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ST-HYACINTHE AREA (WEST HALF) BAGOT, ST-HYACINTHE AND SHEFFORD COUNTIES

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GOVERNMENT OF QUEBEC
DEPARTMENT OF NATURAL RESOURCES

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GEOLOGICAL EXPLORATION SERVICE

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GEOLOGICAL REPORT 101

ST-HYACINTHE AREA (WEST HALF)

BAGOT, ST-HYACINTHE AND SHEFFORD COUNTIES

by

T.H. CLARK

QUEBEC
1964

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ST-HYACINTHE AREA (WEST HALF)

BAGOT, ST-HYACINTHE, AND SHEFFORD COUNTIES

By

T. H. Clark

INTRODUCTION

General Statement

The St-Hyacinthe area (west half) was geologically surveyed by the writer in 1945 for the Quebec Department of Mines (now Department of Natural Resources) as part of a programme to map the St. Lawrence Lowlands of Quebec. Records of wells drilled for oil or gas and of quarries have been brought up to date as of June 1, 1961. The purpose of the general study is to make available as much information as possible concerning such resources as high-calcium limestone for cement and other products and also petroleum and natural gas. In addition, such a synthesis might well lead to the finding of other valuable resources not at present exploited.

Location

The area lies south of St. Lawrence river, and straddles the boundary line separating the flat-lying rocks of the St. Lawrence lowland from the folded rocks of the Appalachian mountain-built province. It is delimited by latitudes 45°30' and 45°45' and by longitudes 72°45' and 73°. It includes parts of Bagot, St-Hyacinthe and Shefford counties.

Population and Access

The largest centre of population in this area is the thriving city of St-Hyacinthe (pop. 20,439)* and its suburb St-Joseph de St-Hyacinthe (pop. 2,709). St-Pie de Bagot (pop. 1,229), the

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

largest village, owes its location, as does St-Hyacinthe, to rapids which cross Noire and Yamaska rivers respectively. Ste-Rosalie (pop. 1,140), St-Thomas d'Aquin (pop. 813), St-Liboire (pop. 613), St-Dominique (pop. 489), St-Simon (pop. 436) and St-Barnabé (pop. 300) are other rural centres. Mixed agriculture, limestone production, and urban factories occupy the population of this area.

The Canadian National Railways main line from Montreal to Halifax passes through St-Hyacinthe and crosses this area obliquely from southwest to northeast. A branch line of the Canadian Pacific Railway runs north and south, passing through St-Joseph on the east side of Yamaska river, opposite St-Hyacinthe. A network of good roads, many of which are paved, connects all parts of the region. The abundance of gravel in the eastern part allows roads to be built and maintained in good condition readily. Sir Wilfrid Laurier boulevard (Route 9), from Montreal to Quebec, passes through St-Hyacinthe and thence runs parallel to the Canadian National Railways line toward Drummondville.

Field Work and Acknowledgments

The base map used for plotting was an enlargement of the west half of the "St. Hyacinthe" map published in 1929 by the Department of National Defence, Ottawa (Canada, 31 $\frac{H}{10}$). No air photographs were available.

Mapping this area was accomplished during the summer of 1945. Very satisfactory assistance was rendered by Gilles Breault.

Outcrops are common only along the wooded St-Dominique ridge. This ridge was traversed at 1,000-foot intervals, and in places traverses were spaced 500 feet or even less apart. Elsewhere rivers and fields were thoroughly covered. In the northeastern part of the area bedrock lies from 2 to 10 feet below the surface, though outcrops are almost completely absent. Pace and compass method of traversing was employed throughout.

It is a pleasure to acknowledge the cooperation received from local proprietors in amassing records concerning their water wells, and from numerous quarry operators for much important information.

Previous Work

The limestones of the St-Dominique ridge have attracted attention for more than a century. Logan (1849, 1863) referred in a score of places to the succession of beds on the St-Dominique ridge and in Yamaska river, in connection with such matters as mineral springs, analyses of limestone, and the presumed course of what has subsequently come to be called "Logan's Line" or the Champlain fault. Ells (1896) added very little except for the lists of fossils identified by Ami (1896). Raymond (1906) commented upon the Chazy fauna from the St-Dominique ridge, and Foerste (1916, 1924) described the outcrop and the fossils occurring at St-Hyacinthe. Johnston (1931), Maddox (1931), and Parks (1931) contributed to the records of gas wells west of St-Hyacinthe. Parks (1914) and Goudge (1935) paid much attention to the limestones of the St-Dominique ridge both as building stones and as sources of lime. Clark (1947) offered a structural explanation for the presence of the St-Dominique ridge.

DESCRIPTION OF THE AREA

Topography and Drainage

The area is a nearly flat plain, sloping gently and evenly down toward the northwest from an elevation of about 300 feet in the southeast corner to a little more than 100 feet in the northwest corner. Two physiographic features disturb the evenness of this plain: first, the valleys of Yamaska river and its tributary Noire river, and second, the St-Dominique ridge. The Yamaska crosses the area from south to north, with banks up to 50 feet high in the north. The St-Dominique ridge extends from St-Pie for nearly 8 miles northward. The extreme southeast corner, bounded approximately by the 300-foot contour line, is moderately hilly.

Besides the Yamaska and Noire rivers, there are no waterways of consequence in this area. Numerous trifling creeks and streams serve to drain off surplus water, but one may walk for 10 miles in a straight line without crossing a stream more than a foot wide. Neither Yamaska nor Noire river is fit for commercial transportation. The bed of the former is transformed in summer into a succession of boulder infested rapids which make even boating hazardous.

Natural Resources

A variety of soils can be found in the area. In the northeastern part, the soils are mostly sandy and not very productive. Between the St-Dominique ridge and Yamaska river clay soils predominate; south of St-Hyacinthe an artificial mixture of peat, peat ash, and the underlying soil has resulted in a rich soil for market gardens. West of Yamaska river the farms are somewhat more prosperous, but on the whole the area is not distinguished for rich soils. About one-tenth of the area is forested, and most of this fraction lies within the St-Dominique ridge.

Limestone of various ages occurring on the St-Dominique ridge constitutes, next to the soil, the most valuable natural resource. For more than a century it has been quarried for building stone, crushed stone for roads and for concrete aggregate, for lime and, in recent years, for agricultural limestone. There is no prospect of a shortage developing for centuries to come. The other rock types occurring in this area, shale and sandstone, have not been utilized. One or two prospects for gold have been opened up, but have been abandoned.

Sand and gravel occur in abundance in the eastern part of the area, where several pits have been developed. Sand near St-Dominique is currently used in asphalt mix prepared at St-Dominique.

GENERAL GEOLOGY

A generalized geological map showing the distribution of the main rock groups, together with a diagrammatic cross-section illustrating their structural relationships, is given in Figure 1.

With the exception of a few dykes, all of the rocks of this area are of sedimentary origin, and all, except possibly the Sillery, are of Ordovician age. The dykes are apparently connected with the Monteregian intrusions of St-Hilaire and St-Bruno mountains, each about 10 miles distant from St-Hyacinthe. The sedimentary rocks do not belong to one stratigraphic unit, bur are separated by thrust faults into three series. The thrust fault bounding the folded rocks of the Appalachian mountain-built province cuts across the southeast corner of the area and separates the Sillery formation on the southeast from all of the younger beds to the northwest . Between this fault, sometimes called Logan's Line or the Champlain fault, and the St-Dominique fault which passes along the western and steeper side

of the St-Dominique ridge, there is a series of rocks ranging in age from Beekmantown, through Chazy, Black River and Trenton, and probably including also the Utica and the Lorraine. West of this latter thrust most of the identifiable exposures belong to the Breault member of the Nicolet River formation; these can be well seen along Yamaska river at St-Hyacinthe and at several points downstream. In the vicinity of St-Barnabé, half a dozen deep wells have cut through between 660 and 1,540 feet of red "Queenston" (Bécancour River) shale immediately beneath the overburden. The rocks occurring in these three series are shown in the accompanying table.

The Sillery formation consists of red and green slates together with quartz-rich grits, and is confined to the southeast corner of the area. The St-Dominique slice sequence begins on the west with limestones and dolomites of Beekmantown age, includes Chazy and Black River beds more or less like those of the Montreal area, and continues eastward with Trenton limestones, which, both lithologically and faunally, cannot be distinguished from the lower and middle Trenton of the St.Lawrence valley. These are succeeded eastward by the St-Germain complex (shales and slates) which probably represents the upper Trenton, Utica, and Lorraine beds of the terrane farther west.

The St-Germain complex also appears along Orme brook, west of the St-Dominique thrust. Although it is not exposed elsewhere to the west of this thrust, a band ranging in width from 1 1/2 miles in the south to 5 miles in the north is assumed to be underlain by this complex. Outcrops of this complex are so folded and faulted that their true stratigraphic relationships cannot be deciphered.

Still farther west the foreland contains beds which, except for local crumpling, were not involved in the deformation which characterizes the rocks of the Appalachians. Only one formation of Lorraine age is recognized here. In the northwest corner of the area, Bécancour River shale, and probably also the Pontgravé River shale, lie immediately beneath the overburden as indicated by logs of deep wells there.

One of the most important structural problems is to determine whether the rocks of the St-Dominique ridge should be considered to be part of the foreland or part of the folded Appalachian mountain-built massif. The lowest rock exposed is identical with the Beldens member of the Chipman formation of Vermont (Cady and Zen, 1960, p. 728), whose position there within the folded belt is unequivocal. On the other hand, the Trenton, and to a somewhat lesser

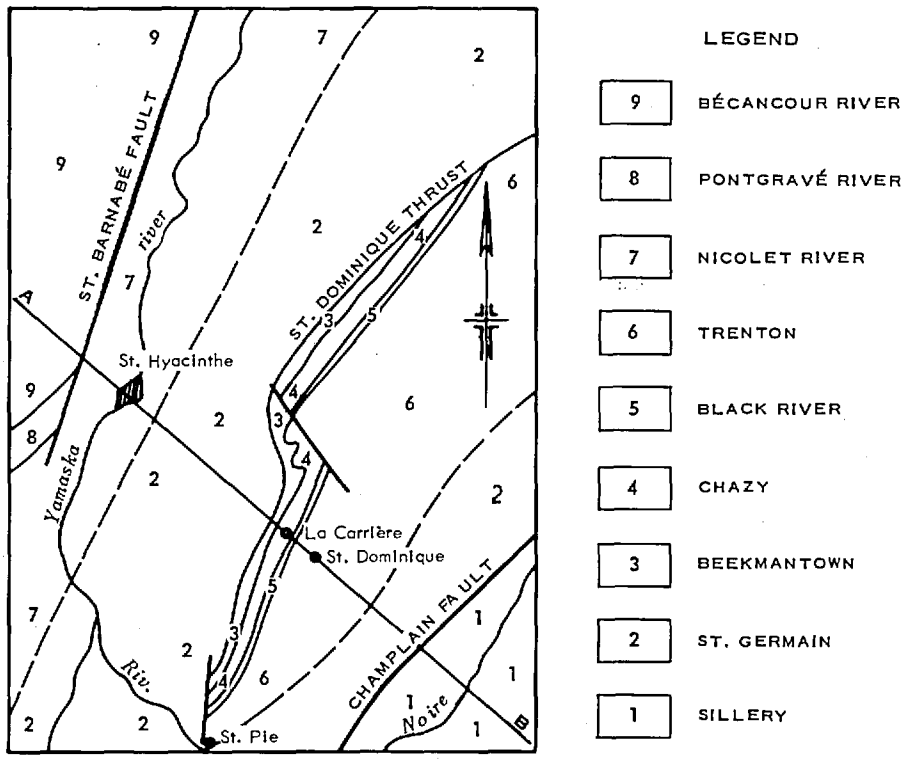
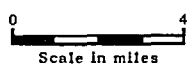


FIGURE 1 A

GENERALIZED MAP OF THE ST. HYACINTHE AREA TO SHOW CHIEF STRATIGRAPHIC AND STRUCTURAL FEATURES.



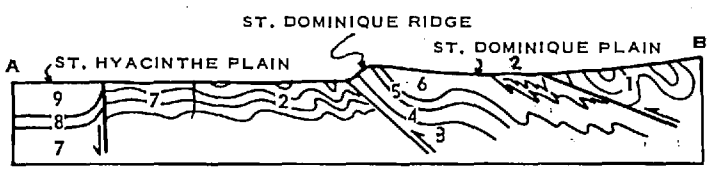


FIGURE 1 B

CROSS SECTION ALONG LINE A-B SHOWN ON FIGURE 1A.

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TABLE OF FORMATIONS

LOWLAND STANDARD CLASSIFICATION			STRATIGRAPHIC UNITS OUTCROPPING OR OCCURRING IMMEDIATELY BELOW OVERBURDEN		
PERIOD	GROUP	FORMATION MEMBER	WESTERN AREA	ST-DOMINIQUE SLICE	GRANBY SLICE
ORDOVICIAN	Richmond	Bécancour River (Queenston)	Present		
		Pontgravé River	Present		
	Lorraine	Nicolet River			
		St. Hilaire	? Present	St.	
		Chambly	Present		
		Breault		Germain	
	Utica	Lachine	St. Germain Complex	Complex	
	Trenton	Tétreaultville			
		Montreal			
		Rosemount		Present	
		St. Michel		Present	
		Mile End		Present	
	Black River	Leray		Present	
		Lowville		Present	
		Pamelia		Present	
	Chazy	St. Dominique			
		St. Dom. ls.		Present	
		St. Dom. ss.		Present	
	Beekmantown	Beldens		Present	
? CAMBRIAN					Sillery

degree the Black River and the Chazy, are practically identical with those of the same age in the foreland around Montreal. The structural evidence indicates that the rocks of the St-Dominique ridge were involved in the mountain building; the stratigraphic evidence is almost wholly in favour of considering these beds part of the foreland, a view adopted in this report.

A second structural feature is the nearly north-south normal fault roughly parallel to, and west of, Yamaska river. This, the St-Barnabé fault, with a displacement of about 2,000 feet, brings into contact two formations of the same sedimentary series. It is in no way comparable in regional importance with the Champlain fault mentioned above.

STRATIGRAPHY

Formations East of the Champlain Fault

Sillery Formation

Southeast of the supposed position of the Champlain fault in this area, the only formation exposed is the Sillery. This formation here consists of coarse-grained, greenish-grey grit together with red, greenish-grey and green slate. These rocks are similar to the typical grit and slate of the Sillery formation as it is exposed northward to Lévis and Quebec and southward over much of the Granby area.

The slate is predominantly red, but here and there bands of grey and, more rarely, nearly white slate are included with it. In a few exposures, thin green layers are interbedded with the red. There is no apparent difference, except for colour, between these slate types; in some cases the green colour appears to be a secondary development after the red. Nowhere was the cleavage seen to be as well developed that the production of roofing slate could reasonably be expected. The best locality to see this slate is in the pastures and open woods within half a mile of the southeastern corner of the area. There, a group of exposures, each up to 100 feet across, gives an excellent idea of the rock types involved.

