONDENSED DIAGRAMMATIC LOG

LOWLANDS EXPLORATION LTD. NO. 6 - NICOLET

(Ste-Perpétue)

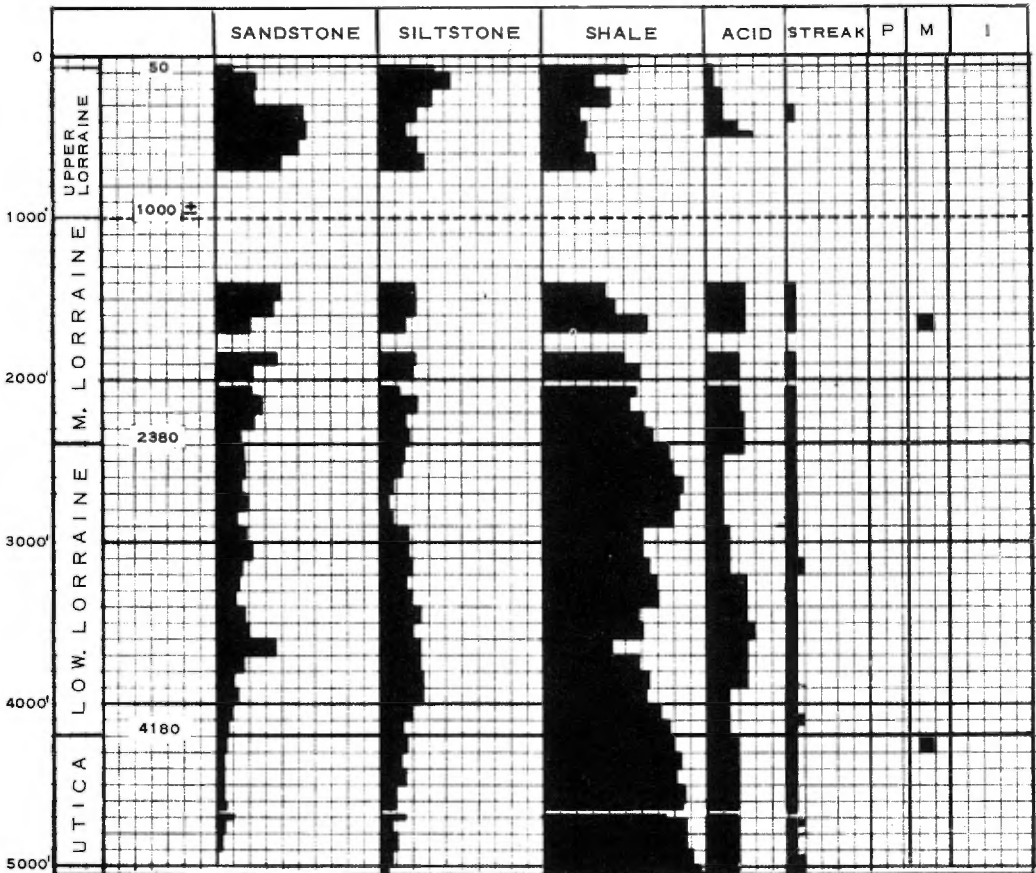


FIGURE 16

D.N.R.Q. 1962 NO. 1457

LOG OF IMPERIAL LOWLANDS NICOLET NO. 6 (ST. PERPÉTUE) WELL

LOWLANDS EXPLORATION LIMITED

Depth in feet	Description			Rotary Rig Cuttings	
0 - 50	Overburden				
	L O R R A I N E	Sandstone, medium grey, fine grained			
		Siltstone, medium grey			
		Shale, medium grey		<u>Streak</u>	<u>Acid</u>
50 - 60		40%	60%	White/faint	Very weak
60 - 70		15%	30	55	do.
70 - 80		No sample			
80 - 90		10	15	75	do.
90 - 100		25	55	20	do.
100 - 110		30	50	20	do.
110 - 120		70	20	10	do.
120 - 130	U P P E R	25*	25	50	* dark mica abundant
130 - 140		No sample			
140 - 150		20	45	35	do.
150 - 160		10	50	40	White
160 - 170		20	60	20	do.
170 - 180		10	50	40	do.
180 - 190		15	50	35	do.
190 - 200		No sample			
200 - 210		5	60	35	brachiopod fragments
210 - 220		20	50	30	do.
220 - 230		5	40	55	White/faint
230 - 240		5	30	65	A few quartz-calcite veins
240 - 250		10	30	60	White
250 - 260		No sample			
260 - 270		20	25	55	1 pc. lt. brown cryst. limestone
270 - 280		30	30	40	do.
280 - 290		80	10	10	do.
290 - 300		40	20	40	do.
300 - 310		60	20	20	2 pc. ls. as above
310 - 320		45	30	25	White/faint
320 - 330		50	30	20	do.
330 - 340		80	10	10	do.
340 - 350		45	25	30	do.
350 - 360		25	45	30	do.

		Sandstone, medium grey, fine grained					
		Siltstone, medium grey					
				Shale, medium grey	<u>Streak</u>	<u>Acid</u>	
360 - 370	UPPER LORRAINE	70%	20%	10%	do.	do.	
370 - 380		65	15	20	do.	do.	
380 - 390		60	20	20	do.	do.	
390 - 400		40*	20	40	* 1 crinoid stem	White	Weak
400 - 410		30	15	55	1 pc. ls. lt. brown cryst.	do.	do.
410 - 420		40	20	40		do.	do.
420 - 430		50	10	40		do.	do.
430 - 440		50*	20	30	* 1 crinoid stem	do.	do.
440 - 450		65*	15	20	* 1 crinoid stem	do.	do.
450 - 460		60	20	20	1 crinoid stem	do.	do.
460 - 470	50	20	30		do.	do.	
470 - 480	70	10	20		do.	do.	
480 - 490	75*	10	15	* Plicated brachiopod fragments	do.	do.	
490 - 500	UPPER LORRAINE	60	25	15		do.	do.
500 - 510		25	40	35	2 pc. lt. brown ls. crystalline	do.	do.
510 - 520		60	10	30		do.	do.
520 - 530		50	30	20	One slickenside	do.	do.
530 - 540		50	20	30		do.	do.
540 - 550		80	10	10		do.	do.
550 - 560		50	25	25		do.	Poor
560 - 570		50	30	20		do.	do.
570 - 580		60	10	30		White	Poor
580 - 590		30	20	50	2 pieces ls., lt. brown crystalline	do.	do.
590 - 678		No samples					
678 - 695		40	30	30	do.	do.	
695 - 709		40	25	35	do.	do.	
709 - 1310		No samples			<u>Upper Lorraine</u> boundary at 1000± <u>Middle Lorraine</u>		
1310 - 1320	MIDDLE LORRAINE	40	20	40	White/faint	Faint/ poor	
1320 - 1350		No samples					
1350 - 1360		50	20	30	do.	do.	
1360 - 1370		50	25	25	do.	do.	
1370 - 1380		20	20	60	A few pc. br. ls.	do.	do.
1380 - 1500		No samples					
1500 - 1510		25	20	55	A few pc. brown ls.	do.	do.
1510 - 1520		25	30	45		do.	do.
1520 - 1530		30	35	35		do.	do.
1530 - 1540		60	10	30		do.	do.
1540 - 1550	30	20	50		do.	do.	

			Sandstone, medium grey, fine grained		
			Siltstone, medium grey		
			Shale, medium grey	<u>Streak</u>	<u>Acid</u>
		15% 20% 65%		White/pale	Fair/ poor
1550 - 1560					
1560 - 1570	40	20	40	do.	do.
1570 - 1580	40	30	30	do.	do.
1580 - 1590	50	10	40	do.	do.
1590 - 1600	25	20	55	do.	do.
1600 - 1610	15	30	55 Fragments of fossils	do.	do.
1610 - 1620	40	10	50	do.	do.
1620 - 1630	20	20	60	do.	do.
1630 - 1640	25	20	55	do.	do.
1640 - 1650	15	20	65 Light grey metabentonite	do.	do.
1650 - 1660	15	20	65 Poor sample	do.	do.
1660 - 1670	5	10	85 do.	do.	do.
1670 - 1680	5	10	85 do.	do.	do.
1680 - 1690	No sample				
1690 - 1700	40	10	50		
1700 - 1830	No samples				
1830 - 1840	40	10	50	White/pale	Poor
1840 - 1850	40	10	50 Poor sample	do.	do.
1850 - 1860	40	10	50 do.	do.	do.
1860 - 1870	40	10	50	do.	do.
1870 - 1880	40	10	50	do.	Poor/fair
1880 - 1890	30	20	50	do.	do.
1890 - 1900	No sample				
1900 - 1910	25	10	65	White	Poor
1910 - 1920	10	10	60	do.	do.
1920 - 1930	20	5	75	do.	do.
1930 - 1940	20	10	70	do.	do.
1940 - 1950	25	10	65	do.	do.
1950 - 1960	10	5	85	do.	do.
1960 - 1970	10	20	70	do.	do.
1970 - 1980	25	10	65	do.	do.
1980 - 1990	45	10	45	do.	do.
1990 - 2030	No samples				
2030 - 2040	70	5	25	do.	do.
2040 - 2050	45	10	45	do.	do.
2050 - 2060	30	10	60	White	Poor
2060 - 2070	20	10	70	do.	do.
2070 - 2080	10	10	80 Poor sample	do.	do.
2080 - 2090	5	20	75	do.	do.
2090 - 2100	20	20	60	White/faint	do.

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			Sandstone, medium grey, fine grained		
			Siltstone, medium grey		
			Shale, medium grey	Streak	Acid
2510 - 2520	-	10%	90%	do.	do.
2520 - 2530	15%	10	75	do.	do.
2530 - 2540	-	10	90	do.	do.
2540 - 2550	10	5	85	do.	do.
2550 - 2560	pr	20	80	do.	do.
2560 - 2570	5*	15	80 * 1 piece brown quartzite	do.	do.
2570 - 2580	5	15	80	do.	Weak/poor
2580 - 2590	20	10	70	do.	do.
2590 - 2600	15	15	70	White/faint	Weak/poor
2600 - 2610	pr	10	90	do.	do.
2610 - 2620	5	5	90	do.	do.
2620 - 2630	5	5	90	do.	do.
2630 - 2640	-	10	90	do.	do.
2640 - 2650	5	5	90	do.	do.
2650 - 2660	5	5	90	do.	Poor
2660 - 2670	5	10	85	do.	do.
2670 - 2680	5	10	85	do.	do.
2680 - 2690	10	15	75	do.	do.
2690 - 2700	5	10	85	do.	do.
2700 - 2710	pr	10	90 Small fragments brachiopods etc.	do.	do.
2710 - 2720	5	10	85	do.	do.
2720 - 2730	5	5	90	do.	do.
2730 - 2740	15	5	80	do.	do.
2740 - 2750	15	10	75	do.	do.
2750 - 2760	15	5	80	do.	do.
2760 - 2770	5	5	90	do.	do.
2770 - 2780	5	5	90	White/faint	Poor
2780 - 2790	10	5	85	do.	do.
2790 - 2800	15	5	80	do.	do.
2800 - 2810	5	5	90	do.	do.
2810 - 2820	10	10	80	do.	do.
2820 - 2830	pr	5	95	do.	do.
2830 - 2840	10	5	85	do.	do.
2840 - 2850	20	10	70	do.	do.
2850 - 2860	10	10	80	do.	do.
2860 - 2870	15	5	80	do.	do.
2870 - 2880	15	5	80	do.	do.
2880 - 2890	10	5	85	do.	do.
2890 - 2900	15	15	70	do.	do.