The sandstone of this formation makes up the bulk of the exposures. It usually stands in fairly bold relief above the surrounding countryside, whereas the slate usually occurs as low exposures, sometimes hardly distinguishable from the soil. In most

of the outcrops the sandstone is greenish-grey and medium to coarse grained. Here and there the grain is coarse enough to justify calling certain beds fine-grained conglomerate. Quartz is the predominating constituent; it is mostly clear and colourless, although grains of a dull pink colour can be seen in many of the coarse-grained varieties and, in a few samples, grains of milky quartz are common. The quartz grains in general range up to 3 mm. in diameter, but rarely are up to 6 mm. Small flakes of a slaty material are common in the coarser-grained rocks. Feldspar is present in grains up to 8 mm., in the road cut on the east-west road half a mile east of Noire river and 3 miles north of the southern boundary of the area. Mica and other elsewhere ordinary constituents of sandstone are rarely seen. Small muscovite flakes, less than 1 mm. across, are commonest in the fine-grained sandstones; similar sized flakes of a greenish slaty material are also common in such sandstones, and they are usually greener than the coarser-grained varieties. Much of the matrix is lightly metamorphosed to a sericite-chlorite mass. Lithologically, it should be classified as a sub-greywacke.

In most exposures, bedding is not easy to find, so that interpretations of the structure of the Sillery complex based on the meagre structural information available are difficult to make. In one place, close to the road junction nearest the southeastern corner of the area, oscillation ripple marks trending N.15°E. and about 2 inches from crest to crest, are very clear. The rocks strike N.10°W. and dip 85°E.

Almost invariably the observed dips of the sandstone are to the southeast, and usually steeply so. In the majority of cases, however, no bedding can be seen. One of the best localities to study this rock is one mile north of the point where Noire river first crosses the southern margin of the area. There, the sandstone is well exposed in a half-mile-long ridge standing at least 60 feet above the plain about it and bordered on the northwest by a precipitous slope. The rock is a uniformly medium-grained sandstone in which undoubted bedding rarely can be seen. It trends N.20°E. and dips 10°E. The gentle eastern slope of this ridge and its steep western slope combine to make it likely that the observed dip is characteristic of the whole exposure.

Slaty cleavage in the argillaceous rocks is nowhere well developed but, where observed, strikes N.15°-35°E. and dips 40°-65°. Nowhere is there sufficient information to work out the structure of the sedimentary rocks on the basis of the bedding-cleavage relationship.

No flow cleavage, and very little fracture cleavage, has been observed in this sandstone.

In a few places, a little pyrite and bornite occur in quartz and chlorite veins cutting the sandstone. Two or three such occurrences where exploratory excavations have been undertaken, are marked by the appropriate symbol on the map. The most northerly of these localities, on lot 16B, Range 6, Milton township (Albert Gaucher, proprietor, 1945), is said to have yielded gold values of $35.00 per ton, but the company concerned was not interested in pursuing the investigation. One of the two pits at this locality is said to have been dug to a depth of 75 feet. Little of interest can be found today on the dump. The rock is a medium- to fine-grained sandstone, much slickensided and veined.

A mile and a half southwest of the above locality, and a quarter of a mile north of Noire river, there are low sandstone exposures in which two exploratory pits were dug about 100 years ago, according to local information. The rock is a medium- to coarse-grained sandstone, considerably sheared, and with an abundance of quartz veins in which no minerals other than quartz and calcite were seen. One pit is about 10 feet by 20 feet across, and is now water filled.

Formations between the Champlain and St-Dominique Faults

In contrast to the irregularly hilly topography of that part of the area occupied by Sillery rocks, the part lying between the Champlain and the St-Dominique faults presents two different kinds of topography, each consistently uniform. The eastern part is a nearly featureless sloping plain, here called the St-Dominique plain, falling from the St-Dominique ridge, to be described next, southeastward to the Champlain fault. Although its width ranges from 3 miles in the south to 6 miles in the north, it falls only a few tens of feet. All of the rocks outcropping over this plain are shales or slates of one variety or another. The second physiographic unit is the St-Dominique ridge. This starts within a mile north of St-Pie, and crosses Route 32 so as to include both St-Dominique and La Carrière. Thence it can be followed, a little east of north, as a prominent ridge 100 feet or more high for 2 miles, dying down as a physiographic feature before the stream which flows through Ste-Rosalie is reached. The western margin of this ridge is nearly everywhere steep, in many places precipitous. The greatest height is about in the middle of its length, where it rises to more than 100 feet above the adjacent plain

LEGEND

- 6 — ST. GERMAIN COMPLEX (UTICA - LORRAINE)
- 5 — TRENTON
- 4 — BLACK RIVER
- 3b — CHAZY ST. DOMINIQUE LIMESTONE
- 3a — CHAZY ST. DOMINIQUE SANDSTONE
- 2 — BELDENS
- OUTCROPS
- MARGIN OF THE RIDGE

0 ½ 1
Scale in mile

La Carrière

St. Dominique

ST. PIE HILL

St. Pie

FIGURE 2

MAP OF THE ST. DOMINIQUE RIDGE, SHOWING THE DISTRIBUTION OF THE VARIOUS FORMATIONS AND THE INFERRED FAULTS.

D.N.R.Q. 1962 NO. 1433

to the west which lies at about 125 feet above sea-level at the base of the ridge. The gentle eastern slope of the ridge grades into the St-Dominique plain. The sequence of rocks observed on the ridge (see map, Figure 2) is given in the Table of Formations, and is described in detail below. The ridge owes its existence to the superior resistance to erosion of the limestones of Beekmantown, Chazy, Black River and Trenton ages. Both the St-Hyacinthe plain to the west and the St-Dominique plain to the east are floored with less resistant shales and slates.

Structurally, the rocks of this unit belong to a self-contained thrust slice. They form one continuous stratigraphic series ranging from Beekmantown to Trenton, and possibly including both Utica and Lorraine. They are everywhere folded, although the degree of deformation varies widely. The more competent limestones of the ridge have been flexed into gentle open folds. The general incompetence of the shales and slates of the St-Dominique plain has led, in the first place, to their crumpling and cleaving and to the virtual annihilation of their original characteristics, and, secondly, to their ready weathering and erosion so that they nowhere stand out in relief. These latter beds are succeeded on the southeast by Sillery rocks, and it was doubtless the overriding by this latter complex along the Champlain fault that produced some of the intense complications seen in the overridden rocks.

There are two localities where the rocks of this division can be seen to good advantage. First, splendid exposures of every subdivision up to and including the Trenton beds can be seen along the highway at and just east of La Carrière in roadside cuts, quarries adjacent to the main road, and in nearby hills and ridgelets. The second, and more compact, locality is on the small hill a mile to two miles north of St-Pie (referred to below as St-Pie hill) where all of these formations are exposed (Figure 3).

Beekmantown Group

Beldens Formation. This is the oldest formation exposed in the St-Dominique ridge. In general it occurs only along the western margin but, in a few places, gentle folding has allowed the Beldens formation to be exposed as fensters within the boundaries of the ridge. The best locality to study this formation is at the so-called Daudelin quarry and nearby outcrops about one-third of a mile due north of La Carrière. There a small rise in the ground

level, about 1,000 feet northeast of Route 32, betrays the presence of more resistant rock. The predominant stratigraphic types, and these are typical of most of the exposures of the Beldens elsewhere, are a pure, light grey limestone, weathering white to dove-grey, and a brown or orange-brown weathering, fine-grained dolomite, medium grey on a fresh surface (Plate 1A, 1B).

From an examination of the rocks exposed in abandoned excavations, and in the bushes and the open country to the north of the main pit the following stratigraphic sequence can be determined:

Top of Section

Feet	Inches	
6		Brown-weathering dolomite
3	4	Solid grey limestone. Phytopsis-like tubes present.
2	6	Rubbly-weathering, impure grey limestone with irregular dolomitic streaks. Fossils present, mostly smooth ostracods.
1		Brown-weathering dolomite
10		Not exposed.
2		Brown-weathering dolomite.
	6	Brown-weathering dolomite with grey limestone in 1-inch fossiliferous layers. The fossils are not easily separated from the rock.
2	6	Brown-weathering dolomite.
	4	Grey limestone. Some layers crowded with fossils, mostly brachiopods and gastropods, seen easily on weathered surface. They do not show on freshly broken faces. Minor faulting, see Plate 1A.
	6	Brown-weathering dolomite. See Plate 1B.
5	6	Well bedded grey limestone. Fossils as above. Uppermost foot contains Phytopsis-like tubes.
1		Brown-weathering dolomite.
	8	Grey limestone.
	2	Brown-weathering dolomite.
	6	Well bedded limestone, in part streaked with brown-weathering dolomite.
	2	Brown-weathering dolomite.
3		Pure grey limestone, in beds about 2 inches thick.
3		Pure grey limestone below, grading upward into very pale-buff-weathering sandy limestone.
	10	Pure light grey limestone, finely banded.

Feet	Inches	
1	6	Light-grey-weathering limestone, dense.
4		Not exposed.
1	3	Light-grey-weathering limestone, dense, upper 2 inches well bedded.
3	6	As above, with Phytopsis-like tubes throughout.
53	9	Total thickness.

A remarkable feature of the limestone of this formation is its close resemblance on both fresh and weathered surfaces to the pale grey, dove-grey-weathering Lowville limestone. Both rocks carry those peculiar fossils, possibly worm-tubes, which in the Lowville formation are known as Phytopsis tubulosa. Were it not for the ubiquitous blebs, streaks, and stringers of rusty-weathering dolomite present in the Beldens limestone, the separation of the latter from the Lowville would be exceedingly difficult in situations where the structural conditions are inconclusive.

The brown- or orange-weathering dolomite and dolomitic limestone are medium grey on a fresh surface, fine to medium grained, and usually completely crystalline. The weathering is not confined to the exposed surface, but penetrates the rock for as much as half an inch, and can be seen developed on both sides of joint planes. The contrast in colour between the pale grey or almost white limestone and the, in some places, bright-orange-weathered dolomite is most striking, and identifies this formation from hundreds of yards away. The interbedding of the limestone and the dolomite is variable; in some places the laminae of the two types are fractions of an inch thick; in others the limestone and the dolomite may each be several inches or several feet thick.

In the presently operated Daudelin quarry the pale grey limestone predominates, though the lower part of the section given above can be seen as the uppermost beds of an anticline into which the quarry is being dug. Thus, below the detailed section given above lies some 50 feet of rock, largely high-calcium limestone, with a few beds, probably not more than 40 inches in all, of dolomitic limestone.

The Beldens formation can also be seen at numerous places along the western margin of the ridge. The most northerly exposure of the rocks of the St-Dominique ridge is in a small abandoned quarry 3 1/2 miles north-northeast of La Carrière, where the light colored limestone and brown-weathering dolomite strike N.40°E. and dip 65°E. About 12 feet is exposed.

The best locality for supplementing the information gained from the quarries near La Carrière is on the western flank of St-Pie hill. So remarkably are several formations exposed on this hill that a map of the distribution is given in Figure 3. On the section line which passes from the summit of the hill toward the northwest, the succession of beds of the Beldens formation is as follows:

Top of section

Feet	Inches	
		White-weathering sandstone of the St-Dominique sandstone member of the St-Dominique formation (Chazy).
13	10	No exposures. Probably top of Beldens formation.
5	1	Buff-weathering dolomite and dolomitic limestone.
	10	Pale dove-grey-weathering limestone.
6		Not exposed.
3	5	Well bedded, dove-grey-weathering limestone.
1	9	Buff-weathering limestone.
2	6	Not exposed.
1	9	Dove-weathering, pale grey limestone.
1	5	Pale grey, buff-weathering limestone.
1	5	Pale grey, dove-weathering limestone.
5	2	Not exposed.
3	4	Pale buff-weathering dolomite and dolomitic limestone, well but irregularly banded.
6	8	Not exposed.
1	9	Grey limestone.
6	8	Pale-buff-weathering dolomite.
31	9	Not exposed.
3	10	Dove-weathering limestone and buff-weathering dolomite, finely interbedded.
2	11	Solid, buff-weathering dolomite.
1	9	Pale-buff-weathering dolomite.
6	10	Medium-buff-weathering dolomite.
30	11	Not exposed. Probably Beldens.
139	7	Total thickness.
		Trenton limestone. Dove weathering dark grey limestone exposed to base of hill.

The relatively greater resistance to erosion of both the overlying St-Dominique sandstone and the adjacent Trenton limestone makes it likely that the missing stretches at the top and bottom of the section given above are underlain by the Beldens dolomite. A glance at the map, however, shows that the thickness given here cannot be the maximum thickness, for the section line does not cross this formation at the widest part of its continuous exposure. Hence an adjustment, by suitable proportionate allowances, is in order, and the maximum thickness of the formation along line a-b of Figure 3 can be determined to be in relation to that of the measured section as 100 is to 60. Therefore the calculated thickness of the Beldens formation on St-Pie hill is 233 feet, and this is also the maximum thickness seen anywhere along the St-Dominique ridge. Similarly the thickness along line c-d can be determined to be 444 feet, but because of interruptions in the exposures this figure, though possibly correct, is not here used.

Fauna and Correlation. Except for ostracods, the fossils of this formation are not sufficiently diagnostic to help in determining its stratigraphic position. They consist of Phytopsis-like tubes and obscure brachiopod and tribolite fragments. Of the ostracods, Carter (1957) p. 10) wrote that all of the species "belong to the Leperditiidae, a few of them apparently related to Isochilina conicalis n. sp., thus partially confirming the Beekmantown age" of the formation. Carter also listed the following ostracods from the Beldens dolomite at St-Dominique (1957, p. 300):

Eoleperditia nana

Isochilina sp.

I. sp., cf. I. conicalis

Leperditia sp.

Structurally this formation underlies the St-Dominique sandstone of Chazy age. Its correlation with developments elsewhere is equally certain. Cady (1945, p. 550), in describing and naming the Beldens as a new formation, wrote of it as follows: "Bright, orange-buff-weathering dolomite in beds 1 to 2 feet thick is interbedded with snow-white marbly limestone.... The sharp color contrast between these two lithologic types is distinctive. The dolomite has

been described as "chamois weathering" (Gordon, 1923, p. 258) and the peculiar sharply cut reticulations of the weathered surface make it look like thread-scored beeswax. Gleaming outcrops can be seen in the fields southeast of Beldens ... and west of the highway north from Middlebury. In the lower part of the formation the white marble beds are less abundant and the rock is a duller buff or grey and less dolomitic".

Chazy Group

St-Dominique Formation. Although the Beldens formation, with inconsiderable exceptions, occupies the forefront of the St-Dominique slice, the most important of the stratigraphic units involved in the maintenance of the St-Dominique ridge is the St-Dominique formation of Chazy age. This consists of two members, an upper St-Dominique limestone member, and a lower St-Dominique sandstone member. This latter grades upwards into the limestone member, but its relationship with the underlying Beldens is unknown, although it is probably unconformable. The economic development at La Carrière has depended largely upon the St-Dominique limestone member for both dimension and crushed stone.

Although excellent exposures can be seen in the quarry region of La Carrière, it seems best to start with a description of the sequence at St-Pie hill, for not only are both the limestone and the sandstone members completely exposed there, but the whole development can be seen in one continuous section. The sandstone is not exposed at La Carrière and can only be seen at half a dozen places along the ridge. The limestone is involved in an undulating structure, well shown in the La Carrière quarries, that makes the elaboration of a single section difficult. Referring to the map of St-Pie hill (Figure 3), two lines were run from the summit, one directly east and the other at N.48°W. Determinations of the rock types, slope of the hillside, and the dip and strike of the beds were made for every 10 feet along the surface, and the following stratigraphic section was worked out:-

Top of section. East side of St-Pie hill. Contact with Black River beds not exposed. Possibly 10 feet missing.