				Sandstone, medium grey, fine grained		
				Siltstone, medium grey		
				Shale, medium grey	<u>Streak</u>	<u>Acid</u>
2900 - 2910	20%	10%	70%	Fragments of pelecypods	White/pale	Weak
2910 - 2920	40	20	40		do.	Poor
2920 - 2930	15	10	75		do.	do.
2930 - 2940	10	20	70		White/pale	Poor/ weak
2940 - 2950	15	20	65		do.	do.
2950 - 2960	10	20	70		do.	do.
2960 - 2970	5	25	70		do.	do.
2970 - 2980	20	30	50		do.	do.
2980 - 2990	20	15	65		do.	do.
2990 - 3000	25	15	60		do.	do.
3000 - 3010	20	25	55		do.	do.
3010 - 3020	30	10	60		do.	do.
3020 - 3030	20	25	55		do.	do.
3030 - 3040	20	35	45		do.	do.
3040 - 3050	25	20	55		do.	do.
3050 - 3060	35	10	55		do.	do.
3060 - 3070	20	10	70		do.	do.
3070 - 3080	30	10	60		do.	do.
3080 - 3090	pr	10	90		do.	do.
3090 - 3100	5	25	70		do.	do.
3100 - 3110	5	25	70		White/pale	Poor/ weak
3110 - 3120	10	20	70		do.	do.
3120 - 3130	pr	15	85		do.	do.
3130 - 3140	pr	10	90		do.	do.
3140 - 3150	25	20	55		White/light	do.
3150 - 3160	20	30	50		do.	do.
3160 - 3170	25	30	45	Fragment of <u>Triarthrus</u>	do.	do.
3170 - 3180	30	20	50		do.	do.
3180 - 3190	5	10	85		do.	do.
3190 - 3200	25	20	55		White/faint	Fair/ poor
3200 - 3210	20	30	50		do.	do.
3210 - 3220	10	20	70		do.	do.
3220 - 3230	20	10	70		do.	do.
3230 - 3240	25	15	60		do.	do.
3240 - 3250	15	10	75		White/pale	do.
3250 - 3260	10	10	80		do.	Fair
3260 - 3270	20	15	65		do.	do.
3270 - 3280	10	15	75		do.	Fair/poor
3280 - 3290	pr	20	80		do.	do.

	Sandstone, medium grey, fine grained				
	Siltstone, medium grey				
	Shale, medium grey			<u>Streak</u>	<u>Acid</u>
3290 - 3300	5%	15%	80%	White/pale	Fair/ poor
	<u>CORE TAKEN 3300 - 3305 See end of log</u>				
3300 - 3310	5	10	85	do.	do.
3310 - 3320	5	15	80	do.	do.
3320 - 3330	20	20	60	do.	do.
3330 - 3340	15	15	70	do.	do.
3340 - 3350	15	25	60	do.	do.
3350 - 3360	10	15	75	do.	do.
3360 - 3370	10	15	75	do.	do.
3370 - 3380	pr	15	85	do.	do.
3380 - 3390	25	35	40	do.	do.
3390 - 3400	pr	15	85	do.	do.
3400 - 3410	25	25	50	do.	Weak
3410 - 3420	10	70	20	do.	do.
3420 - 3430	5	15	80	do.	Fair/poor
3430 - 3440	10	15	75	do.	do.
3440 - 3450	30	20	50	do.	do.
3450 - 3460	50	15	35	White/pale	Fair/ poor
3460 - 3470	10	15	75	do.	do.
3470 - 3480	5	15	80	White/pale	do.
3480 - 3490	10	20	70	do.	do.
3490 - 3500	10	30	60	White/faint	do.
3500 - 3510	10	20	70	do.	do.
3510 - 3520	5	25	70	do.	Fair
3520 - 3530	10	15	75	do.	do.
3530 - 3540	10	15	75	do.	do.
3540 - 3550	30	20	50	do.	do.
3550 - 3560	20	20	60	do.	do.
3560 - 3570	15	20	65	do.	do.
3570 - 3580	20	30	50	do.	do.
3580 - 3590	20	10	70	do.	do.
3590 - 3600	50	20	30	do.	Weak/poor
3600 - 3610	55	20	25	do.	do.
3610 - 3620	45	20	35	do.	do.
3620 - 3630	30	35	35	do.	do.
3630 - 3640	20	30	50	White/faint	Weak, poor
3640 - 3650	20	30	50	do.	do.
3650 - 3660	50	20	30	do.	do.
3660 - 3670	50	30	20	do.	do.

		Sandstone, medium grey, fine grained				
			Siltstone, medium grey			
				Shale, medium grey	<u>Streak</u>	<u>Acid</u>
3670 - 3680	30%	20%	50%		do.	do.
3680 - 3690	20	20	60		do.	do.
3690 - 3700	25	20	55		do.	do.
3700 - 3710	20x	25	55	x <u>Catazyga</u> fragments	do.	do.
3710 - 3720	10	25	65		do.	do.
3720 - 3730	pr	20	80		White/light	Weak
3730 - 3740	25	30	45		do.	Poor/weak
3740 - 3750	30	20	50		White/faint	do.
3750 - 3760	20	30	50		do.	do.
3760 - 3770	30	30	40		do.	do.
3770 - 3780	15	20	65		do.	do.
3780 - 3790	15	30	55		do.	do.
3790 - 3800	5	10	85		White/pale	do.
3800 - 3810	10x	10	80	x <u>Catazyga</u> fragments	do.	do.
3810 - 3820	5	25	70		do.	do.
3820 - 3830	10	25	65		White/pale	Poor/weak
3830 - 3840	5	10	85		do.	do.
3840 - 3850	10	20	70		do.	do.
3850 - 3860	10	25	65		do.	do.
3860 - 3870	20	25	55		do.	do.
3870 - 3880	15	20	65		do.	do.
3880 - 3883	No sample					
3883 - 3890	-	20	80		do.	Weak
3890 - 3900	10	75	15		White/faint	Poor/weak
3900 - 3910	10	15	75		do.	do.
3910 - 3920	10	20	70		do.	do.
3920 - 3930	5	25	70		do.	do.
3930 - 3940	10	30	60		do.	do.
3940 - 3950	15	20	65		White/pale	do.
3950 - 3960	10	30	60		do.	do.
3960 - 3970	15	40	45		do.	do.
3970 - 3980	10	30	60		do.	do.
3980 - 3990	15	25	60		do.	do.
3990 - 4000	20	25	55		do.	do.
4000 - 4010	15	30	55		White/faint	Poor/weak
4010 - 4020	20	30	50		do.	do.
4020 - 4030	10	20	70		do.	do.
4030 - 4040	pr	20	80		do.	do.
4040 - 4050	pr	25	75		White/pale	do.

				Sandstone, medium grey, fine grained		
				Siltstone, medium grey		
				Shale, medium grey	<u>Streak</u>	<u>Acid</u>
4050 - 4060	pr	10%	90%		do.	do.
4060 - 4070	20%	20	60		do.	do.
4070 - 4080	5	10	85		White/light	Poor
4080 - 4090	10	10	80		do.	do.
4090 - 4100	15	10	75		White/pale	Weak
4100 - 4110	pr	20	80	Slickensides pr.	White/pale	Poor/ weak
4110 - 4120	15	10	75	Finely banded 1-2mm.	do.	Weak
4120 - 4130	20	10	70		do.	do.
4130 - 4140	10	10	80		White/light	do.
4140 - 4150	5	15	80		do.	do.
4150 - 4160	5	10	85	Finely banded 1-2mm.	White/pale	do.
4160 - 4170	5	15	80		do.	do.
4170 - 4180	15	10	75		White/pale	Weak
4180 - 4190	5	15	80	Yellow metabentonite pr.	do.	do.
4190 - 4200	5	10	85	do..	do.	do.
4200 - 4210	5	10	85	do.	do.	do.
4210 - 4220	No sample					
				Sandstone, light to medium grey, fine grained		
				Siltstone, medium dark grey		
				Shale, dark grey		
4220 - 4230	5%	25%	70%		do.	do.
4230 - 4240	5	15	80	1 twig bryozoan	do.	do.
4240 - 4250	5	10	85	Yellow grey metabentonite pr.	do.	do.
4250 - 4260	5	25	70		do.	do.
4260 - 4270	5	10	85		do.	do.
4270 - 4280	5	10	85	do.	do.	do.
4280 - 4290	pr	10	90	do.	do.	do.
4290 - 4300	20	10	70		do.	do.
4300 - 4310	pr	15	85		do.	do.
4310 - 4320	10	10	80		do.	do.
4320 - 4330	5	5	90		do.	do.
4330 - 4340	5	15	80		White/pale	Weak
4340 - 4350	5	5	90		do.	do.
4350 - 4360	5	20	75		do.	do.
4360 - 4370	5	15	80		do.	do.

				Sandstone, light to medium grey, fine grained		
				Siltstone, medium grey		
				Shale, dark grey	<u>Streak</u>	<u>Acid</u>
4370 - 4380	5%	5%	90%		do.	do.
4380 - 4390	5	10	85		do.	do.
4390 - 4400	pr	10	90		do.	do.
4400 - 4410	-	25	75		do.	do.
4410 - 4420	pr	10	90		do.	do.
4420 - 4430	5	10	85		do.	do.
4430 - 4440	5	10	85		do.	do.
4440 - 4450	5	30	65		do.	do.
4450 - 4460	5	20	75		do.	do.
4460 - 4470	10	10	80		do.	do.
4470 - 4480	5	10	85		do.	do.
4480 - 4490	5	10	85		do.	do.
4490 - 4500	pr	10	90		White/pale	Weak
4500 - 4510	pr	15	85		do.	do.
4510 - 4520	No sample					
4520 - 4530	10	10	80		do.	do.
4530 - 4540	5	10	85	Yellow metabentonite pr.	do.	do.
4540 - 4550	pr	5	95		do.	do.
4550 - 4560	5	5	90		do.	do.
4560 - 4570	5	10	85		do.	do.
4570 - 4580	pr	5	95		White/light	do.
4580 - 4590	5	10	85		do.	do.
				Shale, dark grey		
4590 - 4600	5	10	85		do.	do.
4600 - 4610	pr	10	90	Yellow-grey metabentonite pr.	do.	do.
4610 - 4620	0	15	85		White/pale	do.
4620 - 4630	5	10	85		do.	do.
4630 - 4640	5	10	85		do.	do.
4640 - 4650	5	10	85		White/pale	Weak
4650 - 4680	No samples					
				CORE 4661/4676		
				See end of log		
4680 - 4690	pr	20	80		do.	do.
4690 - 4700	20	10	70x	* splintery fracture	do.	do.
4700 - 4710	-	20	80	do.	do.	do.
4710 - 4720	5	5	90	do.	do.	do.
4720 - 4730	5	10	85	do.	do.	do.
4730 - 4740	pr	10	90	do.	do.	do.
4740 - 4750	pr	5	95	do.	do.	do.

			Sandstone, light to medium grey, fine grained		
			Siltstone, medium grey		
			Shale, dark grey	<u>Streak</u>	<u>Acid</u>
4750 - 4760	-	5%	95% do.	do.	do.
4760 - 4770	5%	5	90	do.	do.
4770 - 4780	pr	5	95	White/light	do.
4780 - 4790	10	5	85 do.	do.	do.
4790 - 4800	5	5	90 do.	White/pale	do.
4800 - 4810	-	10	90	do.	do.
4810 - 4820	pr	10	90	do.	do.
4820 - 4830	pr	10	90	do.	do.
			Shale, dark grey (not black)		
4830 - 4840	-	10	90%	White/light	Weak
4840 - 4950	10	25	65 calcite veins	do.	do.
4850 - 4860	5	10	85 do.	do.	do.
4860 - 4870	-	10	90	do.	do.
4870 - 4880	-	5	95	White/pale	do.
4880 - 4890	-	pr	100 do.	do.	do.
4890 - 4900	pr	5	95 do.	do.	do.
4900 - 4910	-	5	95 do., calcite veins common slicken- sides pr.	do.	do.
4910 - 4920	-	pr	100	do.	do.
4920 - 4930	5	5	90	do.	do.
4930 - 4940	pr	10	90 slickensides pr.	do.	do.
4940 - 4950	-	5	95	do.	do.
4950 - 4960	pr	10	90 do.	do.	do.
4960 - 4970	pr	10	90	do.	do.
4970 - 4980	pr	10	90	do.	do.
4980 - 4990	pr	10	90 do.	do.	do.
4990 - 5000	pr	15	85	White/light	Weak
5000 - 5010	-	5	95 calcite veins common Slickensides pr.	do.	do.
5010 - 5020	pr	10	90	do.	do.
5020 - 5030	-	10	90 do. do.	do.	do.
5030 - 5040	pr	15	85	do.	do.
5046			Bottom of hole		

IMPERIAL LOWLANDS NICOLET NO. 6 (ST. PERPÉTUE)

LOWLANDS EXPLORATION LIMITED

Depth in feet	Description	<u>Diamond drill core</u>
3300 - 3305 (Lower Lorraine)	Silty shale and siltstone, with a few thin, light grey, sandy beds. Fairly hard Effervescence very slight Streak white to light grey-brown Bedding planes fairly rough, none flat. No black shales Bedding dips uniformly about 20°	<u>Leptobolus insignis</u> C Graptolites present <u>Geisonoceras</u> sp.
4661 - 4666 (Utica)	Very dark grey, almost black, silty shale. Sandy, cross-bedded layers present but rare Streak white to pale brown Effervescence weak 4661-4662 abundance of small graptolites 4662 1/2 slickensides on bedding planes	
4666 - 4676 (Utica)	Black silty shale Sandy, cross-bedded beds 1mm. thick, in groups up to 10mm. Streak white to pale brown on darker beds Effervescence very weak Mostly unfossiliferous, but a few layers rich in small graptolites	

SOUTH SHORE NO. 1 WELL

South Shore Oil Lands Limited

DeBlois, 1959, p. 121

Location:

Lot: 543
Concession: Sud-Ouest de l'Ile
Parish: La Visitation
County: Yamaska
Coords.: East bank, S.W. branch of Nicolet River,
3 miles above La Visitation

Ground Elevation: 149'

RF Elevation: 151'

Spudded: Oct. 13, 1931

Completed: March, 1932

Type of Rig: Cable

Result: Dry Hole

Water

Fresh at: 70'

Log by Belyea:

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 75
Lorraine	75 - 3200

SOUTH SHORE NO. 1

Que. Bur. Mines, Mining Operations for 1931, p. 62, 1932.

" The ... well at La Visitation, owned by South Shore Oil Lands, Ltd., was spudded on October 13th, 1931, but, as a result of lost tools and very bad caving, it was abandoned in March, 1932. A new site was chosen in the same locality, and drilling was under way on the 26th of April."

Snider, L.C. and Farish, L.M., Natural Gas in Quebec, etc. Geology of Natural Gas. Amer. Assoc. Petrol. Geologists, p. 102, 1935.

"South Shore Oil Lands, Ltd., on east bank of west branch of Nicolet River, 3 miles above the village of La Visitation, drilled 1931-1932. Started drilling about 525 feet below the Queenston-Lower Richmond contact and drilled to 3,200 feet without encountering the Trenton limestone. No igneous rock and no encouraging showings of oil or gas were reported. Location is near the crest of an anticline, but the plunge of the axis cannot be determined. A second well is being drilled about 0.25 mile from the site of Well No. 1."

Ann. Rept. Quebec Bur. Mines. Part A. Mining Operations and Statistics for 1932, p. 48, 1933.

"The first boring of South Shore Oil Lands, Ltd., at La Visitation, in Yamaska county, which had been started in October, 1931, met with a very bad caving when nearly 3,000 feet deep, and a lost string of tools could not be fished out. The well was abandoned in March, 1932, and a second was started in April 26th in the same locality. This well had reached a depth of 4,400 feet in August 1932. The results, however, were disappointing. The Lorraine beds are either duplicated by faulting or else they are very steeply inclined, as their thickness is far in excess of what normally would be expected from indications secured from other wells. The normal section in this general region should show, according to the estimates of the Geological Survey, approximately 300 feet of Lower Richmond, 2,500 feet of Lorraine, 350 feet of Utica, and possibly 1,000 feet of Trenton. The company had thus to choose between having to drill, possibly, beyond 6,000 feet to reach the Trenton horizon, or else abandon the well. The drilling rig was dismantled and stored on the site of the well."

SOUTH SHORE NO. 1 WELL

Belyea, 1952, pages 106 - 109

"Location: lot 543, concession Sud Ouest de l'Ile, Paroisse de la Visitation; east bank southwest branch of Nicolet River, 3 miles above la Visitation, Yamaska county, Quebec

Drilled: 1931-32

Rig: cable

Total depth: 3,200 feet

Samples examined by H.R. Belyea, 1946

Depth	Lithology
Feet	
	Lorraine
75 - 95	Shale, greenish grey, soft, drills to rounded fragments, in part finely silty; 40 to 50 per cent greenish grey, impure, fissile, micaceous siltstone and fine-grained sandstone; calcareous cement; bryozoa
95 - 145	Siltstone and fine-grained sandstone, as above; 30 to 40 per cent shale, as above; bryozoa
145 - 155	Siltstone, fine sandstone, and shale, as above; crinoid stem
155 - 205	Missing
205 - 215	Sandstone, greenish grey, fine grained; grades to micaceous, fissile siltstone with calcareous cement; recrystallized shell fragments; 20 to 30 per cent shale, greenish grey, in part finely silty, fossiliferous; bryozoa, crinoid disks, and brachiopods; slickensides and calcite veins; some pale green shaly material may be from fault or metabentonite
215 - 225	Siltstone and fine-grained sandstone, same as above; about 40 per cent shale, as above; a little light grey, fine limestone; Ctenodonta
225 - 245	Siltstone and fine-grained sandstone, as above; about 40 per cent shale, greenish grey, finely silty, as above; few bryozoa and crinoid disks; slickensides, fractures, calcite veins, and sheared green shale 235 to 245 feet
245 - 255	Shale, green, finely silty, as above; about 30 per cent siltstone and fine-grained sandstone, as above; a few fossil fragments
255 - 295	Shale, siltstone, and fine sandstone, as above; calcite veins from 255 to 275 feet
295 - 305	Siltstone and fine-grained sandstone, as above; about 30 per cent greenish grey shale, finely silty; a few fossil fragments
305 - 335	Siltstone, fine sandstone, and shale, as above; bryozoa; calcite veins; pyrite 315 to 325 feet
335 - 345	Siltstone, fine sandstone, and shale, as above; crinoid disks
345 - 375	Siltstone, fine sandstone, and shale; brachiopod, bryozoa, and crinoid fragments
375 - 395	Shale, as above, and some grey, fissile, micaceous, finely silty shale; bryozoa
395 - 415	Shale, grey, soft; drills to rounded fragments; siltstone, grey, micaceous, laminated, slightly calcareous; a little coarsely crystalline shell limestone; crinoids; vein calcite; pyrite
415 - 425	Shale and siltstone, as above; vein calcite, slickensides
425 - 455	Shale and siltstone, as above; bryozoa 445 to 455 feet
455 - 495	Siltstone and fine-grained sandstone, greenish grey, as above; 30 to 40 per cent shale, greenish grey, as above; brown stain on most fragments; crinoids and bryozoa
495 - 505	Siltstone, fine sandstone, and shale, as above; crinoids, bryozoa, and pelecypod fragment
505 - 515	Shale, light greenish grey, same as above; siltstone as above; a little coarse sandy shell limestone
515 - 525	Shale, siltstone, and shell limestone, as above; bryozoa; vein calcite
525 - 535	Shale, siltstone, and a little shell limestone; bryozoa, crinoids, and brachiopods
535 - 545	Shale and siltstone, as above
545 - 565	Shale, light greenish grey, as above; some grey, finely silty, fissile shale; siltstone, as above; fractures and calcite veins; gastropod fragment at 555 to 565 feet