Feet	Inches	
1	4	Grey dolomitic limestone.
5	4	Grey crystalline limestone.
4		Buff dolomite, not uniformly developed along strike. Grades laterally into grey limestone.

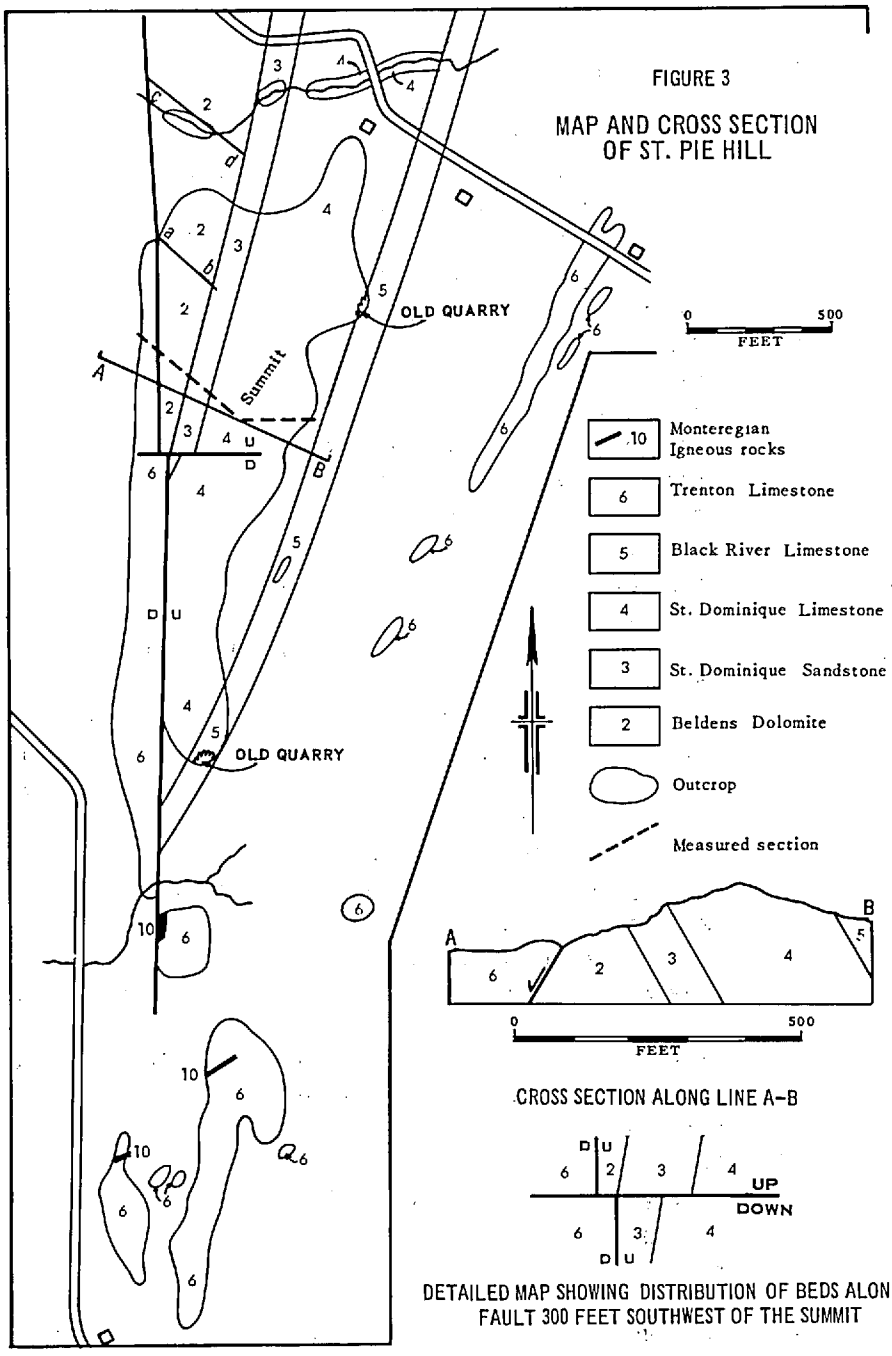


FIGURE 3

MAP AND CROSS SECTION OF ST. PIE HILL

DETAILED MAP SHOWING DISTRIBUTION OF BEDS ALONG FAULT 300 FEET SOUTHWEST OF THE SUMMIT

D.N.R.Q. 1962 NO. 1434

Feet	Inches	
2	8	Massive grey limestone.
2	8	Grey limestone with buff-weathering dolomitic patches.
10	8	Buff-weathering dolomite.
4	8	Not exposed, probably same as bed below.
7	4	Buff-weathering dolomite.
1	4	Greyish-buff-weathering dolomite and limestone, irregularly interbedded.
1	4	Light-buff-weathering dolomite.
	8	Grey limestone.
	8	Cream-weathering dolomite.
	8	Not exposed.
3	4	Massive, buff-weathering dolomite.
	8	Cream-weathering dolomite.
2		Grey crystalline limestone.
6		Not exposed.
1	4	Grey crystalline limestone. Fossiliferous.
3	4	Not exposed.
1	4	Grey crystalline limestone. Fossiliferous.
2	8	Not exposed.
8	8	Streaky limestone, about half-and-half dove-weathering limestone and siliceous matter in irregular stringers. Fossiliferous. Grades upward into dolomitic limestone without streaks.
1	4	Grey crystalline limestone, well banded.
3	4	Light grey limestone, abundant calcite veins.
2		Massive grey limestone.
4	8	Grey limestone with calcite veins.
4	8	Grey limestone with dolomite beds up to 1 inch thick.
2		Not exposed.
4		Grey crystalline limestone with large buff dolomitic blebs and abundant calcite veins.
2	8	Not exposed.
2		Massive, buff-weathering dolomite.
4	8	Massive grey limestone, no blebs or beds of dolomite.
	8	Not exposed.
2	8	Massive grey limestone, with many small buff, dolomitic blebs.
3	4	Massive grey limestone, with a few large dolomitic blebs.
	8	Massive grey limestone, with irregular dolomitic patches.

Feet	Inches	
6		Massive grey crystalline limestone with some calcite veins.
1	4	Not exposed.
1	4	Massive grey crystalline limestone with calcite veins.
4		Not exposed.
6	8	Grey crystalline limestone, not well stratified. A few dolomitic patches.
2		Not exposed.
	8	Buff-weathering dolomite.
1	4	Grey limestone, with network of buff-weathering dolomite.
	8	Grey crystalline limestone.
	8	Massive buff-weathering dolomite.
	8	Not exposed.
3	4	Grey crystalline limestone with blebs of buff-weathering dolomite and calcite veins.
2	8	Grey limestone streaked with network of buff-weathering dolomite.
8		Grey crystalline limestone with buff-weathering patches and beds. Much veined with calcite. Fossiliferous. Summit of hill.
3	4	Irregular mixture of grey crystalline limestone and buff-weathering dolomite and dolomitic limestone.
5	2	Not exposed, probably same as above.
3	10	Not exposed.
4	9	Limestone with abundant siliceous material in irregular streaks more or less parallel to bedding.
	10	Sandy grey crystalline limestone.
7	9	Massive crystalline limestone, criss-crossed with calcite veins.
11	1	Same as above, but with many streaks of buff-weathering dolomite parallel to bedding.
12	10	Not exposed.
	10	Sandy limestone, brown-weathering.
	10	Sandy limestone, grey-weathering.
8	7	Grey limestone, with siliceous streaks parallel to bedding.
11	1	Not exposed.
6		Grey limestone with siliceous streaks parallel to bedding.
1	9	Not exposed.
231	4	Thicknesses of St-Dominique limestone member.

Feet	Inches	
6	10	Sandstone, fine grained, calcareous at base.
5	2	Same as above, grading downward into equal amounts of sandstone and grey limestone bands.
11	2	Sandstone, fine grained.
8	7	Sandstone, fine grained. Lower 5 feet white-weathering, upper part brown-weathering.
8	7	Sandstone, fine grained, calcareous, pitted from weathering.
14	7	Not exposed.
5	2	Calcareous shale, streaky with siliceous material.
5	2	Not exposed.
	10	White sandstone, fine grained.
6	10	Rusty sandstone, fine grained.
1	9	Not exposed.
1	9	Sandstone, rusty weathering, fine grained.
1	9	Not exposed.
	10	Sandstone, fine grained.
2	7	Limestone, grey, hard, siliceous.
	10	Not exposed.
	10	Sandstone, white, fine grained.
	10	Not exposed.
16	4	White-weathering, fine-grained sandstone.
8	8	Same as above, with algal (fucoidal) markings. Probable base of St-Dominique sandstone member.
109	1	Thickness of St-Dominique sandstone member.
231	4	Thickness of St-Dominique limestone member.
340	5	Thickness of St-Dominique formation at St-Pie hill.

Elsewhere the St-Dominique sandstone can be seen to advantage at the northwestern end of a poor woods road which transects the St-Dominique ridge about 3 miles north of St-Pie. There, 260 feet of sandstone and arenaceous limestone can be measured across the surface. The dip is 30°, and the strata are therefore 130 feet thick. Close to the base there is a 6-inch layer rich in algal (fucoidal) markings, similar to those in the lowest bed in the St-Pie hill section. The sandstone is cleaner and in places medium grained, in contrast to the generally rusty, fine-grained rock at St-Pie hill. It can also be seen in the "main quarry" (p. 54) at La Carrière.

With regard to the St-Dominique limestone, the lithologic types listed above in the section from St-Pie hill are in no way different from those of the quarries of La Carrière, save that in the quarries the beds are, as one would expect, more massive (Plate IIA). For instance, Goudge (1935, p. 183) describes one unbroken layer 15 feet thick.

A few details seen elsewhere which do not appear in the St-Pie section are described below. First, in the exposures around La Carrière, the uppermost Chazy limestones are in places filled with small stromatoporoid fossils half an inch or so across. Second, in the woods to the north of Route 32 there is a great development of what appears to be a coarse oölitic limestone, but the oölites are composed of black material that may be organic. Third, whenever the middle and the upper parts of the limestone have been exposed to weathering a very characteristic surface "decoration" results. As described by Goudge (1935. pp. 181-183), the stone "formerly quarried for building stone is very dark grey, fine-grained, very heavily bedded and is striped parallel to the bedding with wavy seams of siliceous, ferruginous, magnesian material that weathers to a light brown in contrast to the light grey colour that the remainder of the stone assumes on exposure. This siliceous material is more resistant than the rest of the stone and on weathered surfaces it stands out in relief." Parks (1914, p. 77) describes the same stone as follows: "It is distinctly composed of two elements -- a lighter very fine grained crystalline component and a darker, argillaceous portion in which crystalline structure is not observable with the hand lens. These two types of rock are mingled together throughout the beds in a very irregular manner, giving to the smoothed surface of the stone a characteristic mottled appearance by means of which the St-Dominique stone may be recognized very easily.

"On corrosion the contrast between the two components is more pronounced. The dark part assumes a dirty brownish colour and the lighter portion shows the ordinary whitish grey colour with a fine 'pepper and salt' effect, showing it to be composed of pulverized fossil fragments. In the dark part also are to be seen still darker lines which are probably due to bituminous matter".

One pervading characteristic of all the Chazy limestones of the area is their crystalline nature. This the formation shares with the Laval limestone of the Montreal area. In the latter locality the crystallinity has been shown to result from the accumulation of echinoderm fragments. This is also likely to be the case

with the St-Dominique limestone, although there has been little evidence of cystoids and none of crinoids.

Another common feature is the presence of calcite-filled gash veins, which occur on the flanks of the low anticlines and accompany the minor faults that cut the limestone (Plate IIB). Such veins are almost never seen in the overlying Black River or Trenton limestones, probably because those formations were plastically deformed in accommodating themselves to the stress involved in the folding.

Fauna and Correlation. Very little earlier work has been done on the fauna of the Chazy limestones of the St-Dominique ridge. Ells (1896, pp. 115-117J) published four lists of species provided by Ami, all coming from St-Dominique. One of these is quoted from Logan (1863, p. 206). Many of the names listed refer to incompletely identified fossils. Ten years later Raymond (1906, p. 555) compiled a composite list, revising the nomenclature appropriately. This list (with modern generic names in parentheses) follows:

Raymond's composite list of fossils from the Chazy limestone of the St-Dominique region. Corrected names, etc. given in parentheses.	VALCOUR ISLAND			MONTREAL
	DAY POINT	CROWN POINT	VALCOUR	
Palaeocystites tenuiradiatus	D	C	V	M
Bolboporites americanus	D	C		M
Fletcheria incerta?			V	M
Hebertella borealis (Mimella)				M
Plesiomys platys	D	C	V	M
Hebertella acuminata (Mimella)				
Rafinesquina alternata (Probably incorrect)				
Clionychia montrealensis			V	M
Raphistoma stamineum		C	V	M
Liospira americana				
Trochonema umbilicatum				
Ophileta sp, cf. O. compacta				
Pleurotomaria sp., cf. P. laurentina				
Lonchodomas halli	D	C		
Bathyurus sp., cf. B. angelini				
Isotelus harrisi	D	C	V	
Asaphus marginalis (Basilicus)	D	C	V	
Illaenus globosus (Bumastus)	D	C	V	M
Solenopora compacta (Parachaetetes)				

In commenting on the above list Raymond (1906, p. 557) remarked "While it is not possible to refer any of these faunas (including the fauna listed above) to any one of the three divisions of the Chazy recognized at Chazy and Valcour Island, yet they show all these localities are in the region of the typical Chazy fauna".

During the course of the present work, our fairly large collection has been examined in a preliminary manner, and it is felt that the following identifications are to be relied on. In addition, there are probably many new species awaiting description, particularly among the strophomenid and orthid brachiopods and the asaphid trilobites. The identifications so far arrived at by both the present writer and by Usher (1947, p. 38), given in the list below, are sufficient to assure the stratigraphic position of the St-Dominique limestone within the Chazy group, but more extended paleontological elaboration of the fauna is required to show its precise place within the subdivisions of that group. The work of H.J. Hofmann (see bibliography) will doubtless provide new information, but final conclusions have not yet been reached.