Depth	Lithology
Feet	Lorraine - con.
565 - 575	Shale and siltstone, as above, with brown stain
575 - 605	Shale, greenish grey and grey, fissile, as above; a little siltstone, as above
605 - 615	Shale and a little siltstone, as above; calcite veins
615 - 645	Shale and a little siltstone; brachiopod fragment 615 to 625 feet
645 - 665	Shale and siltstone, as above, with brown stain
665 - 675	Shale, greenish grey to grey, fissile, as above; much siltstone grading to fine-grained sandstone, as above; few fossils
675 - 685	Shale, siltstone, and sandstone, as above; fractures and vein calcite
685 - 705	Shale, siltstone, and sandstone, as above; brachiopod imprint, 695 to 705 feet
705 - 755	Shale, siltstone, and sandstone, as above; crinoid disks, 705 to 725 feet
755 - 765	Shale, siltstone, and sandstone; fragment of Proetus
765 - 785	Shale, siltstone, and sandstone, as above; crinoid disks
785 - 825	Shale, siltstone, and sandstone, in part interlaminated; ostracods 785 to 805 feet
825 - 835	Shale, siltstone, and sandstone; fragment of Ctenodonta
835 - 845	Shale, siltstone, and sandstone, as above; crinoid disks
845 - 905	Shale, greenish grey; rounded fragments, as above; greater proportion of grey, fissile shale; siltstone and fine sandstone, as above; a few fossil fragments
905 - 915	Shale and siltstone, in part interlaminated
915 - 925	Siltstone and fine-grained sandstone, light grey, as above; shale, chiefly grey, fissile; some interlaminated shale and siltstone; brachiopod fragment
925 - 985	Siltstone and shale, as above; in part interlaminated
985 - 995	Siltstone and shale; in part interlaminated; crinoid disks
995 - 1,015	Siltstone and shale; crinoid fragments and inclusions of calcite - probably fossils
1,015 - 1,035	Siltstone and shale, as above; some sandy, recrystallized shell limestone
1,035 - 1,045	Siltstone and shale, as above; crinoid stem
1,045 - 1,125	Siltstone, fine-grained sandstone, and shale, as above
1,125 - 1,135	Siltstone, fine-grained sandstone, and shale, as above, with calcite veins
1,135 - 1,195	Siltstone, fine-grained sandstone, and shale, as above
1,195 - 1,225	Shale, chiefly greenish grey, some grey, fissile; much siltstone and fine-grained sandstone, as above; some recrystallized fossil fragments forming sandy limestone
1,225 - 1,265	Shale, grey, finely silty, fissile and irregularly bedded; some light grey, smooth, fissile shale and greenish grey shale, as above; much siltstone and fine-grained sandstone; bryozoa fragments 1,255 to 1,265 feet
1,265 - 1,275	Shale and siltstone, as above, with brown stain
1,275 - 1,305	Shale, as above; 10 to 20 per cent siltstone, as above; fossil fragments
1,305 - 1,315	Shale and siltstone, as above; fractures and calcite veins
1,315 - 1,405	Shale and siltstone, as above; bryozoa fragments 1,315 to 1,335 feet
1,405 - 1,425	Shale and siltstone, as above; brachiopod fragment 1,405 to 1,415 feet
1,425 - 1,455	Siltstone and fine-grained sandstone, as above; in part with fossil fragments making a sandy, shell limestone; shale, as above
1,455 - 1,475	Sandstone, fine-grained, as above; much siltstone and a little grey, fissile shale
1,475 - 1,495	Shale, grey, fissile, micaceous; grey, finely silty shale, with irregular cleavage; siltstone and fine-grained, grey, impure sandstone
1,495 - 1,505	Shale, siltstone, and fine sandstone, as above; brachiopod fragment
1,505 - 1,515	Shale, as above; some light grey, firm, smooth, fissile shale; siltstone, as above, in part varying to silty, shell limestone; bryozoa
1,515 - 1,565	Shale, siltstone, and fine sandstone, as above; bryozoa 1,555 to 1,565 feet; vein calcite 1,535 to 1,545 feet
1,565 - 1,575	Shale and siltstone, as above; in part interlaminated; crinoid disks
1,575 - 1,585	Shale, siltstone, and fine sandstone; a little sandy shell limestone; bryozoa, crinoid disks; trace pyrite
1,585 - 1,595	Shale, siltstone, and fine sandstone; vein calcite
1,595 - 1,625	Shale, siltstone, and fine sandstone, as above; brachiopod 1,615 to 1,625 feet
1,625 - 1,635	Siltstone and fine-grained sandstone; shale, as above
1,635 - 1,645	Shale, grey, fissile, micaceous; some light greenish grey shale and light grey, smooth, fissile shale; siltstone and fine-grained sandstone, as above; brachiopod fragments
1,645 - 1,655	Shale, grey, smooth, fissile; some interlaminated siltstone
1,655 - 1,695	Shale, grey, micaceous, finely silty, fissile in part; some greenish grey and light grey, smooth, fissile shale; siltstone and fine-grained sandstone, as above, some with recrystallized shell fragments
1,695 - 1,785	Shale, siltstone, and fine sandstone, as above; crinoid disks 1,695 to 1,715 feet; brachiopods 1,775 to 1,785 feet
1,785 - 1,805	Shale, siltstone, and fine sandstone; calcite veins
1,805 - 1,865	Shale, siltstone, and fine sandstone; fragment of Proetus 1,855 to 1,865 feet

Depth	Lithology
Feet	Lorraine - con.
1,865 - 1,945	Shale, grey, fissile, slightly silty; some shale with rough cleavage; siltstone and fine-grained sandstone, micaceous, laminated; black carbonaceous specks; some with recrystallized shell fragments; crinoid disks 1,875 to 1,885 feet
1,945 - 1,955	Shale and siltstone, as above; in part interlaminated; crinoid stems; calcite veins
1,955 - 1,975	Shale and siltstone, as above
1,975 - 1,995	Shale, as above; a little siltstone and silty shell limestone
1,995 - 2,005	Shale and siltstone, as above; brachiopod fragment
2,005 - 2,015	Shale, as above; more siltstone than above
2,015 - 2,065	Shale and siltstone, as above; fragment of Proetus 2,015 to 2,025 feet
2,065 - 2,075	Shale and siltstone, as above; slickensides and vein calcite
2,075 - 2,095	Shale, as above; 30 to 40 per cent siltstone; siltstone and shale, in part interlaminated
2,095 - 2,105	Shale and siltstone; stained brown
2,105 - 2,125	Shale and siltstone, as above
2,125 - 2,175	Shale, grey, fissile, micaceous, smooth; 30 to 40 per cent siltstone; some recrystallized shell fragments
2,175 - 2,215	Shale and siltstone, as above; vein calcite 2,175 to 2,185 feet
2,215 - 2,235	Siltstone, as above; some shale
2,235 - 2,245	Siltstone and shale, as above; metabentonite
2,245 - 2,265	Siltstone and shale, as above
2,265 - 2,275	Siltstone and shale, in part interlaminated
2,275 - 2,305	Siltstone and shale, as above
2,305 - 2,325	Siltstone and shale, as above; a little lighter grey, smooth, fissile shale
2,325 - 2,335	Siltstone and shale, as above; bryozoa and brachiopod
2,335 - 2,405	Siltstone and shale, as above; bryozoa 2,355 to 2,365 feet
2,405 - 2,435	Shale, grey, finely silty, fissile; some darker grey, silty shale with rough cleavage; a little grey, smooth, fissile, pencil shale, with pyrite nodules; much siltstone and fine-grained sandstone, as above
2,435 - 2,495	Siltstone and fine-grained sandstone, as above; shale, as above; bryozoa and broken shell fragments
2,495 - 2,565	Siltstone, fine sandstone, and shale, as above
2,565 - 2,575	Siltstone and shale, as above, with brown stain; a little brown, silty dolomite
2,575 - 2,585	Siltstone, fine-grained sandstone, light grey, slightly calcareous; black, carbonaceous specks; shale, as above
2,585 - 2,595	Siltstone, fine sandstone, and shale, as above; bryozoa fragments
2,595 - 2,605	Siltstone and shale, as above; metabentonite; calcite veins; bryozoa
2,605 - 2,615	Siltstone and shale, as above
2,615 - 2,645	Shale as above; some greenish grey shale; siltstone and fine sandstone about equal to shale in amount; bryozoa
2,645 - 2,665	Siltstone and sandstone, greenish grey, fine grained, slightly calcareous; shale, grey, fissile, silty, as above
2,665 - 2,675	Siltstone, sandstone, and shale, as above
2,675 - 2,695	Siltstone, sandstone, and shale, as above; brown stain; bryozoa
2,695 - 2,715	Shale, grey, fissile, finely silty and smooth, fissile, pyritic; much siltstone, as above; brachiopod and crinoids; Cornulites 2,705 to 2,715 feet
2,715 - 2,745	Shale and siltstone, as above
2,745 - 2,795	Siltstone and minor shale, as above
2,795 - 2,805	Siltstone and shale; metabentonite; calcite
2,805 - 2,865	Siltstone and shale, as above; pyrite; bryozoa 2,825 to 2,835 feet
2,865 - 2,875	Shale, mostly grey, smooth, fissile, pyritic; some darker grey, fissile shale; siltstone, as above; bryozoa
2,875 - 2,915	Shale and siltstone, as above
2,915 - 2,995	Shale, darker grey than above, finely silty, fissile; some dark grey, smooth, fissile shale; siltstone, light grey, calcareous
2,995 - 3,005	Shale, as above, in part pyritic; siltstone, as above; metabentonite; calcite
3,005 - 3,065	Shale, as above; in part pyritic; siltstone, as above
3,065 - 3,105	Shale, medium to dark grey, in part silty, with rough cleavage; some siltstone, as above
3,105 - 3,135	Shale, medium to dark grey, as above; a little shale with a brownish streak, finely silty, fissile; a little siltstone, as above
3,135 - 3,145	Shale, as above; a little siltstone; metabentonite; calcite veins
3,145 - 3,165	Shale, as above; a little siltstone; bryozoa 3,145 to 3,155 feet
3,165 - 3,175	Shale, medium to dark grey, as above; in part with a brown streak; a little brown, sandy dolomite
3,175 - 3,185	Shale, as above
3,185 - 3,200	Shale, dark grey, mostly with a brown streak

Note. This well appears to have been drilled almost entirely, if not entirely, in the Lorraine. The last samples, 3,175 to 3,200 feet, contain shales with a brown streak. These may be in the Utica or in the lower part of the Lorraine, which may give a brownish streak. The top of the well is probably not far below the Richmond. The South Shore No. 2 well, in lot 541, drilled through at least 100 feet of Richmond.

Ministère des Richesses naturelles
SERVICE DOCUMENTATION TECHNIQUE

SOUTH SHORE NO. 2 WELL

South Shore Oil Lands Limited

DeBlois, 1959, p. 122

Location

Lot: 541

Concession: Sud-Ouest de l'Ile

Parish: La Visitation

County: Yamaska

Coords.: 120' from W. LL., 50' from S. LL. and
300' from E. LL.

Ground Elevation: 99'

RF Elevation: 101'

Spudded: April 26, 1932

Completed: August, 1932

Type of Rig: Cable

Result: Dry Hole

Water

65', 640'

Log by Belyea:

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 110
Richmond (Pontgravé River)	110 - 210
Lorraine	210 - 4404

SOUTH SHORE NO. 2 WELL

Belyea, 1952, pages 109-113

"Location: lot 541, concession Sud Ouest de l'île, municipalité de la Paroisse de la Visitation,
Yamaska county, Quebec

Elevation: 150± feet

Drilled: 1932

Total depth: 4,100 feet

Rig: cable

Samples examined by H. R. Belyea, 1946

Depth	Lithology
Feet	Richmond
	Pontgravé River Formation
110 - 130	Shale, light greenish grey, soft, calcareous, fissile; siltstone, light grey, calcareous; limestone, light grey, dense
130 - 150	Shale, greenish grey, flaky; drills into rounded fragments; a little grey, calcareous siltstone; bryozoa
150 - 160	Shale, as above; some grey, fine limestone; bryozoa
160 - 180	Shale, as above; a little siltstone; bryozoa
180 - 190	Shale, as above; some calcareous siltstone and light grey, fine, silty limestone; <i>Zygospira kentuckyensis</i> identified by Alice E. Wilson
190 - 210	Shale, limestone, and siltstone, as above; bryozoa and crinoid disks; calcite veins 200 to 210 feet
	Lorraine
210 - 250	Shale, greenish grey, soft, flaky; drills to rounded fragments; varies to medium grey, fissile shale; siltstone and fine-grained sandstone, greenish grey, micaceous, slightly calcareous, laminated; contains black, carbonaceous specks; bryozoa and crinoids
250 - 260	Shale, as above; calcite veins
260 - 280	Shale, as above; some siltstone
280 - 310	Shale and siltstone, as above; fragments of brachiopods, bryozoa, and crinoids
310 - 320	Shale, as above; calcite veins; some siltstone
320 - 340	Shale, as above; some siltstone
340 - 350	Shale and siltstone, as above, but with brown stain
350 - 410	Shale and siltstone, as above; bryozoa 350 to 360 feet
410 - 420	Shale and a little siltstone, as above, but with a brown stain
420 - 480	Shale, as above; a little siltstone, as above; calcite veins, and fractures 450 to 460 feet
480 - 490	Shale and a little siltstone, as above; calcite veins; crinoid disks
490 - 520	Shale and a little siltstone, as above, but with slickensides, fractures, and calcite veins
520 - 540	Shale and a little siltstone, as above; trilobite fragment at 530 to 540 feet
540 - 550	Shale, greenish grey, similar to above; siltstone, greenish grey, as above; sandy limestone composed of coarsely recrystallized shell fragments, probably same as sandy shell limestone lenses seen in outcrops; calcite veins
550 - 570	Shale and siltstone, as above; slickensides and calcite veins
570 - 590	Shale and siltstone, as above; crinoid disks
590 - 610	Shale, greenish grey, flaky, and greenish grey, fissile, as above, but with a larger proportion of fissile shale; light greenish grey, calcareous siltstone, as above; bryozoa
610 - 630	Shale and siltstone, as above, but with a greater proportion of siltstone
630 - 650	Shale and siltstone, as above, in about equal amounts; sandy shell limestone; brachiopods, bryozoa, and crinoid disks
650 - 700	Shale and siltstone, as above; bryozoa, 650 to 680 feet
700 - 710	Shale, as above; more siltstone than above; sandy shell limestone; bryozoa
710 - 760	Shale and siltstone, as above, with calcite veins from 730 to 760 feet
760 - 770	Shale, siltstone, and sandy shell limestone; crinoid disks; calcite
770 - 830	Shale and siltstone; bryozoa, crinoid disks
830 - 910	Shale and siltstone; bryozoa 830 to 860 feet; brachiopods 890 to 910 feet
910 - 920	Shale, siltstone, and sandy limestone; slickensides
920 - 950	Shale and siltstone, as above
950 - 970	Shale and siltstone; sandy recrystallized shell limestone; bryozoa; slickensides and calcite veins
970 - 1,010	Shale and siltstone, as above; calcite veins
1,010 - 1,020	Shale, as above; siltstone, as above, in part very calcareous; fossil fragments
1,020 - 1,040	Shale and siltstone, as above; bryozoa; calcite veins
1,040 - 1,070	Shale and siltstone, as above, with calcite

Depth	Lithology
Feet	Lorraine - con.
1,070 - 1,090	Shale, siltstone, and sandy shell limestone; bryozoa and crinoid disks 1,080 to 1,090 feet
1,090 - 1,100	Shale and siltstone; slickensides and calcite veins
1,100 - 1,110	Shale, as above; siltstone, as above, with fossil fragments
1,110 - 1,160	Shale and siltstone; abundant bryozoa
1,160 - 1,170	Shale, greenish grey, mostly darker than above, fissile, splintery, micaceous, slightly silty; some light greenish grey shale, in rounded fragments, as above; siltstone and fine-grained sandstone, light greenish grey, laminated, impure, micaceous, calcareous, in part interlaminated with shale; scattered fossil fragments
1,170 - 1,280	Shale, siltstone, and fine sandstone, as above; bryozoa 1,170 to 1,180 feet; gastropod 1,220 to 1,230 feet; crinoid disk 1,270 to 1,280 feet
1,280 - 1,290	Shale, siltstone, and fine sandstone; fossiliferous; in part grading to a sandy shell limestone
1,290 - 1,310	Shale, siltstone, and sandstone, as above
1,310 - 1,320	Shale, as above; more siltstone and fine sandstone than above; brachiopods and recrystallized fossil fragments
1,320 - 1,370	Shale, siltstone, and fine sandstone, greenish grey, as above; grades to sandy shell limestone
1,370 - 1,400	Shale, siltstone, fine sandstone, and shell limestone; bryozoa
1,400 - 1,410	Shale, siltstone, and fine sandstone, as above
1,410 - 1,420	Shale, siltstone, and sandstone, as above; slickensides and calcite veins
1,420 - 1,430	Shale, siltstone, and fine-grained sandstone, as above; sandstone commonly with recrystallized shell fragments; brachiopod fragments
1,430 - 1,480	Shale, siltstone, and fine sandstone, as above; brachiopod fragments 1,450 to 1,460 feet
1,480 - 1,500	Shale, siltstone, and fine sandstone; grades to sandy shell limestone; brachiopods and crinoid disks
1,500 - 1,510	Shale, siltstone, and fine sandstone; crinoid disks
1,510 - 1,520	Shale, siltstone, and sandstone, as above; bryozoa
1,520 - 1,560	Shale, siltstone, and fine sandstone; pyrite 1,520 to 1,530 feet
1,560 - 1,590	Shale, siltstone, fine sandstone, and sandy shell limestone; brachiopods and bryozoa
1,590 - 1,630	Shale, siltstone, fine sandstone, and sandy shell limestone; crinoid disks
1,630 - 1,640	Shale, siltstone, fine sandstone, and sandy shell limestone; bryozoa
1,640 - 1,660	Shale, siltstone, and fine sandstone; crinoid disks 1,650 to 1,660 feet
1,660 - 1,690	Shale, siltstone, fine sandstone, and sandy shell limestone
1,690 - 1,740	Shale, grey, fissile; less siltstone and fine sandstone than above; fossil fragments less abundant; calcite veins; crinoid disks 1,720 to 1,730 feet
1,740 - 1,750	Shale, grey, as above; nearly an equal amount of siltstone and fine sandstone; sandy shell limestone; bryozoa and crinoids
1,750 - 1,770	Shale, siltstone, and sandstone, as above; with calcite veins
1,770 - 1,830	Shale, grey, mostly smooth and fissile, but some darker grey, silty, and irregularly bedded; some siltstone and fine sandstone, as above
1,830 - 1,840	Shale, grey to dark grey, as above; siltstone and fine sandstone in excess of shale
1,840 - 1,860	Siltstone and fine sandstone, as above; grey shale, as above; sandy shell limestone
1,860 - 1,880	Siltstone, fine sandstone, and shale, as above
1,880 - 1,890	Siltstone, sandstone, and shale, with brown stain
1,890 - 1,920	Siltstone, sandstone, and shale, as above; crinoid disks 1,910 to 1,920 feet
1,920 - 1,960	Siltstone, sandstone, shale; calcite 1,920 to 1,940 feet
1,960 - 2,060	Siltstone, sandstone, and shale, as above; crinoid disks 1,960 to 1,970 feet; calcite veins, 2,000 to 2,030 feet
2,060 - 2,070	Siltstone, sandstone, and shale; sandy shell limestone
2,070 - 2,110	Siltstone, sandstone, and shale, as above; bryozoa and crinoids 2,070 to 2,080 feet
2,110 - 2,120	Siltstone, sandstone, and shale, as above; some sandy shell limestone
2,120 - 2,200	Siltstone, sandstone, and shale, as above; brachiopod fragments 2,130 to 2,140 feet and 2,190 to 2,200 feet
2,200 - 2,230	Siltstone, sandstone, and shale; bryozoa and crinoids
2,230 - 2,260	Siltstone, sandstone, and shale; bryozoa and brachiopods 2,230 to 2,250 feet
2,260 - 2,300	Siltstone, sandstone, and shale; crinoid disks 2,260 to 2,270 feet
2,300 - 2,320	Siltstone, sandstone, and shale; calcite veins
2,320 - 2,370	Siltstone, sandstone, and shale; brachiopod fragments 2,320 to 2,350 feet
2,370 - 2,380	Siltstone, sandstone, and shale, as above; pelecypod (Clidophorus), brachiopod
2,380 - 2,400	Siltstone, sandstone, and shale, as above; brachiopod fragments
2,400 - 2,420	Shale, medium grey, most silty; in part smooth, fissile; in part with irregular fracture; much siltstone and fine, grey sandstone, some of which is interlaminated with shale; sandstone is dolomitic in part
2,420 - 2,430	Shale, siltstone, and fine sandstone, as above; slickensides and calcite veins
2,430 - 2,470	Shale, siltstone, and fine sandstone, as above; greenish grey, silty, micaceous metabentonite

Depth	Lithology
Feet	Lorraine - con.
2,470 - 2,560	Shale, siltstone, and fine sandstone, as above
2,560 - 2,570	Shale, siltstone, and fine sandstone; calcite veins
2,570 - 2,580	Shale, siltstone, and fine sandstone; a little green metabentonite
2,580 - 2,620	Shale, siltstone, and fine sandstone, as above
2,620 - 2,630	Shale, siltstone, and fine sandstone, as above; slickensides and vein calcite
2,630 - 2,670	Shale, siltstone, and fine sandstone, as above
2,670 - 2,710	Shale, siltstone, and fine sandstone, as above; slickensides and vein calcite
2,710 - 2,850	Shale, siltstone, and fine sandstone, as above
2,850 - 2,860	Shale, siltstone, and fine sandstone, as above; dull green-grey metabentonite; fragment of Cryptolithus
2,860 - 2,880	Shale; some siltstone and fine sandstone
2,880 - 2,890	Shale; some siltstone and fine sandstone; calcite and quartz veins
2,890 - 3,040	Shale; some siltstone and fine sandstone, as above
3,040 - 3,050	Shale; some siltstone and fine sandstone, metabentonite
3,050 - 3,080	Shale; some siltstone and fine sandstone, as above
3,080 - 3,090	Shale; some siltstone and fine sandstone; much metabentonite
3,090 - 3,120	Shale; some siltstone and fine sandstone; fragment of Cryptolithus 3,110 to 3,120 feet
3,120 - 3,230	Shale; some siltstone and fine sandstone, as above; brachiopod fragments 3,160 to 3,170 feet
3,230 - 3,250	Shale; some siltstone and fine sandstone; slickensides and calcite veins
3,250 - 3,360	Shale; some siltstone and fine sandstone, as above
3,360 - 3,370	Shale; some siltstone and fine sandstone, as above; slickensides and calcite veins
3,370 - 3,450	Shale; some siltstone and fine sandstone, as above
3,450 - 3,460	Shale, medium grey, smooth, fissile, and dark grey, silty, with irregular fracture; some lighter grey, dolomitic siltstone; in part interlaminated with shale
3,460 - 3,470	Shale, as above; some siltstone; slickensides
3,470 - 3,610	Shale, as above; some siltstone
3,610 - 3,650	Missing
3,650 - 3,970	Shale, as above; some grey siltstone
3,970 - 3,990	Shale and siltstone, as above; a little light brownish grey, very silty, finely crystalline dolomite
3,990 - 4,000	Shale; some siltstone, as above; slickensides and calcite veins
4,000 - 4,020	Shale; some siltstone, as above
4,020 - 4,023	Siltstone; interlaminated shale; grey, micaceous, argillaceous siltstone; grey, fissile shale
4,023 - 4,100	Missing
4,100 - 4,187	Siltstone, sandstone, and shale; greenish grey, argillaceous, micaceous, very slightly calcareous siltstone, grading to fine sandstone; dark grey, fissile, micaceous shale
4,187 - 4,210	Sandstone, light greenish grey, micaceous, slightly calcareous, argillaceous; siltstone, grey, micaceous, shaly; grey shale, in part micaceous
4,210 - 4,290	Siltstone and shale; dark grey, fissile, micaceous shale and greenish grey, micaceous, slightly calcareous siltstone; interlaminated siltstone and shale
4,290 - 4,340	Siltstone, sandstone, and shale; greenish grey, micaceous, argillaceous, very slightly calcareous siltstone and fine-grained sandstone; grey to dark grey shale
4,340 - 4,345	Shale, siltstone, and dolomite; grey to dark grey shale; greenish grey siltstone, as above; grading to grey, silty dolomite
4,345 - 4,360	Siltstone, sandstone, and shale; greenish grey siltstone, as above; grey, fine-grained, micaceous, argillaceous sandstone; grey to dark grey shale
4,360 - 4,400	Shale and siltstone; grey to dark grey shale; grey dolomitic siltstone, grading to silty dolomite

Note. The upper part of this well is in the marine Richmond, the Pontgravé River formation. The contact of the Pontgravé River with the Lorraine has been tentatively placed at 210 feet, giving a thickness of 100 feet of Richmond below the drift.