List of fossils identified from the St-Dominique limestone by Usher (U) and by the writer (C) with their known occurrence elsewhere		VALCOUR ISLAND			MONTREAL
		DAY POINT	CROWN POINT	VALCOUR	
Ptychopleurella porcia	U			x	x
Orthambonites exfoliata	C	x			
Multicostella platys	U		x	x	x
Valcourea strophomenoides	U C		x		x
Dactylogonia incrassata	U		x	x	
Glyptomena? distans	U		x	x	
Macrocoelia champlainensis	U C		x		x
Camarella varians	U C		x	x	
Rostricellula plena	U			x	x
R. pristina	U		x	x	
R. sp., cf. R. orientalis	U			x	x
Raphistoma staminèum	U C	x	x	x	x

		VALCOUR ISLAND			
		DAY POINT	CROWN POINT	VALCOUR	MONTREAL
Lophospira rectistriata	U	x	x		
Basilicus marginalis	U C	x	x		
Isotelus platymarginatus	U		x	x	
Homotelus obtusus	U C	x		x	
Isoteloides angusticaudus	U		x	x	
Vogdesia bearsi	U				
Illaenus punctatus	U		x	x	
Thaleops conifrons	U C				Mingan I.
Eoharpes ottawensis	U C	x			
Lonchodomus halli	U C		x		
Cybeloides primus	U C	x	x		
Calliops annulatus	U C	x	x		x
Eurychilina latimarginata	U C	x	x	x	
Schmidtella sp., cf. S. crassimarginata	C			x	

The common genera around Montreal -- Rostricellula, Mimella, Blastoidocrinus, and Bolboporites -- are almost or completely missing from St-Dominique rocks. Raymond (1913, p. 146) referred to the Montreal fauna as " ... a modification of the fauna of the upper of the three divisions (Valcour) of the Chazy on Lake Champlain." Clark (1944, p. 259) published a compilation of the Chazy fauna from Quebec, mostly from the vicinities of Montreal and Ottawa, and later (1952) listed all Chazy species known in the Montreal area. These lists, compared with those of the faunas of the three divisions of the Chazy of the Lake Champlain region, showed closest resemblance to that of the upper, or Valcour, division. One of the diagnostic species is Rostricellula plena, exceedingly abundant in the Valcour division and also in the Ottawa and Montreal sections. Neither it, nor the closely allied species R. raymondi, nor the abundant Montreal species Bolboporites americanus is known from St-Dominique. Therefore, it cannot be said that the St-Dominique development shows exclusive relationship to either the Day Point, the Crown Point, or the Valcour formations, nor

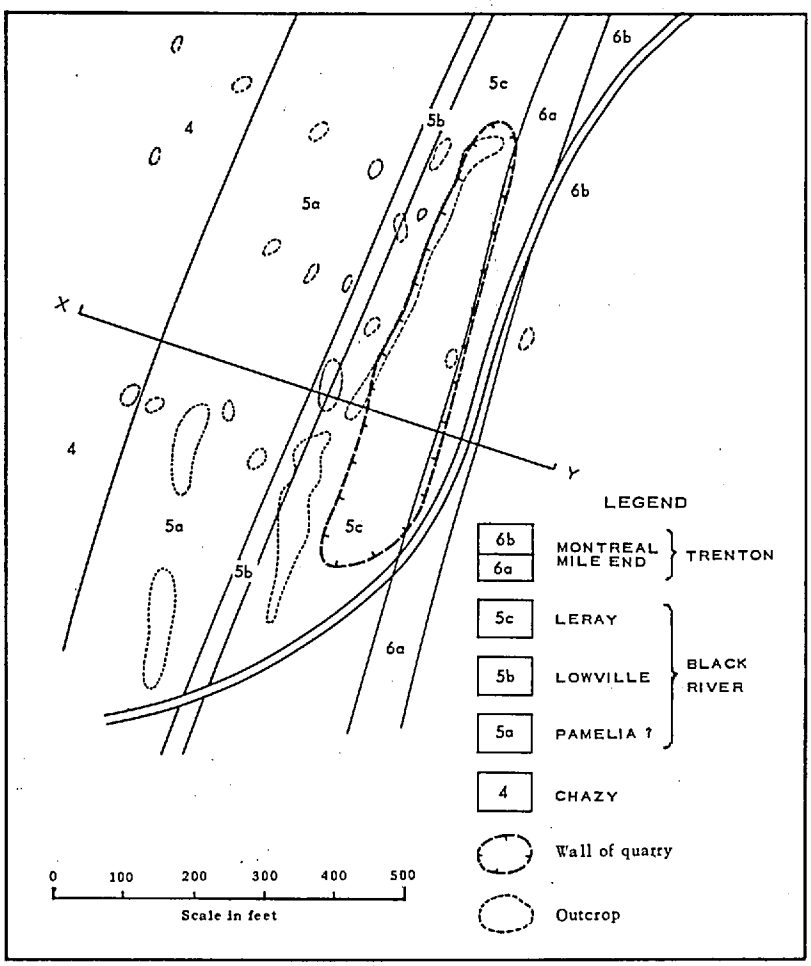
does it appear to be closely associated with the Laval formation of Valcour age around Montreal. It might be best, therefore, merely on the basis of its inherent features, to classify it as Chazy, undivided, and to await the results of more detailed collecting and identifications.

Black River Group.

Above the Chazy limestone there lie three formations assigned to the Black River group. The almost complete absence of fossils and of intervening exposures renders uncertain the correlation of these formations with the standard Black River sections elsewhere. However, in view of the order of deposition of lithologically similar beds, it is assumed that these are the stratigraphic equivalents of the Leray, Lowville, and Pamelia formations of the Montreal area. They are relatively thin; the maximum total thickness for the beds of the group is 71 feet. No fossils have been found in the so-called Pamelia beds, which eventually may be shown to be uppermost Chazy.

Good exposures of the fresh rock can be seen at two places; first, in quarries at La Carrière, some of which were formerly operated for decades for lime rock, and, second, in an old quarry half a mile southwest along the strike from the highway at these quarries. In the woods northeast of the highway, Leray limestone has been identified, but no Lowville or Pamelia. Southwest of the highway the only rocks identified as of Black River age, other than in the localities given above, are to be seen about 1,000 feet south of the woods road which cuts across the ridge about 3 miles north-northeast of St-Pie, and in one or two intermediate outcrops. Farther south, some of the rocks occurring along the east flank of St-Pie hill belong to the Black River group.

The most nearly complete section of the Black River rocks is to be seen in the second locality mentioned above. This is an old abandoned quarry three quarters of a mile due south of La Carrière, at the end of a half-mile-long farm road going southwest from the highway. The quarry (see Figure 4) is 700 feet long and its walls range up to 15 feet in height. At its widest, it is 115 feet across. Exposures are to be found in the close vicinity of the quarry, especially in the wooded territory to the west. The floor of the quarry is in part covered by water, in part by soil.



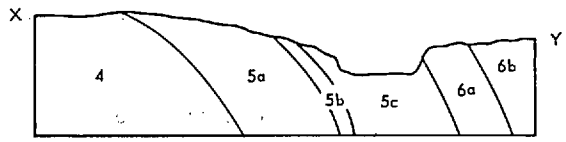


FIGURE 4

MAP AND CROSS SECTION OF ABANDONED QUARRY
ONE MILE SOUTH OF LA CARRIERE

D.N.R.Q. 1962 NO. 1435

The map and structure section (Figure 4) show that the beds are part of the east limb of an anticline whose axis strikes almost exactly toward the quarries of Black River rocks at La Carrière. Not only are Black River rocks exposed here, but the underlying Chazy and the overlying Trenton can be seen, though not in contact with the intervening Chazy. The stratigraphic section seen in the quarry and in the immediate neighbourhood is as follows:

Group	Formation	Thickness	Description
Trenton	Montreal		
	St-Michel member		Dark grey, shaly and slabby limestone, weathering dark grey. Contains Cryptolithus. Exposed on a small knoll east of the farm road about opposite the middle of the quarry.
		66'	No exposures.
	Mile End member	5'	Fragmental crystalline limestone containing bryozoa, etc. Exposed continuously along eastern wall of quarry.
Black River	Leray	16'	White-weathering limestone, oölitic at the top; in part conglomeratic with pebbles of limestone up to 1 inch across, in part fragmental with the grain of a coarse sandstone.
		6'	Dark, fine-grained, crystalline limestone, medium-grey-weathering. A few beds of limestone conglomerate.
		4'	Dark conglomeratic limestone, pebbles up to 1 inch across, weathering light grey.
		18'	Dark, fine-grained fragmental limestone. Quartz grains up to 1 mm. present but uncommon. Thick and irregularly bedded, crossbedded. Fragments of unrecognizable trilobites.
		44'	Total thickness of the Leray

Group	Formation	Thickness	Description
	Lowville	7'	Sandy limestone, with abundant quartz grains, rounded and frosted, up to 1 mm. Grades upward into exceedingly fine-grained, pure, pale dove-grey limestone with Tetradium. Other fossils rare; poor gastropods and pelecypods, neither collectible nor identifiable.
	Pamelia	15'-20'	Grey, yellow- to brown-weathering dolomite and magnesian limestone. Bedding obscure. No fossils. No contact with overlying or underlying beds. Might possibly belong to the Chazy.
Chazy	St-Dominique	10'+	Medium- to coarse-grained crystalline limestone, dolomitic streaks and patches common. Small Solenopora-like fossils up to 1 inch across. Other fossils scarce.

The group of quarries near the highway at La Carrière is worth describing. One of these is southwest of the road, the others lie to the northeast. Of these latter, the two most northerly have recently been worked for lime. The stratigraphic section in the quarries north of the road is as follows:

Group	Formation	Thickness	Description
Black River	Leray	6' exposed	Medium grey, light-grey-weathering, even-grained fragmental limestone, probably an echinoderm detritus. Some pink calcite crystals. Unevenly bedded in detail. Crossbedded in places. Some layers are so rich in quartz grains (rounded and frosted, up to 5 mm.) as to be properly called a sandstone.

Group	Formation	Thickness	Description
	Lowville	13' exposed	Dense, light grey, white-weathering limestone. A small part of this rock is made up of calcite crystals up to 5 mm. across. These do not seem to be crystallized echinoderm fragments but the result of the crystallization of the dense calcareous material of the rock. Phytopsis tubulosa common; no Tetradium or other fossils seen. Evenly bedded in layers from 2 to 12 inches thick. Two zones of intraformational conglomerate at the top.
	Pamelia	10' exposed	Brownish-orange-weathering, finely crystalline dolomite. No fossils. Medium grey when fresh. Separated from Lowville by a vertical fault. No contacts with adjacent Chazy, to which it might possibly belong.

The small quarry nearest the road is water-filled and has not been used for several decades. In its southwest corner, the Lowville limestone has a westerly dip, possibly related to the faulted contact visible in the nearby road cut, or possibly the reflection of a small anticlinal swell seen in the quarry south of the road (Figure 7).

South of the road is an old quarry, not visible from the road, but located immediately behind a roadside cross, and almost in line of strike with the quarries just described. The structure shown in the northeast wall (Figure 7) is probably the continuation northward of the anticlinal structure seen in the quarry half a mile to the south-southwest (Figure 4). No new rock types occur here. About 10 feet of Lowville limestone and 20 feet of Leray limestone are exposed. Many of the beds are slickensided with striations trending N.70°W. and indicating a movement of the upper beds toward the west-northwest.

Trenton Group

The bulk of the St-Dominique ridge consists of limestones and shales of Trenton ages. Within the wooded portion of the ridge exposures are few and poor, but the presence of the limestones of this

group is usually betrayed by an abundance of fracture cleavage slabs or blocks of pale-grey-weathering, dark grey to almost black limestone. Wherever the woods have been cleared, as has been done within half a mile of the St-Dominique highway, the Trenton limestones and shaly limestones have lost their thin protective soil cover and stand exposed in low or in prominent ridges. The abundance of argillaceous material in the original sediment allowed the development in the resulting rock of a poorly defined flow cleavage, which, together with an equally poor fracture cleavage, makes the rock split across the bedding in most places (Plate III A), thus rendering the search for fossils usually unsuccessful.

Basal Beds. The lowest bed of this group can be found in contact with the Leray limestone in the old quarry half a mile south of the highway at La Carrière (Figure 4). The rock here is a fragmental, partly crystalline limestone rich in comminuted shells and bryozoan colonies too poorly preserved to be identified. The rock forms the eastern wall of the quarry, and not more than 5 or 6 feet are exposed. It may be the equivalent of the Mile End limestone of the Montreal area and the Deschambault limestone of the region between Montreal and Quebec. The rock of the quarry adjacent to the old Mercure garage (known locally as the Mercure quarry) presumably belongs to this same Lower Trenton formation, though it is lithologically different. Its black colour, solid appearance, general lack of argillaceous material, and its stratigraphic position make it possible that it is the equivalent, in part, of the 66 feet of unexposed strata of the southern quarry.

Montreal Formation, St-Michel Member. There follows, to the east of the basal beds of the Trenton group in the old quarry last mentioned, a gap representing 66 feet of missing beds. Then there follows a shaly limestone, exposed in a small knoll (Figure 4). This rock contains Cryptolithus tesselatus and strikes north-north-easterly toward the Cryptolithus-bearing beds extensively distributed north of the St-Dominique highway. These latter rocks are everywhere shaly limestones, in which Cryptolithus tesselatus is in places very common. The entire fauna collected and recognized is meagre, and consists of the following species:

Prasopora simulatrix
Rafinesquina alternata
Sowerbyella punctostriata
Cryptolithus tesselatus
Flexicalymene senaria

None of these species, except Cryptolithus tesselatus which elsewhere is restricted to the lower middle part of the Trenton, is of much value in placing the containing beds in any of the subdivisions of the Trenton group. Around Montreal Cryptolithus occurs only at the base of the St-Michel member of the Montreal formation.

Montreal Formation, Rosemount Member. Next above the Cryptolithus beds come dark bluish grey to almost black limestones, weathering light- to medium-dove-grey, in beds up to 3 inches thick separated by thin shaly partings. Lithologically, this development resembles the Tetreaultville formation (Upper Trenton) of Montreal but, faunally, it is the equivalent of the Rosemount member of the Middle Trenton Montreal formation. It is best seen in the prominent ridge, half a mile long, the southern end of which reaches the main highway about one mile northwest of St-Dominique church, and also in the so-called "New Quarry" opened up in 1961, south of Route 32 where it turns to the northeast toward Britannia Mills Station. Fossils abound, but because of the prevalence of cleavage, accompanied by and possibly genetically related to localized high dips and faulting, together with the emplacement of one or two dykes, these fossils are almost impossible of extraction from the rock. By assembling the faunal lists from all of the nearby exposures the fauna of this formation is as follows:

Prasopora simulatrix
Trematis terminalis
Rafinesquina alternata
Resserella sp., cf. R. rogata
Sowerbyella punctostriata
Plectorthis plicatella
Platystrophia amoena
Zygospira recurvirostris
Eotomaria sp.
Flexicalymene senaria
Isotelus sp., large
Ceraurus sp.
Cheirocrinus plates
Crinoid stems

Most of the species in the above list are long ranging forms, but the assemblage as a whole is the same as that of the Rosemount member of the Montreal formation (Clark, 1952, p.71) The absence of Cryptolithus separates it from the underlying St-Michel member, and, as far as the Montreal succession is concerned, the

absence of Rafinesquina deltoidea and related species, cystoids in abundance, Conularia, and large cephalopods separates it from the overlying Tetreaultville formation.

Higher Trenton Beds. Immediately to the east, and therefore stratigraphically above these Rosemount beds, are some thin-bedded, finely banded shaly limestones. These are well exposed northwest of the road 1 1/2 miles northeast of the road corner on the main highway between St-Dominique and La Carrière. The banding in this rock is remarkably fine and regular. Beds of from .5 mm. to 10 mm. of light coloured crystalline limestone alternate with thinner beds of dark, fine-grained, apparently non-crystalline limestone or shaly limestone. No fossils were seen in this rock, but in beds probably immediately underlying it small gastropods abound.

St-Germain Complex (Mostly Utica and Lorraine Shales)

East of the finely banded rock of Trenton age just described there are but scattered exposures, best seen in a belt a mile or so wide stretching from about the vicinity of St-Pie in a north-northeasterly direction for 10 miles to the eastern margin of the map. Road cuts afford most of the exposures, but low outcrops away from the roads also contribute. Throughout this belt the rock is predominantly slaty, and apparently has little in common with the Trenton limestones. The lithologic types ally them more closely to the shales of the Utica and the Lorraine groups, although it is quite possible that they include some of the uppermost Trenton beds which, along the eastern side of the St.Lawrence Lowland, are known to be shaly limestone or shale (Clark, 1959). As in the Upton area on the north, most of these shales and slates have been so badly disturbed that it is best to assign them to the St-Germain complex.

The closest geographic approach of these rocks to the Trenton limestone outcrop can be seen in the road cuts in the vicinity of the four corners a mile or so north of St-Pie, where fine-grained, micaceous slates and slaty limestones have been exposed. Although there seems to be a definite flow cleavage, the rocks break for the most part along bedding planes. There are no recognizable fossils, but two brown- and orange-weathering beds, each about 6 inches thick, contain small black flakes which possibly are organic fragments. This latter type of rock is similar in all respects to the buff-weathering limestones interbedded with the Utica shale. So close are these beds to the Trenton limestone, and so great is the difference in the structural deformation affecting the two rock types that they may well have been juxtaposed by a fault along which the slates have been brought westward.

The same type of highly deformed rock occurs in the bed of Noire river at St-Pie (Figure 8) where a sill of basic rock caused rapids before the power dam was constructed. Below the dam a few basic dykes and the sill are associated with isoclinally folded, fissile, micaceous slates containing both grey- and buff-weathering limestone beds rarely as much as a foot thick. One of the grey limestones contains fragmentary fossils of crinoid stems, brachiopods, bryozoa, and trilobites, none of which is identifiable. In some of the shale beds poorly preserved graptolites of a Utica aspect have been found. Ells (1896, p. 19J) mentions long, straight graptolites occurring between the railway and highway bridges, a locality inaccessible since the building of the dam. The outcrops in the river bed at St-Pie will be described in detail under Structural Geology, and a map of the outcrop to show the type of structure characteristic of the St-Germain complex is given in Figure 8.

About a mile and a half northeast from St-Pie village there are pasture outcrops of grey slaty shales and quartzites. These yielded no fossils. In spite of this there is much in their lithology to ally them with the greenish grey shales and sandstone of the Lower Lorraine. In fact, all of the exposures seen to the northeast of St-Pie are lithologically identifiable with the Lower Lorraine and do not resemble the beds of any other formation. Nine miles northeast of St-Pie and one mile northeast of St-Hector there are exposures in which the shale and slate contain fragments of bryozoa and brachiopods of the same general kinds as those that characterize the Lower Lorraine shale of the Nicolet River section. But even there, where these shales are practically undisturbed, they are predominantly unfossiliferous. It is not, therefore, surprising to find so many small isolated exposures of well cleaved, slightly metamorphosed Lower Lorraine rocks to be unfossiliferous. Still farther to the northeast, 1 1/2 miles south of St-Liboire and also near the village itself abundant sandstone beds are interbedded with the slaty shale. This combination is a characteristic of the upper part of the Lower Lorraine. Hence, it appears that, in general, there is a gradation in age from old to young going eastward from the St-Dominique ridge -- a generalization which obtains within the ridge itself. Because, however, of the uncertainty of determining the stratigraphic relationships of most of these slaty outcrops it seems best to refer all of the region east of the known Trenton belt of outcrop to the St-Germain complex.

Formations West of the St-Dominique Fault

The area west of the St-Dominique fault is physiographically a nearly flat plain with an average elevation of approximately 100 feet above sea-level, and is here called the St-Hyacinthe plain. Exposures are limited to the bed of Yamaska river which transects the plain, and to the bed of its tributary, Orme brook, 2 miles northeast of Ste-Rosalie. West of Yamaska river no exposures are known, but the logs of half a dozen deep wells provide a picture of the sub-surface stratigraphy. All of the exposures along Yamaska river belong to the Breault member of the Nicolet River formation. Those northeast of Ste-Rosalie, on Orme brook, are probably also of the same age but, because of their complicated structure and slaty cleavage, it is better to refer them to the St-Germain complex. The boundary between the recognized Breault exposures and the St-Germain can only be guessed at. The logs of the two wells 2 miles east of Ste-Rosalie (DeBlois 1959, pp. 156, 157) show that the St-Germain complex is at least 3,569 feet deep in that locality. West of the Yamaska the well logs show a thousand feet or more of Bécancour River red and green beds and several thousand subjacent feet of Pontgravé River and Nicolet River beds.

Breault Member, Nicolet River Formation.

Along Yamaska river both at and below St-Hyacinthe there are several areas where shales and sandy shales, carrying Cryptolithus bellulus, of the Breault member are exposed on one or both sides of the river. In all cases, except the exposures due west of St-Simon, the shales are soft and crumbly, with thin beds of limestone and sandstone, and are but slightly folded, dips of more than 10° being exceptional. Moreover, all of these exposures are fossiliferous, and contain a fauna characteristic of Foerste's Cryptolithus zone of the Lorraine (Foerste, 1916, 1924). The St-Simon exposures are of thin-cleaving shales dipping 85° to the west, with abundant 1- to 2-inch beds of sandstone. No fossils were found in these rocks. They resemble in many respects the unfossiliferous shales along Yamaska river just across the boundary between the St-Hyacinthe area and the Upton area immediately to the north.

The exposures at St-Hyacinthe occupy the bed of Yamaska river for half a mile below the power dam (Plate IV A). The upper part of this section, between the dam and the highway bridge, has already been described by Foerste (1916, pp. 53-56). The accompanying sketch (Figure 5a) shows the extension of the exposures beyond those mapped by Foerste, and provides an interpretation of the structure.

The rocks consist almost entirely of soft shale with a minor amount of sandy and silty shale. Only one or two beds of sandstone or limestone were located. Half a dozen dykes are present, and all are presumably related to the intrusive bodies of mounts St-Hilaire or Yamaska. The lower 1,000 feet along the right bank of the river presents a very simple structure, as do the exposures mapped by Foerste above the highway bridge. In between these stretches, however, the structure is very complicated (see structure sections, Figures 5 b,c). The present interpretation is that the exposures represent the result of the rupture and crushing of a large drag fold. Later reorganization by faulting could account for the non-persistence of the through-going thrusts.

No new fossil identifications have been made during the present investigation. Hence, Foerste's lists (1916, pp. 53, 55 and 1924, pp. 107, 136, 163, 177, 211), consolidated into one, will suffice. There is no doubt from this list that this section as a whole belongs to the "Cryptolithus zone" or Breault member of the Nicolet River formation. The consolidated faunal list follows:

Fossils collected and identified by Foerste from Breault shale, bed of Yamaska river at St-Hyacinthe. Present writer's notes in brackets. Known distribution shown at right.	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St.Hilaire member *Pholadomorpha* zone	Chambly member *Proetus* zone	Breault member *Cryptolithus* zone	
Lingula hyacinthensis				x	
Dalmanella sp.					
(*Resserella* sp. prob. *R. multisecta*				x	
Leptaena moniquensis			x	x	
Catazyga headi	x	x	x	x	
Zygospira modesta	x	x	x	x	x
Cuneamya sp., cf. *C. scapha-brevior*	x	x			
Ctenodonta hyacinthensis				x	
Clidophorus planulatus		x	x	x	
C. brevis				x	
Colpomya faba pusilla			x	x	

	Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
		St.Hilaire member *Pholadomorpha* zone	Chambly member *Proetus* zone	Breault member *Cryptolithus* zone	
C. sp., cf. *C. constricta*				x	
Cymatonota pholadis	x	x	x	x	
Lyrodesma sp., cf. *L. poststriatum*		x	x	x	
Byssonychia radiata	x	x	x	x	
Clionychia curta		x	x	x	
Modiolopsis hyacinthensis				x	
Archinacella pulaskiensis	x	x	x	x	
Sinuites cancellatus	x	x	x	x	x
Cyrtolites sp., cf. *C. subplanus* (prob. n. sp.)					x
C. cp., cf. *C. parvus*				x	
Lophospira (?) *hyacinthensis*				x	
Cryptolithus bellulus				x	
Triarthrus huguesensis				x	
Calymene sp.					
Ohiocrinus sp., cf. *O. geniculatus*				x	
Heterocrinus sp.					

One strongly suspects that the section of 720 feet mapped and measured by Foerste is not a natural one. To be sure, all the beds dip fairly uniformly in the same direction, but the prevalence of faults makes the thickness, calculated on the basis of width of outcrop and average dip, unreliable.

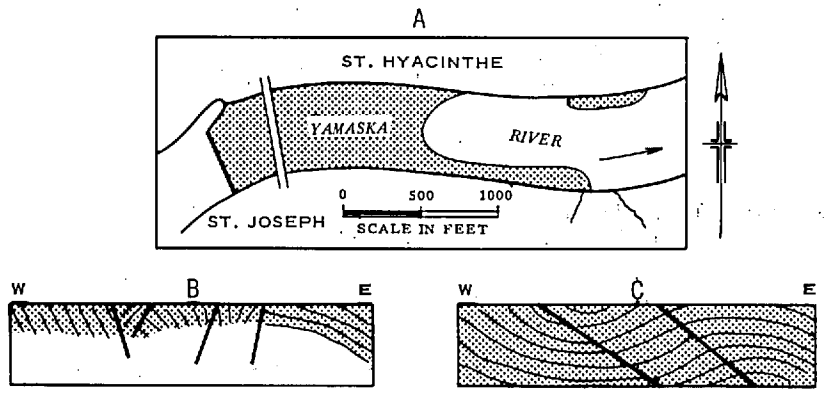


FIGURE 5

A MAP OF THE EXPOSURES IN THE BED OF YAMASKA RIVER AT ST. HYACINTHE

B CROSS SECTION ALONG RIGHT BANK, AS SEEN FROM THE SOUTH.

C SUGGESTED CROSS SECTION OF FIGURE 5B BEFORE COMPLICATIONS INDUCED BY FAULTING

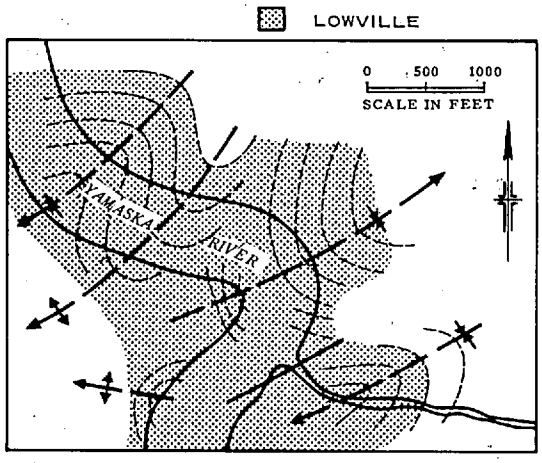


FIGURE 6

MAP OF PART OF YAMASKA RIVER 5 MILES NORTH OF THE DAM AT ST. HYACINTHE TO SHOW FOLD AXES. EXPOSURES NEARLY CONTINUOUS ON BOTH BANKS. DIPS RANGE UP TO 7°.

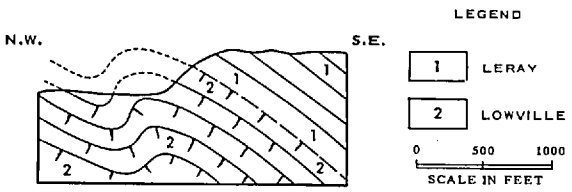


FIGURE 7

CROSS SECTION THROUGH ABANDONED QUARRY IN BLACK RIVER, SOUTH OF ROAD AT LA CARRIÈRE. LOOKING NORTHEAST

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Farther downstream, 4 1/2 and 5 1/2 miles from the dam at St-Hyacinthe, there are fairly extensive exposures of shale on both sides of Yamaska river and for 1,000 feet up Orme brook. These are mostly soft, crumbly, silty shales, with minor amounts of sandstone and limestone in thin beds rarely as much as an inch thick. Along the Yamaska all the dips are low except at the southernmost end of the exposures, where high dips prevail. High dips also are the rule in the beds farthest upstream along the tributary. These high dips are probably the result of local folding or faulting. A map of the outcrops and the postulated structure at this locality is given in Figure 6. The following faunal list was compiled from identifications from the few fossiliferous layers throughout the section. It leaves no doubt that these beds should be referred to the Breault member of the Nicolet River formation.

A mile and a half downstream from the mouth of Orme brook exposures can be seen along the banks of a small creek entering Yamaska river from the east, and also for a few hundred feet downstream along Yamaska river. Actually, at low water, one can cross the river here on foot. The rocks are well bedded shale and thin sandstone layers, dipping 10°-15° westward. Probably not more than 250 feet of strata are involved here.

A little more than 2 miles farther downstream, and still on the east bank of the river, at a point almost due west of St-Simon, black to dark grey shales are poorly exposed at the river's edge. Sandstone beds up to 2 inches thick abound, and fragments of graptolites can be found. These beds strike N.8°E. and dip 85° west. This structure is in harmony with similar beds just across the boundary line in the Upton area.

List of fossils collected from banks of Yamaska river below St-Hyacinthe, with known stratigraphic range. a - 3 1/2 miles below St-Hyacinthe b - Right bank, 1 mile farther downstream, at mouth of tributary. c - Right bank, 1650 feet below mouth of tributary.		Pontgravé River (Richmond)	Nicolet River (Lorraine)			Utica or Trenton
			St-Hilaire member *Pholadomorpha* zone	Chambly member *Proetus* zone	Breault member *Cryptolithus* zone	
Resserella multisecta	a b c				x	
Leptaena moniquensis	a b			x	x	
Cuneamya scapha-brevior	b c	x	x			
Ctenodonta borealis	b c		x	x		
Clidophorus postvolutus	b c				x	
Modiodesma modiolare	c	x	x	x	x	
Sinuites cancellatus	b	x	x	x	x	x
Geisonoceras sp.	c					
Cryptolithus bellulus	a b c				x	
Triarthrus huguesensis	a b c				x	
Calymene sp.						
Isotelus sp.						
Lepidocoleus jamesi	c	x	x	x	x	x
Byssonychia hyacinthensis	b				x	

The Yamaska river exposures described above all belong to the *Cryptolithus* zone (Breault member) of the Nicolet River formation. With the exception of the last described exposure and minor parts of others, all show only moderate deformation. Where high dips occur, as on Orme brook and elsewhere, the deformation is explicable as incidental to local faulting or drag folding. The most northerly exposures may show in their structure an approach to that of the St-Germain complex. Some of the faults may be reflections of the major St-Barnabé fault, which parallels the Yamaska river and which has allowed the Bécancour River beds to be brought into contact with the Breault member beds. The order of movement involved is 2,000 feet, which is sufficiently great to have affected the Breault beds as described above.

St-Germain Complex.

Four and a half miles east-northeast of St-Hyacinthe there are exposures along Orme brook, the only important tributary entering Yamaska river below St-Hyacinthe. At the first road crossing below the Canadian National Railways main line there are thin-bedded shales and sandstones about which there is nothing diagnostic except that they might well belong to the Lower Lorraine. The bedding is, for the most part, nearly vertical. A record of attitude readings follows:

200 feet below bridge -- N.20°E., dip 75° E. Shale
50 feet above bridge -- N. 20° E., dip 80° E. Shale and sandstone
500 feet above bridge -- N.30° E., dip 45° E. Shale.