The remainder of the well appears to be in Lorraine shales and sandstone, giving 4,190 feet of Lorraine, an extremely thick section as compared with the other wells."

NICOLET NO. 1 WELL

The Croinor Pershing Mines Ltd.

DeBlois, 1959, p.123

Location

Lot: 244
Range: Grand Rang Nord-Est
Parish: St. Grégoire
County: Nicolet
Coords.: 200' from W. LL., 350' N. of highway No. 3

Ground Elevation: 86'

RF Elevation: 88'

Spudded: June 15, 1956

Completed: Oct. 3, 1956

Driller: Inspiration and Development Co.

Type of Rig: Diamond Drill

Result: Dry Hole

Log by T.H. Clark: (See revised log on next page.)

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 100
Queenston (Bécancour River formation)	100 - 380
Queenston (Carmel River member) ..	380 - 385
Richmond (Pontgravé River formation)	385 - 525
Lorraine (Nicolet River formation -- St. Hilaire member)	525 - 930
Lorraine (Nicolet River formation -- Chambly member) ..	930 - 1580
Lorraine (Nicolet River formation -- Breault member) ...	1580 - 1975
Lorraine (Leclercville formation)	1975 - 2875

The geological log submitted by the Company is as follows (Rep. on Min. Ind. in 1956, p. 52):

0 -	91 feet	 Overburden
91 -	172	 Queenston red shales
172 -	361	 Richmond
361 -	643	 Upper Lorraine
643 -	1,743	 Middle Lorraine
1,743 -	2,204	 Lower Lorraine
2,204 -	2,493	 Utica
2,493 -	2,875	 Trenton

The writer's final log is given below in summary:

Overburden	0 - 100 feet
Bécancour River	100 - 380
Carmel River member	380 - 385
Pontgravé River	385 - 525
Nicolet River	
St. Hilaire member	525 - 930
Chambly member	930 - 1,490
Breault member	1,490 - 2,400
Utica	2,400 - 2,875

LOG OF NICOLET NO. 1

Croinor - Pershing Mines Ltd.

T.H. Clark, April, 1961
(Condensed from log dated June, 1959)

Depth in feet		Description	<u>Diamond drill core</u>
0 - 100		Overburden	
100 - 116	BECANCOUR RIVER	Shale, red brown, sandy. Gypsum crystals and molds	
116 - 118		Shale, greenish grey, sandy. Gypsum rare	
118 - 138		Shale, red brown, sandy. Gypsum crystals and moulds common	
138 - 139		Shale, greenish grey and plain grey, latter with gypsum rosettes	
139 - 380		Shale, dark brownish red, sandy. No gypsum	
380 - 385	C. R.*	Shale, greenish grey, sandy. Internal slickensides	
385 - 387		Shale, grey, no slickensides. Burrow and small pelecypod	
387 - 391	PONTGRAVE RIVER	Shale, grey, sandy bands abundant and evenly spaced. Fossils present. <u>Zygospira kentuckiensis</u> , etc.	
391 - 400		Shale, grey, sandy beds infrequent, 1" more or less	
400 - 425		Shale, medium dark grey, soft. Limestone with <u>Zygospira kentuckiensis</u>	
425 - 450		Shale, medium dark grey, a little sandstone and limestone. Fossils	
450 - 475		Shale, medium dark grey, beds of sandstone up to 5", a few beds of limestone up to 1". Fossils common	
475 - 500		Shale, medium dark grey. Sandstone beds common, up to 2". Limestone rare, up to 2". <u>Catazyga headi</u> , <u>Streptelasma rusticum</u>	
500 - 525		Shale, medium dark grey. Limestone and sandstone beds very common	
525 - 550		Shale medium dark grey, decomposed readily when wetted. Sandstone bands from 1/4" to 4", total of 10% of core. Cut and fill structure. Fossils very abundant	
550 - 575		Shale as above. Sandstone 7 1/2%. Fossils very abundant	
575 - 600		Shale, medium dark grey, decomposes when wetted. Fossils abundant. Sandstone beds from 1/4" to 4", 5% of core. Limestone 1% - 2%	
600 - 625	NICOLET RIVER ST. HILAIRE MEMBER	Shale as above. Sandstone 10%, Limestone 2%, in beds up to 2"	
625 - 650		Shale as above. Sandstone in thin beds up to 1/2". No limestone	
650 - 675		Shale as above. Sandstone 2%, in beds up to 2". No limestone Horizontal slickensides	

*Carmel River

675 - 700	ST-HILAIRE MEMBER	Shale, dark grey, finely micaceous. Sandstone 3% to 4%, No limestone. Strong 45° slickensides
700 - 725		Shale dark grey. Sandstone 2%, in beds up to 6". Limestone 2% - 3%.
725 - 750		Shale as above. SS. abundant in thin beds, merging into shale, probably 5% of core. Ls. very rare. Fossils common
750 - 775		Shale dark grey, finely micaceous. Ss. beds up to 8", average 10%. No ls. Horizontal slickensides
775 - 800		As above Fossils common
800 - 825	NICOLET RIVER	Shale as above. Ss. up to 8", 10% of core. Ls. up to 1", 2 1/2% of core. Fossils present Horizontal slickensides
825 - 850		Probably as above. Core badly shattered
850 - 875		Shale as above. Ss mostly as thin stringers. 12% of core. Fossils present
875 - 900		Shale and sandstone as above. Ss. 6%. Horizontal slickensides Fossils present
900 - 925		Medium grey to medium dark grey shale, Sandy beds few and thin, 2 1/2% Fossils present
925 - 930	CHAMBLEY MEMBER	Shale and sandstone as above. Ss. 7%. Steep slickensides
930 - 950		Shale as above. Ss. very fine grained, 8%. Fossils abundant
950 - 975		Shale dark grey, finely micaceous. Sandstone fine grained, in beds up to 10", averaging 12%. Fossils abundant Faint horizontal slickensides
975 - 1000		Shale as above. Ss. very fine grained up to 5" but mostly 1/2" - 1/4", average 19%. Fossils abundant
1000 - 1025		Shale as above, pale purplish brown streak. Sandstone as above, faintly calcareous, beds up to 2"; average 10%. Fossils abundant Horizontal slickensides
1025 - 1050	NICOLET RIVER	Shale and sandstone as above. Ss. 18%. Fossils common
1050 - 1075		Medium dark grey shale, pale purplish brown streak. Well bedded ss. bands, faint effervescence. Ss. 10% Fossils abundant
1075 - 1100		No record
1100 - 1125		Shale, medium to dark grey. Sandstone fine grained light grey, well bedded, up to 6", average 10%. Fossils abundant
1125 - 1150		Medium grey shale. Sandstone very fine grained, cross-bedded. Shale streak pale purplish. Fossils abundant in thin bands
1150 - 1175	NICOLET RIVER	Medium dark grey shale, pale purplish streak, non-calcareous. Sandstone very fine grained, very slightly calcareous. Fossils abundant in a few thin bands
1175 - 1200		Dark to medium grey shale, pale brownish streak, non-calcareous. Sandstone very fine grained to medium grained, weakly calc. Fossils common in thin bands
1200 - 1225		Dark grey shale, as above. Sandstone light grey, as above. Siltstone medium grey, very faintly calc. Fossils present in shale bands

1225 - 1250	CHAMBLEY MEMBER	Medium to dark grey shale, pale brown streak, non-calc., micaceous. Sandstone, siltstone and fossil bands as above. Fossils common. Ss. 8%; siltstone 11%
1250 - 1275		Shale, sandstone, and siltstone as above. Ss. 16%; siltstone 5%
1275 - 1300		Medium to dark grey shale, pale brown streak, non-calc., micaceous. Sandstone very fine grained, weakly calc. Siltst. medium grey, faintly calc. Fossils present. Ss. 9%; siltstone 5%. Limestone present. Fossils present Horizontal slickensides
1300 - 1325		Shale, sandstone and siltstone as above. Ss. 10%; siltstone 3%. No limestone. Fossils present.
1325 - 1350		Core missing
1350 - 1375	NICOLET RIVER	Shale as above; ss. 9%; siltstone 8%. No limestone. Slickensides and veins
1375 - 1400		Shale as above; ss. 11%; siltstone 7%; limestone 5%. Fossils present
1400 - 1425		Shale as above; ss. 6%; siltstone 8%; limestone 5%. Fossils present
1425 - 1450		Shale as above; ss. cross-bedded 5%; siltstone 5%. Fossils present
1450 - 1475		Shale as above; ss. 4%; siltstone 6%. Fossils present
1475 - 1490	BREAUVT MEMBER	Shale as above; ss. 4%; siltstone 4%. Fossils present
1490 - 1500		Shale as above; ss. 10%; siltstone 5%. Fossils present, <u>Triarthrus</u>
1500 - 1525		Shale as above; ss. 12%; siltstone 3%. Fossils present, graptolites
1525 - 1550		Shale as above; ss. 15%; siltstone none. Fossils present
1550 - 1575		Shale as above; ss. 13%; siltstone 3%. Fossils present. Steep joint
1575 - 1600	NICOLET RIVER	Shale as above; ss. 16%; siltstone 6%. Fossils present, <u>Cryptolithus</u>
1600 - 1620		Shale as above; ss. 12%; siltstone 1 1/2%. Fossils present, <u>Cryptolithus</u>
1620 - 1625		Core missing
1625 - 1650		Shale as above. Ss. 22%; siltstone 2.5%. Fossils common, <u>Cryptolithus</u>
1650 - 1675		Shale as above; ss. 20%; siltstone 6%. Fossils common, <u>Cryptolithus</u>
1675 - 1700	NICOLET RIVER	Shale as above; ss. 17%; siltstone 6%. Fossils present, <u>Leptobolus</u>
1700 - 1725		Medium to dark grey shale, micaceous and silty, non-calc., light brown streak. Sandstone, light grey, fine grained, slightly calc., cross-bedded. Siltstone, medium to dark grey, faintly calc. Fossils scarce ss. 19%; siltstone 6%. <u>Cryptolithus</u> , <u>Leptobolus</u> , <u>Triarthrus</u>
1725 - 1750		Shale as above; ss. 12%; siltstone 10%. <u>Cryptolithus</u> , <u>Triarthrus</u>
1750 - 1775		Shale as above; ss. 8%; siltstone 7%. <u>Cryptolithus</u> , <u>Leptobolus</u> , <u>Triarthrus</u>