No more exposures are met upstream as far as route 9 and the Canadian National track; from there on, good exposures occur discontinuously as far as the next road crossing upstream, and for half a mile beyond. Throughout this stretch the strikes range from N.20° E to N.60° E., but N.20° E. and N.30° E., are commonest. The dips range from 30° to 80° east, and there is a marked change toward the lower dips as one goes upstream.

For the most part, these rocks could well fit into the Breault member of the Nicolet River formation. However, exposures of buff-weathering limestones characteristic of the Utica may be found 300 feet above the railway bridge and again 200 feet above the next road crossing upstream. In spite of careful search no fossils were found. It is probable that these rocks were overridden from the east by the St-Dominique slice, and rendered nearly isoclinal at that time. In the circumstances it would be in order to map them either as a lower part of the same series as that of the Yamaska exposures (Breault), or as, in part at least, the Utica formation. Because of stratigraphic uncertainties and structural complications it is considered best to include these outcrops in the St-Germain complex.

Ste-Rosalie Well Cores. Corroboration of the assignment of the Ste-Rosalie exposures to the St-Germain complex comes from the cores of Ste-Rosalie Wells No. 1 and No. 2. Although only fragments of core were preserved from Ste-Rosalie No. 1 they were sufficient to indicate that there was no essential difference between the rocks in which the two wells were drilled. Ste-Rosalie No. 2, the log of which is given in Appendix A, penetrated a mass of black and

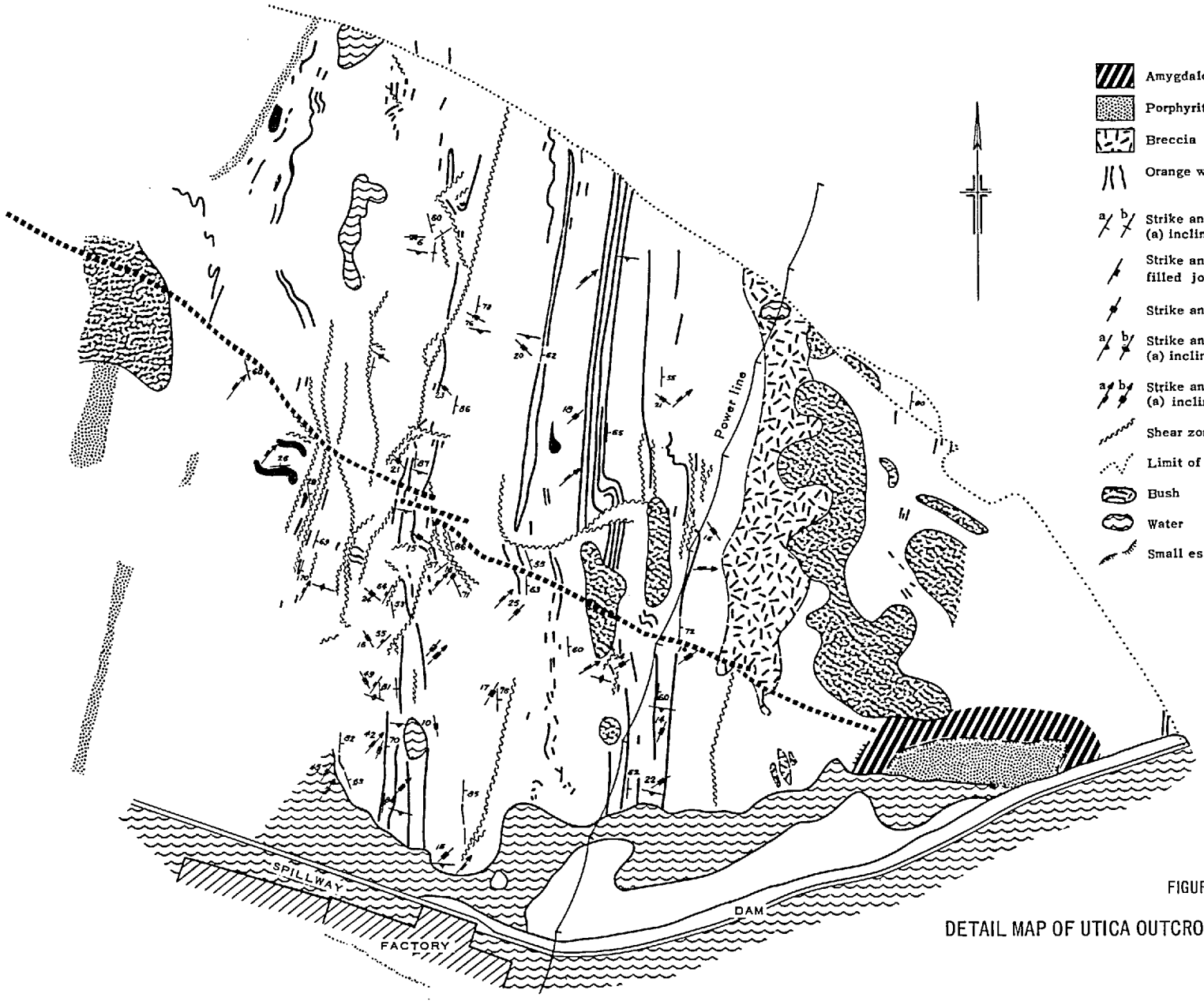


FIGURE 8

DETAIL MAP OF UTICA OUTCROP IN NOIRE RIVER AT ST. PIE

D.N.R.Q. 1962 NO. 1439

dark grey shale with numerous sandstone beds from a millimetre to a couple of feet thick, similar in all respects to the rock outcropping alongside the railway tracks nearby. There are no fossils (a few obscure graptolite fossils were seen in the core from Ste-Rosalie No. 1, but were not identifiable), but the rock in places looks like the Utica shale, though most of it more closely resembles the Lorraine sandy shale. The dips of the shale beds throughout the core are between 40° and 60°; cleavage is parallel or subparallel to the bedding, and slickensides are very common. In the more sandy beds cleavage is independent of the bedding or is absent. Several of the sandstone beds show plastic deformation, probably a preconsolidation phenomenon rather than one connected with folding. On both stratigraphic and structural bases, the rocks of the cores deserve to be included in the St-Germain complex.

Unexposed Formations of the St-Hyacinthe Plain

The belts of outcrop of the Pontgravé River and the Nicolet River formations in the western part of the map are not based upon actual exposures but are necessitated by distributional features on neighbouring areas, particularly the Beloeil area (Clark 1955), and are in accord with conclusions drawn from the study of the logs of the deep wells in the northwest corner of the area (Figure 9), and of Ste-Madeleine No. 1 well (Beloeil area). That the region to the northwest of the St-Barnabé fault is underlain by red Bécancour River (Queenston) rocks, is shown by the logs of all of the deep wells drilled there except one (Appendix A). The log of Canadian Natural Gas No. 3 starts directly in grey rocks, presumably Pontgravé River, and continues into grey Nicolet River beds. As suggested under Structural Geology the grey shales probably occur in a sliver caught between the main St-Barnabé fault and a subsidiary fracture.

IGNEOUS ROCKS

Dykes and sills, rarely more than 5 feet thick, outcrop in the southern part of the area and have been encountered in the deep wells in the northwestern corner. More than one half of the dykes strike toward Mount St-Hilaire and a few strike toward the nearer Mount Yamaska. This orientation does not, of course, prove genetic relationship with the mounts concerned. There is no information concerning the trend of the igneous bodies found underground in the wells of the St-Barnabé region.

All the dykes are composed of dark, basic rock, ranging from very fine to medium-coarse grained; some are vesicular or amygdaloidal. Hornblende and augite are the principal minerals identifiable megascopically, and both occur as phenocrysts up to 10 mm. across.

Two sills of basic rock encountered in drilling Ste-Rosalie No. 2 well were approximately 1 and 2 feet thick respectively.

STRUCTURAL GEOLOGY

In describing the stratigraphy of this area a three-fold division was made into:

(a) the Sillery area to the southeast
(b) the St-Dominique ridge and plain
(c) the St-Hyacinthe plain.

These divisions are separated by faults, the evidence for which, and the structural features of each division, are given below.

The Sillery Area

Although only a small corner of the area is mapped as Sillery, the rocks are well enough exposed to assure their correlation with the Sillery beds of the Granby area to the south and the Upton area to the north. Moreover, the same rocks occur discontinuously northward to Sillery and Lévis. Throughout this stretch they show the same stratigraphic characteristics -- greenish-grey sandstone and grit interbedded with red, grey, and green shale and slate. Everywhere from Quebec to Granby these beds are strongly folded and, as a result of the erosion of the less resistant shale and slate, sandstone ridges stand out above the surrounding plain. None of these ridges is more than a mile long and, although such a limitation may in some cases be a reflection of original localized deposition, it is more likely to be the result of cross faulting. Cross faults have been seen in only one exposure; they may be elements in a general system of similarly oriented faults, some stronger elements of which have acted as exposure-bounding factors.

The exposures of Sillery rocks are too limited in both number and continuity to allow any general picture of the regional structure to be worked out. Because practically all of the sandstone beds dip to the east the structure is probably that of a series of isoclinal folds overturned to the west. The great complexity of

attitudes in the slate bodies is what would be expected as a result of the deformation of an incompetent bed held between or controlled by strong, unyielding, sandstone layers. Slaty cleavage is present in most of the shales, and is fairly uniform in attitude, striking approximately N.20° E., and dipping 65° east. Little fracture cleavage can be seen in these rocks.

The contact between the Sillery rocks and those to the west is not seen here, and only indirect evidence that the contact is a thrust fault can be given. The Sillery formation is supposed to be of Cambrian age, and elsewhere occurs exclusively in the Appalachian folded province. In Quebec, it lies adjacent to rocks on the west which are not only much younger than the Sillery, but which are stratigraphically of a different nature. These western rocks are devoid of strong competent elements such as those that characterize the Sillery formation and, at least close to the contact with the Sillery, are far more strongly crumpled and contorted than are the Sillery rocks themselves. This distortion, however, grows less and less well marked as one gets farther from the Sillery area, and is best interpreted as the effect of the westward overriding Sillery slice.

In this area the rocks adjacent to, and west of, the Sillery area are considered to be Trenton or younger in age. In the Granby area to the south the Sillery rocks have been thrust westward over distorted Ordovician rocks, and there is nothing in the present area to oppose this explanation. Consequently the contact is considered to be the same thrust which bounds the Sillery in the Granby and Sutton areas to the south. It is here considered to be one unit in a complex of thrusts collectively known as Logan's Line or the Champlain fault.

St-Dominique Ridge and Plain

This division is characterized by a series of competent beds gently and undulatingly folded throughout the ridge and dipping toward the east at angles rarely exceeding 10°. These are followed across the plain by stratigraphically higher incompetent shaly beds that become steeper and steeper in dip and are probably intensely isoclinally folded near their eastern limit.

St-Dominique Ridge

Folds and faults. The map showing the distribution of the geological formations over the St-Dominique ridge (Figure 2) indicates some of the irregularities attendant upon the otherwise uniform dip to the east. The beds undulate down the dip, with the result that irregularities in the bands of outcrop as mapped are promoted. Thus, two low folds are shown north of La Carrière, each with a northeasterly plunge. This plunge is probably directly responsible for the relatively great width of outcrop of the Chazy limestone 1 1/4 miles north-northeast of La Carrière. A plunge in the opposite direction a half mile northeast of this point is probable in view of the much lessened width of outcrop of the Chazy limestone, and, in fact, another quarter mile farther north, a small southward plunging syncline in Chazy sandstone is visible.

It must also be noted that the varying widths of, say, the Chazy limestone may be due in part to the differential tilting of the fault blocks into which the ridge appears to have been transversely broken. Observations on the dips do not wholly corroborate the value of this factor, however, and a combination of block tilting and plunging folds is considered more logical. South of the St-Dominique road the Chazy limestone preserves a nearly uniform width of outcrop, about one-third of a mile, and evidence of plunging folds, either from the map or from the field, is lacking. There is, to be sure, a considerable narrowing of the Chazy belt of outcrop about half a mile north of St-Pie hill, but this can be related to block tilting consequent upon the formation of the mapped cross faults.

Cross faults are introduced into the map wherever no other structure can reasonably be invoked to explain non-continuation of belts of outcrop. None of these faults was seen and, in fact, no direct field evidence of them came to light. In the northern part of the ridge they have been mapped with a strike of about N.45° W., which must not be considered as anything but a direction of convenience, though it may well be correct. The faults were determined, hypothetically, to be about half-way between traverse lines; because most of these latter were 1,000 feet apart, the faults may be a few hundred feet out one way or the other. To the south of the highway the faults are drawn so as to strike more nearly north in order to accord with the dislocations at both ends of the assumed fault lines.

A probable strike fault, here named the St-Pie fault, traverses the western edge of St-Pie hill (Figure 3), where the dark grey Trenton limestone has been brought into juxtaposition, from north to south, with the Beldens dolomite, St-Dominique sandstone, St-Dominique limestone, the Black River beds, and possibly the lower part of the Trenton limestone. The minimum vertical displacement where the top of the continuously exposed Beldens and the dark grey Trenton limestone are in contact is 561 feet. The Beldens has a minimum thickness of 233 feet, and hence the minimum displacement at the northern end of the hill is 794 feet. This might be increased if we were able to evaluate the positions within the Trenton formations of the limestones on the two sides of the fault. Because the Trenton limestone west of the fault has the appearance of the middle part of the Rosemount member of the Montreal formation, the gap within the Trenton may be as much as 150 feet, thus making the total vertical displacement approach 1,000 feet.

Cleavage. Only faint cleavage can be determined in most of the rocks of the ridge. The Beldens (Plate IB) shows a very poor cleavage. Immediately to the east of the highest part of the ridge between La Carrière and St-Dominique the Trenton limestones and calcareous shales show prominent cleavage (Plate IIIA) whose general attitude is about N.20° E., dip 60° east. On the long ridge that lies north of the highway and parallel to the road to Britannia Mills station, cleavage so dominates the Trenton rocks that it is practically impossible to break them along bedding planes, and as a result no fossils can be extracted. Good road cuts between La Carrière and St-Dominique show this cleavage very well.

Gash Veins. The Chazy limestone has been particularly susceptible to tension cracking, with later filling of the voids with calcite (Plate IIB) and, locally, the Beldens is so affected. Most of the other formations have withstood such deformation. In the quarries north of the road at La Carrière the gashes are obviously the result of tension accompanying the formation of a low anticline which itself was probably a response to the thrusting westward of the St-Dominique slice.

St-Dominique Plain.

Outcrops in this part of the area are rare except in the vicinities of St-Pie, St-Hector de Bagot, and St-Liboire, where shales, or more properly slates, predominate. In the neighbourhood of St-Liboire overturned beds are common, and steep cleavage dips have been measured everywhere. There is little to determine the age of the rocks. Some in the vicinity of St-Pie might be Trenton, Utica,

or Lorraine. Elsewhere most seem to fall within the Lorraine, as far as is indicated by the lithology. It is impossible to map the three possible subdivisions separately. Hence, on both structural and stratigraphic grounds, this part of the area is referred to the St-Germain complex.