1775 - 1800		Shale as above; ss. 6%; siltstone 4%. <u>Geisonoceras</u> , <u>Triarthrus</u>
1800 - 1825		Shale as above; ss. 8%; siltstone 3%. <u>Triarthrus</u>
1825 - 1850		Shale as above; ss. 10%; siltstone 4%. <u>Triarthrus</u>
1850 - 1875		Shale as above; ss. 15%; siltstone 3%. <u>Cryptolithus</u> , <u>Geisonoceras</u>
1875 - 1900		Shale as above; ss. 11%; siltstone 5%. Joints. Metabentonite. <u>Geisonoceras</u>
1900 - 1925		Shale as above; ss. 12%; siltstone 8%. Steep joint. Slickensides. <u>Cryptolithus</u> , <u>Triarthrus</u> , <u>Geisonoceras</u>
1925 - 1950		Shale as above; ss. 8%; siltstone 3%. Joints, horizontal slickensides. <u>Geisonoceras</u>
1950 - 1975		Shale as above; ss. 12%; siltstone 5%. <u>Leptobolus</u> , <u>Geisonoceras</u>
1975 - 2000		Shale dark grey to black, with abundance of thin sandy layers, mostly about 1/4". Breaks up readily. Streak, ss. as above ss. 15%; siltstone none. Fossils very scarce. <u>Cryptolithus</u> , <u>Geisonoceras</u> , <u>Leptobolus</u>
2000 - 2025	BREAULT MEMBER	Shale as above; ss. 13%. <u>Leptobolus</u> , <u>Geisonoceras</u>
2025 - 2050		Shale as above; ss. 15%; siltstone 1%. <u>Geisonoceras</u> , <u>Leptobolus</u> , <u>Triarthrus</u>
2050 - 2075		Shale mostly black, banded type; ss. 12%; siltstone 1%. <u>Leptobolus</u> , <u>Geisonoceras</u> , <u>Triarthrus</u>
2075 - 2100		Shale mostly black; ss. 14%; siltstone 1%. 2095-2100 no record <u>Leptobolus</u> , <u>Geisonoceras</u> , <u>Triarthrus</u>
2100 - 2125		Record lost
	NICOLET RIVER	Shale black, very micaceous, merges into thin bedded ss. Sandstone mostly in 1/4" bands, some massive, some colour banded. Fossils scarce. Slightly calcareous. Streak light brown.
2125 - 2150		Shale as above; ss. 18%; siltst. 5%. <u>Geisonoceras</u> , <u>Leptobolus</u>
2150 - 2175		Shale as above; ss. 17%; <u>Dalmanella</u> , <u>Geisonoceras</u> , <u>Leptobolus</u>
2175 - 2200		Shale as above; ss. 16%. Graptolites abundant. <u>Geisonoceras</u> , <u>Leptobolus</u>
2200 - 2225		Shale as above, but less micaceous; ss. 19%. Strong joints 60° - 80° Graptolites, <u>Geisonoceras</u> , <u>Leptobolus</u>
2225 - 2250		Shale as above; ss. 17%. 80° joints and horizontal slickensides. <u>Triarthrus</u> , graptolites, <u>Geisonoceras</u> , <u>Leptobolus</u>
2250 - 2275		Shale as above; ss. 22%. 60° joint. Horizontal slickensides. Graptolites, <u>Geisonoceras</u> , <u>Leptobolus</u>
2275 - 2300		Shale as above; ss. 22%. 80° joint. Graptolites, <u>Geisonoceras</u> , <u>Leptobolus</u>
2300 - 2325		Shale medium to dark grey, fairly micaceous. Streak lt.-md. brown. Sandstone in thin 1-5mm. bands, cross-bedded, slightly calc. Fossils very scarce
		Shale as above; ss. 19%. 70° joint. Graptolites, <u>Geisonoceras</u> , <u>Leptobolus</u>
2325 - 2350		Shale as above; ss. 16%. 80° joint Graptolites, <u>Geisonoceras</u> , <u>Leptobolus</u>
2350 - 2375		Shale as above; ss. 8%. 20° to 45° slickensides Graptolites, <u>Leptobolus</u>

2375 - 2400	Shale as above, less micaceous; ss. 7% Graptolites, <u>Leptobolus</u>
2400 - 2425	Shale as above; ss. 19%; siltstone 4%. Steep joint Graptolites, <u>Leptobolus</u>
2425 - 2450	Shale, medium to dark grey, streak as above Sandstone in beds 1 - 5 mm. thick, slightly calc. Fossils very scarce
2450 - 2475	Shale as above; ss. 19%; siltstone 4%. Steep joint, 60° joint Graptolites, <u>Leptobolus</u> , <u>Geisonoceras</u>
2475 - 2500	Shale as above; ss. 11%. Graptolites, <u>Leptobolus</u> , <u>Geisonoceras</u>
2500 - 2525	Shale as above; ss. 8%. Core much broken up. Joints and slicks. Graptolites, <u>Leptobolus</u> , <u>Geisonoceras</u>
2525 - 2550	Shale as above; ss. 10%. 45° and horizontal slicks. Bedding at 10° Graptolites, <u>Leptobolus</u> . Fossils v. rare
2550 - 2575	Shale as above; ss. 10%; Weak slickensides Graptolites, <u>Leptobolus</u>
2575 - 2600	Shale as above; ss. 12%. Steep joint Graptolites, <u>Leptobolus</u> , <u>Triarthrus</u>
2600 - 2625	Shale as above; ss. 8%. Fossils almost absent Graptolites, <u>Leptobolus</u>
2625 - 2650	Shale as above; ss. 7%. Steep joint. Fossils almost absent Graptolites, <u>Leptobolus</u> Horiz. slick.
2650 - 2675	Shale as above; ss. 3%; siltstone 7% Metabentonite Graptolites, <u>Leptobolus</u>
2675 - 2700	Shale as above; ss. 5%; siltstone 3%. Metabentonite Graptolites, <u>Leptobolus</u>
2700 - 2725	Shale as above; ss. 4%; siltstone 2%. Vert. joint, horiz. slick. <u>Leptobolus</u>
2725 - 2750	Shale as above; ss. 6%; siltstone 5%. <u>Leptobolus</u>
2750 - 2775	Shale as above; ss. 3%; siltstone 4%. Steep calcite vein <u>Leptobolus</u> , <u>Geisonoceras</u>
2775 - 2800	Shale as above; ss. 3%; siltstone 5%. 80° joint Graptolites
2800 - 2825	Shale medium to dark grey Sandstone where present mostly in 1/4" beds Streak and acid as before. Fossils practically absent
2825 - 2850	Shale as above; ss. 3%; siltstone 2%. Vert. joint Graptolites, <u>Leptobolus</u>
2850 - 2875	Shale as above; ss. none; siltstone 3%. Vertical joint, small veins Graptolites, <u>Leptobolus</u>
	Shale as above; ss. 2%; siltstone 2%. 80° joint, horiz. slick. <u>Leptobolus</u>
	Shale as above; ss. .5%, in 1/4" to 1/2" beds; siltst. 1%. Bottom of hole, 1956 <u>Leptobolus</u>

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QUEBEC FUEL NO. 1 WELL

The Quebec Fuel Company

DeBlois, 1959, p.124

Location

Lot: 566	Spudded: 1908
Concession: Petit Chenal	Completed: 1909
Parish: Yamaska	Type of Rig: Cable
County: Yamaska	Result: Dry Hole
Ground Elevation: 34'	Log: (author not stated)
RF Elevation: 36'	

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 180
Richmond (Bécancour River)	180 - 540
Richmond (Pontgravé River)	540 - 570
Lorraine - Utica	570 - 3060

This well is reported on in Quebec Bureau of Mines reports (1929B, 1930D) and by Johnston (1931) and Snider and Farish (1935). Only the last adds anything to the summary given above, namely, that there were "Gas showings at four horizons in the Lorraine - Utica".

FOREST WELL

(DeBlois, 1959, page 137)

Location

Lot: 516	Spudded: 1885
Concession: Beauséjour	Completed: 1885
Parish: St. Grégoire	Type of Rig: Cable
County: Nicolet	Result: Dry Hole
Ground Elevation: 123'	Total Depth: 2900'
RF Elevation: 125'	

This well is reported on in Quebec Bureau of Mines reports for 1929 (p. 87B) and 1930 (p. 47D). The latter adds that it was drilled on the land of Archelle Forest, 1/2 mile south of the road. "It gives enough gas to supply a house, but was never used, and the hole is now plugged. The drill penetrated 144 feet of soil to rock. No log is available but it is stated that the rocks are quite different from those in the Trudel well" (see below).

GUILLEMETTE WELL
(DeBlois, 1959, p. 143)

Location

Lot: 517	Spudded: About 1873
Concession: Beauséjour	Completed: About 1873
Parish: St. Grégoire	Type of Rig: Cable
County: Nicolet	Result: Dry Hole
Seigniory: Roquetaillade	Gas at: Unknown depth
Ground Elevation: 107'	Oil at: Unknown depth
RF Elevation: 109'	Total Depth: 3000'

The Quebec Bureau of Mines report for 1930 (p. 47D), under the heading "Cadastral lots 517 and 578 (518), also 510 Beauséjour" states that three wells were sunk on the property of Joseph Guillemette about 1918 ("about 12 years ago"). "They reached depths varying from 2,000 to 3,000 feet and voided some gas and a little oil. The output was insignificant and the holes were plugged". (See also Que. Bur. Mines Ann. Rep. for 1929, p. 88B).

NICOLET COLLEGE WELL
(DeBlois 1959, p. 150)

Location

Town: Nicolet	Spudded: 1885
County: Nicolet	Completed: 1896 (deepened)
Coords: In the vicinity of the College of Nicolet	Type of Rig: Cable
	Result: Dry hole
Ground Elevation: 69'	Gas at: 604', 1800'
RF Elevation: 71'	Log:

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden (clay)	0 - 100
Overburden (sand)	100 - 110
Lorraine and Utica	110 - 2270

Quebec Bureau of Mines reports for 1929 (p. 113B) and 1930 (p. 48D) indicate that this well was drilled to 1,110 feet in 1885 and deepened in 1895-96 to 2,270 feet. In one case (1929), it is said that a "little gas was encountered at 604' feet", and in the other (1930) that no gas was found. Other reports (Geol. Survey of Canada Ann. Rep. for 1895, p. 71A; Johnston, 1931; Snider and Farish, 1935) are essentially repetitions of the above.

TRUDEL WELL (Mr. Poirier, Operator)

(DeBlois, 1959, p. 158)

Location

Lot: 501
Concession: Beauséjour
Parish: St. Grégoire le Grand
County: Nicolet

Ground Elevation: 129'

RF Elevation: 131'

Spudded: 1885

Completed: 1885

Type of Rig: Cable

Result: Gas Well

Reported flow: 250 Mcf./day

Water

74'

Gas at: 75', 316', 370', 580', 640', 820'

Log:

<u>Formation</u>	<u>Depth interval (in feet)</u>
Overburden	0 - 80
Richmond (Bécancour River)	80 - 640
Richmond (Pontgravé River)	640 - 1115

TRUDEL WELL

Obalski, J. - Rept. Comm. Crown Lands 1884, p. 83

"About eight arpents southeast of the concession road, and parallel to it, is a patch of land some four arpents in length, from which combustible gas arises. The soil is composed of clay and sand for a depth varying from fifty to sixty feet. From all the borings made down to the hard rock gas escaped in great abundance. At the center of lot 501 a hole some fifteen feet deep had been dug and had become filled with rain water. In this had been placed a barrel, open at one end, with a gun-barrel fitted into the other. The gas escaping from the gun-barrel has been burning since January of this year with a flame more than a foot high. A small well has also been sunk on lot No. 500, from which gas escapes incessantly. At other points an ordinary barrel is filled in a very short time. I caused some sounding to be made in my presence with iron rods about half an inch in diameter, and found in great part a bed of clay overlying a thin layer of black sand which in turn rests upon hard rock, which according to the geological map should be the upper schist of the Trenton formation. The protocarbonated hydrogen gas is similar to that which is found on the north side of the river and appears to me to have a similar origin, that is in bodies of petroleum lying below the rocks above mentioned. The contour of the land appears to be irregular, and I would recommend that borings should be made within the belt referred to.

The proprietors who have been living for thirty years on these lands assured me that they had always been aware of these emanations of gas."

Obalski, J., Mines and Minerals of the Province of Quebec, p. 73, 1890.

"Measured in 1887 by Mr. Coste, the well at St. Gregoire yielded at the rate of 50,000 cubic feet per 24 hours and it was further ascertained that, after being closed for an hour, it gave a pressure according to the manometer of 350 lbs. to the square inch."

TRUDEL WELL

Laflamme, M. L'Abbé. Trans. Roy. Soc. Canada 1888, sect iv, p. 16, 1889.

"Durant l'été de 1885, sur les encouragements de M. Obalski, ingénieur du gouvernement de Québec, on commença à percer un puits à Saint-Grégoire, au sud du Saint-Laurent. On cherchait cette fois non pas du gaz, mais du pétrole. On voulait arriver au Trenton, dans l'espérance d'y trouver en abondance le précieux liquide. Le caractère bitumineux de ce calcaire avait été alors mis en évidence plus que jamais par certaines observations faites dans le calcaire lui-même, à la Pointe-aux-Trembles, près de Québec, et les espérances des mineurs avaient été ainsi ravivées.

Le choix spécial que l'on avait fait de Saint-Grégoire, était dû en partie au fait que, sur la ferme d'un M. Trudelle, concession de Beauséjour, on avait observé un dégagement gazeux absolument analogue au puits Saint-Pierre à Louiseville. On ne croyait pas que le gaz put ainsi se dégager du sol sans qu'il y eut au-dessous un réservoir de pétrole servant de générateur et de producteur. Il est maintenant acquis qu'il n'y a pas de concomitance géologique et l'existence de sources payantes de pétrole

.....

Une première veine de gaz inodore fut rencontrée dans le drift, une seconde à 316 pieds, une troisième à 370, et une quatrième à forte tension, à 580. La pression de cette dernière fut suffisante, d'après M. Obalski, pour lancer des pierres à une hauteur de soixante pieds, ce qui suppose une vitesse, à l'orifice, d'environ 62 pieds par seconde. Une autre veine de gaz fut rencontrée à la profondeur de 820 pieds, dans le schiste noir. Chose remarquable, on n'a pas frappé une seule veine d'eau, du moment que l'épaisseur du drift a été traversée.

Les travaux, arrêtés le 20 octobre 1885, n'ont pas été repris depuis. L'ouverture a laissé, durant près de trois ans, sortir un volume de gaz que M. Obalski évalue à 250,000 pieds cubes par jour, ce qui nous paraît bien un peu exagéré. On a essayé à diverses reprises de fermer le tube de sortie en y enfongant à grands coups de masses de fort bouchons en bois, mais ce système d'obturer, par trop rudimentaire, n'a pas réussi, et les bouchons n'ont pas pu résister à la pression intérieure du gaz. Cette pression en toute probabilité doit dépasser 200 livres au pouce carré.

Il est vraiment regrettable qu'une quantité très considérable en définitive du meilleur combustible que l'on connaisse se perde ainsi journellement sans que personne ne s'en occupe. On admet en Pensylvanie et dans l'Ohio que 15,000 pieds cubes de gaz peuvent facilement remplacer une tonne de houille dans les applications industrielles. Dans ce cas, en supposant que le débit ne soit, à Saint-Grégoire, que 50,000 pieds cubes par 24 heures, ce qui nous semble beaucoup plus rapproché de la vérité que le chiffre de 250,000, nous arrivons à une perte de plus de 65,000,000 de pieds cubes depuis la date du creusage de ce puits, à peu près l'équivalent de 2,520 tonnes de houille, c'est-à-dire près de 12,000 dollars! Il nous semble qu'une législation destinée à prévenir de semblables gaspillages trouverait ici la place."

TRUDEL WELL

Parks, W.A., 1930, part D, p.46

"Roquetaillade Seigniory, Nicolet County.

1. Cadastral Lots 500 and 501:

The concession-road north of the range Beausejour cuts the northern part of lots 500 and 501. In 1885 a well was sunk by a local company (N.P. Poirier) on lot 501 (Jean Trudel) to a depth of 1,115 feet, in drift for 75 feet and the rest in rock. Gas was struck at 400 feet and a supply was obtained sufficient for heating and lighting five or six houses, also for cooking. This well is still yielding, but is used at present for only three dwellings; it is capable of supplying six. The well is connected directly to houses without any accumulation tank. The original pressure is stated to have been 42 pounds. See analysis VIII, p. 79 (This is given immediately below)

Carbon dioxide	0.0	Percentage by volume
Oxygen	0.7	
Total hydrocarbons as methane	90.5	
Nitrogen (by difference)	88.8	
Helium	.06	

Log of Trudel Well	(Thickness)	(Depth)
Blue loam with thin layers of sand	47 (feet)	47 (feet)
White sand; emanations of gas	5	52
Gravel; emanations of gas and water	15	67
Black sand, dense; water, but no gas	7	74
Sandstone, somewhat calcareous, oily ooziings ...	80	154
Same as preceding, but harder and finer grained	60	214
Red shale	75	289
Red shale, lighter colour	10	299
Shale, nearly black	16	315
Shale, blackish brown, not hard; abundant and sudden flow of gas, having a strong smell of kerosene	54	369
Red shale; emanation of gas	105	474
Red shale, somewhat greyish	50	524
Softer red shale	55	579
Red shale; another strong flow of gas	60	639
Impure calcareous rock, apparently containing magnesia. Another vein of gas	20	659
Calcareous rocks	60	719
Oily, calcareous rock	100	819
Black shale, flow of gas	40	859
Black shale, compact	225	1084
Depth of well		1115

The interpretation of this log is difficult. There seems to be (1) 74 feet of loam, sand and gravel, (2) 140 feet of sandstone, (3) 425 feet of Queenston red shale, (4) 180 feet of limestone, and (5) 265 feet of black shale. The sandstone (2) is not known in exposures above the Queenston shale in Quebec. In Ontario the Whirlpool sandstone overlies the Queenston. If this sandstone is Whirlpool it follows that a Silurian sea invaded the area. On the other hand, the thinness of the red shale indicates great erosion before the deposition of the sandstone, which is perhaps better interpreted as an indurated Pleistocene deposit. The 180 feet of limestone below the Queenston is probably Lower Richmond. The "black" shale (5) is probably not black, but grey, and is to be regarded as Lorraine.

"A second well was drilled on this property in 1904 by the Canadian Gas and Oil Co. It is located about 300 feet south of the old well and reached a depth of about 1,400 feet. Very little gas was obtained and the hole is now plugged."

Johnston, 1931, pp. 88,89:-

" St. Grégoire District. The log of the Trudel well on lot 501, concession of Beauséjour, is No. 11 of the following list of logs. The Canadian Gas and Oil Company sank wells near the Trudel well. Of these: No. 1 was drilled to about 1,400 feet passing into red shale at 485 feet; No. 2 was drilled to 801 feet passing into red shale at 450 feet; and No. 3 was drilled to 500 feet. No commercial yield of gas was reported from any of the three wells. The log of Bergeron well located 2 miles west of St-Grégoire on Pointu concession is log No. 12 of the following logs. The Quebec Department of Mines Annual Report, part B, 1929, page 87, contains information on five other wells in this district, drilled to depths up to 3,000 feet. No detailed logs seem to be available. A little gas flow, not of commercial value, is reported in all but one. The position of the wells is such that it is not probable the Trenton limestone was reached. All these wells are now abandoned."

Snider, L.C. and Farish, L.M., 1935, p. 103

"'Trudel well' drilled south of St. Gregoire, county of Nicolet, by local syndicate in 1885, still producing small flow of gas. Gas reported encountered at 316, 370, 580, 640, and 842 feet. Total depth 1,115 feet. Commenced in Queenston and finished in 'Lorraine' shales. Other wells in vicinity failed to develop commercial gas."

Information gained by Clark in 1943

Wooden poles were used in putting down drills when this well was dug. Veuve Trudel states that formerly she had eight customers each paying her \$40.00 per year for access to the gas from this well. Now, because of the rusting of the pipes, and consequent leakage of the gas, and the expense of installing new pipes, she is the only user. She expects to burn wood this winter (1943-44), to counteract the dampness consequent upon burning the gas. For this purpose she used one cord in the winter of 1942-43.

APPENDIX E

INFORMATION CONCERNING QUARRIES

Name of Quarry: Notre Dame Quarries Company Limited
(Information furnished by Mr. M. E. Hart, president,
June 2, 1961)

Location: Notre Dame du Bon Conseil, Drummond County

Owner: Notre Dame Quarries Company Ltd.

Operator: " " " " "

Type of Rock: Quartzite

Approximate Dimensions: 40 acres

Number of Men Employed: 30

Equipment: One 42" x 48" Kennedy VanSaun Jaw Crusher; No. 10
Bulldog Traylor Gyratory Crusher; 4' Symons cone
crusher; No. 6 Allis-Chalmers cone crusher;
Dominion power shovel; three 15-ton Euclid trucks;
2 1/2 yard Michigan loader; conveyors;
dust collecting system; Chicago pneumatic air
trac drill; two 550 C.F.M. stationary compressors

Production: 200 tons/day

Analysis of Stone:

SiO ₂ and insolubles	83.07%	Loss on ignition	4.63
CaO	5.21	MgO	0.75
Fe ₂ O ₃	3.96	Residue	0.40
Al ₂ O ₃	1.98		
			100.00

Henri Clermont
Chemist for City of Montreal

Name of Quarry: François Yergeau

Location: Lot 49, Rang La Rivière, Parish of St. Pie de Guire,
Yamaska Co.

Owner: As above A second quarry 200 feet upstream,
of similar dimensions and rock, is

Operator: As above owned by Edgar Courchesne, Lot 50,
Rang as above

Type of Rock: Calcareous shale with thin sandstone beds. Upper
Lorraine age.

Approximate Dimensions: 50' wide. Working face up to 10' high

Number of Men Employed: --

Equipment: --

Production: Irregular. "30,000 to 40,000 tons have been quarried for
road metal". Letter from H.W. McGerrigle,

Analysis of Stone: Feb. 17, 1961

Remarks:

Several hundred tons have been quarried and stockpiled.
The stone has been used for surfacing roads in the
adjoining range. The sandstone, which makes up perhaps
15 to 20% of the whole, is hard and resistant. The
remainder is a calcareous shale which easily decomposes
under weathering conditions

The quarries are at the base of a steep river bank
75 feet high, and are approximately at high water
level.

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