Noire river at St-Pie. A remarkable exposure which falls within the area of the St-Germain complex, but is readily identified as Utica, can be seen in the bed of Noire river at times of low water (Figure 8). The clue to the gross structure is the distribution of the orange-weathering limestone beds (Plate IV B), made obvious by the contrast between them and the beds of black shale. The strike of the bedding trends north, with steep dips (53° to 86°) to the east. No criterion for determining the tops of the beds was found. Although many minor crumplings of the beds occur, particularly on the western part of the ourcrop, no large-scale folding is apparent, hence no duplication of the strata by folding is demanded. Nor is any necessary, for the width of outcrop of the shale from the western border of the breccia westward is about 250 feet, giving a thickness, on the basis of an average dip of 70°, of 234 feet. It is likely that the Utica part of the St-Germain complex has at least twice this thickness.

Joints, everywhere abundant, can be grouped as follows. First, a system with dips of 30° or less (✓ on Fig. 8) which, with some irregularities, conforms to the attitudes of a shallow syncline plunging to the west. This system seems to be independent of bedding, dykes, and other deformative effects. Second, in the western part of the outcrop some of the fault and shear zones terminate in a series of closely spaced calcite-filled joints (✓ on Figure 8) 1 mm. or so wide and 1 cm. to 2 cm. apart. They may lie at an angle to the direction of the related fault or shear zone and usually die out within 3 feet. A third set (✓ on Figure 8) consists of joints which strike fairly consistently north-northeast, dip steeply to the northwest, and are spaced usually several feet apart over the whole outcrop. The fourth, and most persistent type, is the east-west regional tension joint (✓ on Figure 8), with vertical or near-vertical dips.

Many steeply dipping shear zones, practically all carrying carbonates, traverse the rocks with a trend parallel to, or a little more northeasterly than, the strike of the beds. Where well defined, these shear zones are as much as 1 cm. to 2 cm. wide.

Bedding cleavage is well developed throughout the shales. Although this allows the collecting of graptolites in a few favoured spots, the preservation of these fossils robs them of any stratigraphic value. The bedding-cleavage relationship persists even in those spots where the intense deformation of the rocks has induced the shales to strike almost at right angles to the adjacent orange-weathering limestone beds.

The dykes and limestone beds in the western part of the outcrop have been transformed by boudinage and other deformative processes into irregular assemblages of blocks with,in some cases,little common or regional orientation, thus resulting in a large-scale tectonic breccia. A second type of breccia, confined to the eastern part of the outcrop is quite different. This is a large, irregular mass about 250 feet long and up to 50 feet wide, roughly parelleling the bedding, and consists of a mixture of various kinds of limestone for the most part, with a few blocks of shale and sandstone, up to 10 feet across. The limestone and other rocks are unrelated to local types, though many of them have a Trenton aspect. The cross-cutting nature of the western margin of the breccia and the almost complete absence of deformation effects pervading the remainder of the outcrop seem to preclude the possibility that this breccia is of sedimentary origin. The prevalence of blocks of limestone of Trenton, and even older, aspects indicates a transfer upward of these blocks, and it is quite possible that this breccia is the result of crustal disturbances,. perhaps those accompanying the initial phases of Monteregian intrusions. If so, then this breccia would take its place alongside the St-Helen Island breccia and a dozen others in the general Montreal area. In age, it would long post-date the shales within which it now occurs.

Disconnected, perhaps fragmented, dyke bodies composed of porphyritic amphibole lamprophyre lie more or less parallel to the bedding in the western part of the outcrop. A more or less continuous dyke of amygdaloidal trap traverses the outcrop at approximately right angles to the bedding and very closely parallels the regional joints referred to above. This is probably the youngest rock of the outcrop. The sill immediately below the dam in the eastern part of the outcrop is composed largely of the latter type of rock, though the lowermost part, perhaps an independent intrusion, resembles the amygdaloidal trap of the western dykes.

Although this relatively small outcrop is almost completely composed of Utica beds, its complicated structure is that of the St-Germain complex. The latter will, as time and attention allow,

be separated into component formations. In the meantime it is best to refer to this occurrence as St-Germain (Utica), and to consider its structure to be typical of the complications of the whole complex, regardless of the component formations.

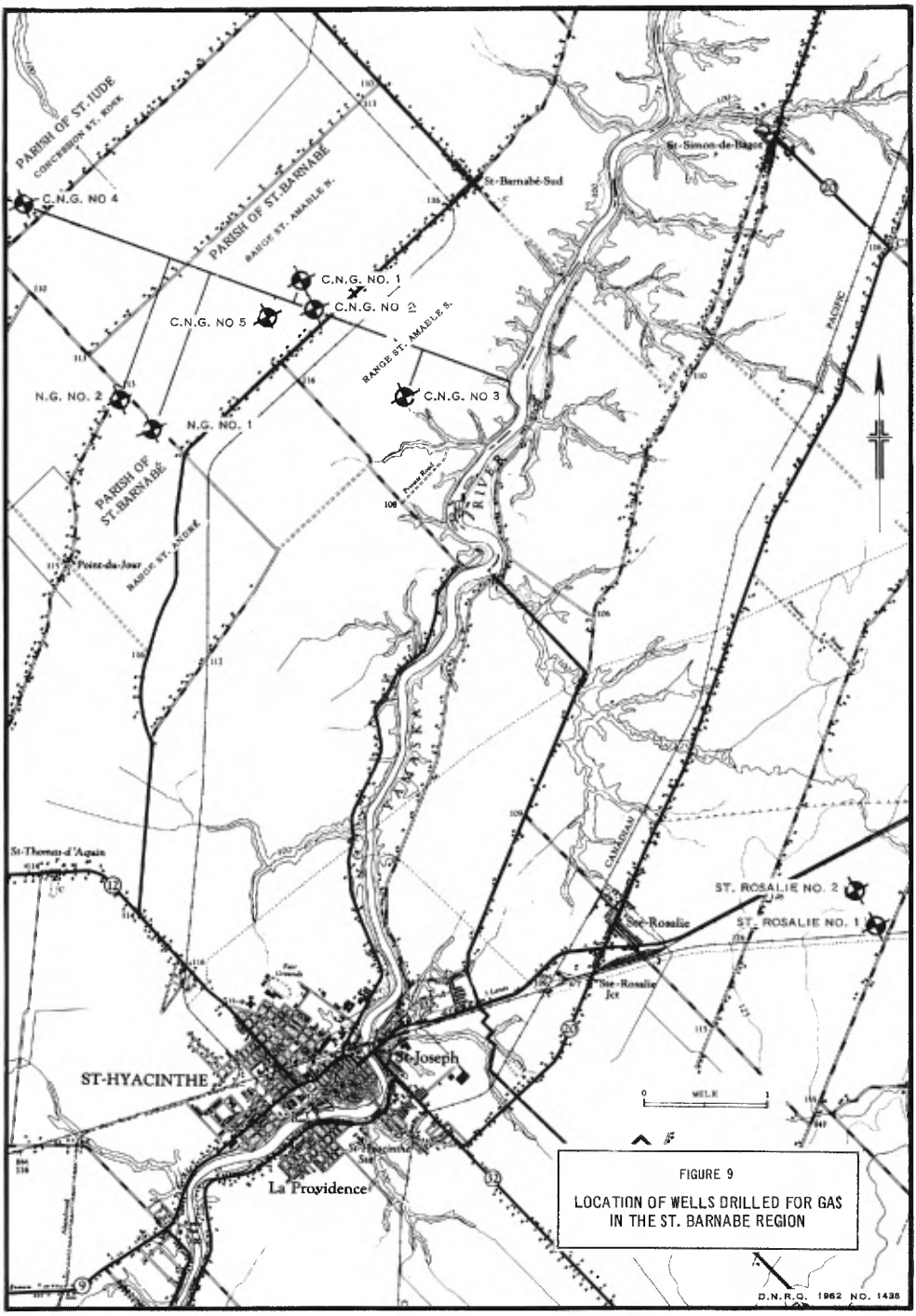
St-Hyacinthe Plain

East of Yamaska River

Along the central part of this area, on both sides of Yamaska river, the rocks are gently folded with easterly dips of rarely more than 10°. Folds, seen along the banks of Yamaska river a few miles below St-Hyacinthe (Figure 6) plunge gently to both north and south. Farther to the east the structure becomes one of steeper, nearly vertical dips, probably with isoclinal folding occurring along the lower reaches of Orme brook and in the exposures near St-Simon. Nevertheless, these exposures are definitely part of the Breault member of the Nicolet River formation. Still farther to the east, where Orme brook crosses the Canadian National Railways main line, there is both stratigraphic and structural confusion, and the rocks exposed there should be placed within the St-Germain complex. This is also true of the area drilled by the wells Ste-Rosalie Nos. 1 and 2 (Appendix A). Where one should draw the boundary between the St-Germain rocks and others which can be stratigraphically identified cannot be determined here; its position on the map is drawn arbitrarily.

West of Yamaska River

The structural setting of the rocks below the surface in the northwest corner of the area has already been referred to (text and Figure 1). A line joining Canadian Natural Gas No. 4 with Canadian Natural Gas No. 2 is roughly perpendicular to the regional strike, and therefore a satisfactory cross section line (Figure 9). Canadian Natural Gas No. 1 and Canadian Natural Gas No. 5 are so close to this line that no adjustment need be made here. Canadian Natural Gas No. 3 lies half a mile south of the line, and the two wells drilled by the National Gas Company are more than a mile south of the line. By comparing the depths below sea-level of the base of the Bécancour River (Queenston) in the wells, it can be seen (Figure 10) that in general the base dips gently to the west. Hence the beds concerned lie on the eastern flank of a syncline, which elsewhere (Clark 1947, p. 15) the writer has called the Chambly-Fortierville


PARISH OF ST. JUDE
CONCESSION ST. JOHN
PARISH OF ST-BARNABÉ
RANGE ST. AMABLE N.
C.N.G. NO 4
St-Barnabé-Sud
St-Simon-de-Bagot
C.N.G. NO. 1
C.N.G. NO 2
C.N.G. NO 5
RANGE ST. AMABLE S.
C.N.G. NO 3
N.G. NO. 2
N.G. NO. 1
PARISH OF ST-BARNABÉ
Point-du-Jour
RANGE ST. ANDRÉ
Power Road
RIVER
PACIFIC
CANADIAN
ST. ROSALIE NO. 2
ST. ROSALIE NO. 1
Ste-Rosalie
Ste-Rosalie Jct
St-Thomas-d'Aguin
ST-HYACINTHE
St-Joseph
La Providence
0 MILE 1
FIGURE 9
LOCATION OF WELLS DRILLED FOR GAS
IN THE ST. BARNABE REGION
D.N.R.Q. 1962 NO. 1438

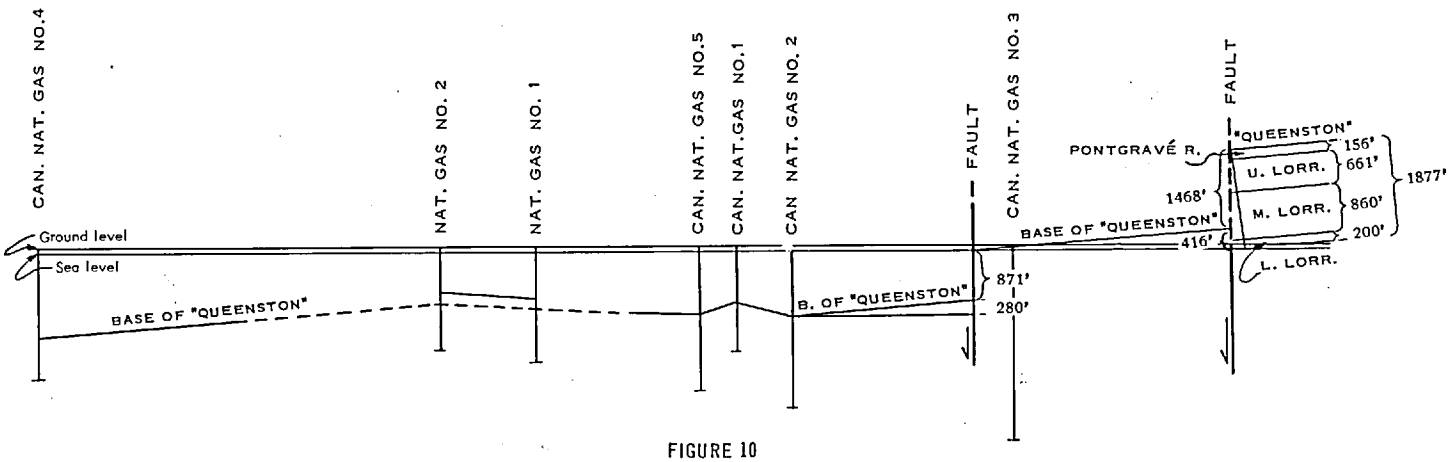


FIGURE 10

SECTION ACROSS PART OF THE NORTHWESTERN CORNER OF THE AREA TO SHOW THE CONFIGURATION OF THE BASE OF THE BÉCANCOUR RIVER (QUEENSTON) FORMATION AS SHOWN BY LOGS OF DEEP WELLS. ALSO THE POSITIONS OF TWO FAULTS MADE NECESSARY BY THE DATA GIVEN. See figure 9

D.N.R.Q. 1963 NO. 1440

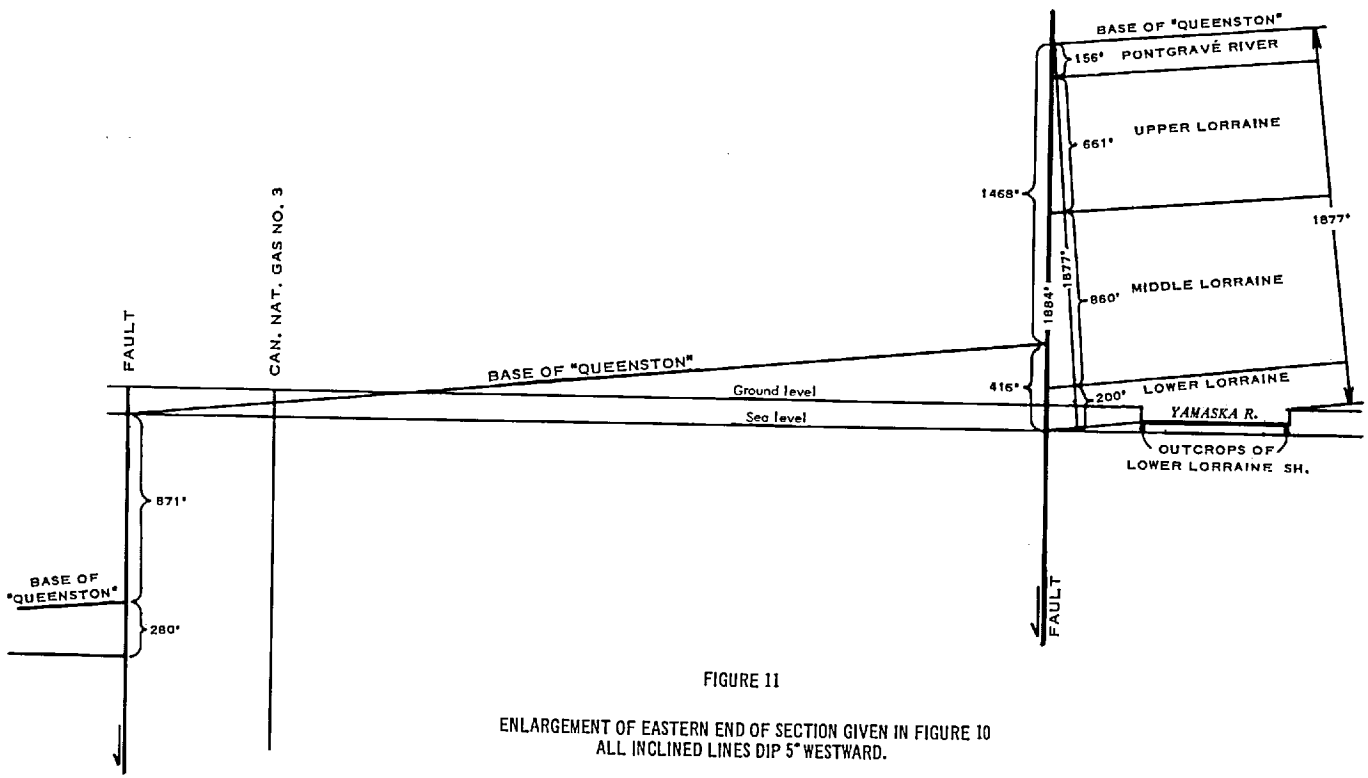


FIGURE 11

ENLARGEMENT OF EASTERN END OF SECTION GIVEN IN FIGURE 10
ALL INCLINED LINES DIP 5° WESTWARD.

D.N.R.Q. 1962 NO. 1441

syncline. The minor anomaly in the depths of the base of the Bécancour River can easily be resolved by introducing an undulation in the westward dipping beds. The two National Gas Company wells lie to the south of the chosen section line, and their much smaller depth figures for the base of the Bécancour River indicate that the fold plunges to the north or northeast, a structural feature already well established from the mapping of the Beloeil area to the southwest (Clark 1955, p. 48). Lastly, there is the case of Canadian Natural Gas No. 3, which lies half a mile south of the section line, and is remarkable in not showing any red Bécancour River in its log; instead, the samples may well belong to the marine Richmond (Pontgravé River) formation at the top, and to the Lorraine (Nicolet River) formation below. The structural implications of this peculiar occurrence are given below.

St-Barnabé Fault. The calculated dip of the base of the Bécancour River formation from Canadian National Gas No. 2 to, let us say, the surface of the ground at a spot corresponding to the projection of Canadian Natural Gas No. 3 on to the section line is 20°. This is abnormally high and a fault (Fault A, Figure 10) is introduced to allow the dip to be reduced to 5° in keeping with dips on the flank of the central part of the syncline hereabouts. As drawn on the accompanying section (Figure 10) the fault shows a vertical displacement of 871 feet, a figure arrived at by appropriate calculations and an assumption that the base of the Bécancour River is at sea-level at the intersection of the fault with the section line. Continuing this dip as far as the west bank of Yamaska river, the base of the Bécancour River would lie 423 feet above the Lower Lorraine (Breault member) shales outcropping on the west bank of the river. Into this distance must go the following:

Pontgravé River formation	156 feet thick
Nicolet River formation	
St-Hilaire formation	661 feet thick
Chambly member	860 feet thick
Total	1,677 feet

Therefore, a stratigraphic displacement of at least the difference between 1,677 and 423 feet is indicated along a second fault (Fault B, Figure 10). To this minimum of 1,254 feet should be added that thickness of the Nicolet River (Breault member, 1,020 feet thick) existing above the Yamaska river exposures. In these latter, neither Cryptolithus nor Leptaena is common, so that they do not lie at the top of the member. How far down they belong it is not possible to say, but

200 feet could be an absolute minimum, and 500 feet a possible minimum. Adopting the former figure, the stratigraphic displacement close to Yamaska river becomes 1,454 feet, and the vertical displacement along a vertical fault plane, 1,461 feet. If it be supposed, as is reasonable, that the fault near Canadian Natural Gas No. 3 is a branch of the main, St-Barnabé, fault to the east, then the total vertical displacement along the fault planes is the sum of the two figures (871 and 1,461 feet) given above, or 2,332 feet. A similar figure would be obtained were the faults not placed exactly as assumed above. Should the dip of the base of the Bécancour River increase toward the east, that is away from the axis of the fold, the displacement would turn out to be tens of feet less. Allowing for all of the uncertainties and assumptions involved, the total displacement along the St-Barnabé fault zone is of the order of 2,000 feet.

ECONOMIC GEOLOGY

Geological materials of importance, in addition to the soil, are limestones of La Carrière region and deposits of gravel and sand. Although natural gas has not yet been proved a valuable resource, the data concerning its occurrence and attempted exploitation are assembled in this report.

Limestone

For more than a century limestone has been quarried at La Carrière where Route 32 from St-Hyacinthe ascends the western edge of St-Dominique ridge. At least a score of old quarry holes and trial pits attest the industrious search for stone suitable for various purposes. "Most of the quarries are close to the highway between St-Dominique and St-Hyacinthe, and are west of the village in the locality known as La Carrière, but limestone is available along the side of the ridge for three miles both northeast and southwest of the highway. The products are crushed stone, flux, and stone for lime-burning. Formerly large quantities of stone for engineering construction and for building purposes in St-Hyacinthe and the neighbouring villages were also procured here." (Goudge 1935, p. 181).

"The stone is all of the calcium and high-calcium types, but there is a considerable variation in appearance and in purity. That formerly quarried for building stone (Chazy) is very dark grey, fine-grained, very heavily bedded and is striped parallel to the bedding with wavy seams of siliceous, ferruginous, magnesian material that weathers to a light brown in contrast to the light grey colour

that the remainder of the stone assumes on exposure. This siliceous material is more resistant than the rest of the stone and on weathered surfaces it stands out in relief. Apparently overlying this type of stone is 50 feet of a very fine-grained to dense, brittle, dove-grey limestone (Black River of this report) which in some places is pure but in others contains much sand. The pure stone of this type is quarried for lime burning. Pure limestone is also seen along the base of the ridge to the north of the main group of quarries (Beldens of this report) and it has been quarried in that locality for flux." (ibid.,p. 181, 183).

"The most westerly of the quarries along the St-Hyacinthe road is at the foot of the ridge just northeast of the curve on the road and ..... was formerly worked by the Grand Trunk Railway Company for dimension stone for bridge piers and abutments, but it has been abandoned for many years. It is 500 feet long, has been worked 125 feet into the hillside, and exposes 25 feet of fine-grained, dark grey limestone streaked with ferruginous, siliceous material. Bedding is exceptionally heavy, one bed being 15 feet thick without a distinct parting plane. Short thick veins of white calcite and crystals of pyrite are common." (ibid., p. 183). Goudge continues with a description of most of the known quarries, but, partly because of absorption by subsequent quarrying, it is not possible now to identify all of them.

At the present time (May, 1961) only three quarries are active. St-Dominique Quarries Company is extending the large quarry until recently operated by Mercure Company and known today as the main quarry. This is east of La Carrière school house and almost due north of the old Grand Trunk quarry, and is on, and is being extended along, a minor anticlinal swell in the Chazy limestone. The entire production is crushed for road material, concrete aggregate, and asphalt mix.

The St-Dominique Quarries Company operates the Daudelin quarry, half a mile north of La Carrière, in the Beldens formation. The limestone is of high quality, and the entire output goes into the production of agricultural limestone.

A newly formed company, Nouvelles Carrières Ltée, of St-Hyacinthe, has in recent months opened up workings in Middle Trenton (possibly Rosemount) limestone.

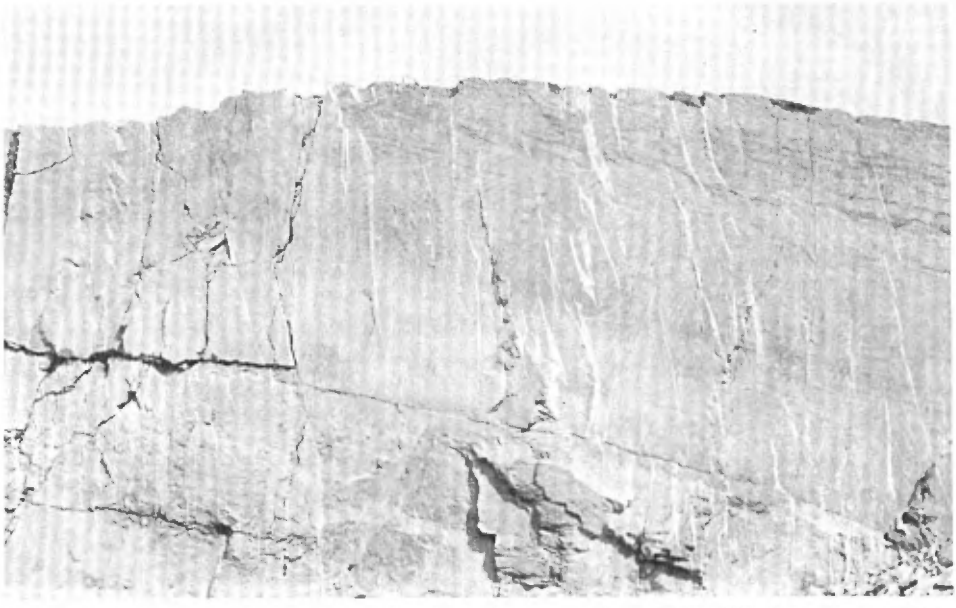
Plate I

A. Beldens dolomite at La Carrière. Alternations of orange-weathering dolomite and pure white limestone. Note small-scale faulting.

B. Beldens dolomite at La Carrière. Orange-weathering dolomite and white limestone. Cleavage dips about 50° to right (southeast).

Plate II

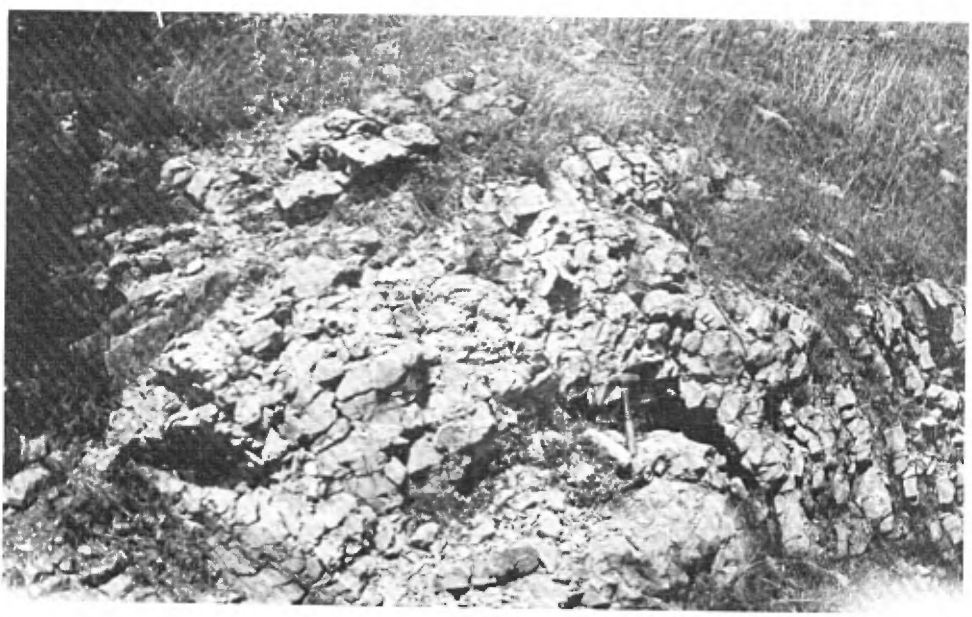
A. Quarry in St-Dominique limestone at La Carrière, showing low anticline. Looking NNE., along the strike.



B. Detail of face of above quarry, showing characteristic calcite-filled tension cracks.

Plate III

A. *Cryptolithus*-bearing Trenton limestone, highway cut between La Carrière and St-Dominique. Bedding dips 45° to right (northwest), cleavage steeply in same direction. Looking SW.



B. Small anticline in Upper Trenton limestone adjacent to St-Pie fault at southern end of St-Pie hill. Looking N.

Plate IV

A. Lower Lorraine shale (Breault member). Bed of Yamaska river at St-Hyacinthe.

B. Orange-weathering limestone bed, probably Utica, in St-Germain complex. Bed of Noire river at St-Pie.

The old Baran quarry, formerly operated by Mercure Company for lime, is now inactive. This is south of the old Mercure garage, and is excavated in the lowest Trenton limestone.

No quarries are being worked at present in the Black River formations. Until recently Adrien Bousquet produced stone for his lime kilns by carefully prying this limestone with crowbars, using a minimum of power, so as to provide blocks of appropriate size for stacking in his kilns.

Neither the St-Dominique sandstone nor any of the shaly post-Middle Trenton formations has been utilized.

Gravel and Sand

Distributed extensively over the surface of the St-Dominique plain are gravel deposits of considerable local importance. Although not of the best quality, containing too high a percentage of shaly constituents to resist weathering and abrasion satisfactorily, nevertheless this gravel is acceptable material for surfacing secondary roads. Accompanying the gravel are deposits of sand which are rarely used except in the manufacture of asphalt mix.

Natural Gas

Contrary to expectations, little is said locally about natural gas. Probably the flurry and excitement of the drilling campaign for gas northwest of St-Hyacinthe in 1910, with its disappointing results, have served to inure the local people against gas-optimism. The story of the "gas field" can be found in several places (see particularly Johnston 1931; Parks 1930, 1931). In brief, gas has been known to issue from water wells in a number of places in the vicinity of St-Barnabé, just as it is known to issue elsewhere. "The escape of gas from pools and the occurrence of gas in wells bored for water, led to the formation of a company, La Compagnie de Gaz et Pétrole de St-Barnabé, to systematically drill for oil and gas in the St-Hyacinthe district" (Parks 1930, p. 96B). "All the companies engaged in this field met with failure ..... Despite this failure it can scarcely be considered that this region has been fully tested. The wells were sunk almost at random and the anticlines were not systematically located" (ibid., p. 98B). The three references given above are the best sources of information today. Appendix B of this report contains records of deep wells drilled for oil and gas, and their logs. The names of the wells and some structural implications resulting from a study of their logs have already appeared in this report.

In the geological cross section in Figure 10 there is a suggestion, borne out by the depth below sea-level of the base of the Bécancour River formation, that small undulations occur in the sedimentary rocks of the northwestern corner of the area. These, occurring on the eastern flank of a major syncline, might well be loci of accumulations of natural gas, the uncontrolled escape of which from these terrace structures might have given rise to the notion of a gas field a few decades ago. Certainly this idea is worth consideration by development companies. It has also been suggested for the Upton area to the north that local anticlines near St-Hugues in the southwest corner of that area are worth prospecting. The latter structures, projected southwestward along the regional strike into the St-Hyacinthe area, may well be the factor responsible for the accumulation and escape of gas in the St-Barnabé district.

APPENDIX A

REGISTER OF DEEP WELLS

1. Canadian Natural Gas No. 1
2. Canadian Natural Gas No. 2
3. Canadian Natural Gas No. 3
4. Canadian Natural Gas No. 4
5. Canadian Natural Gas No. 5
6. National Gas No. 1
7. National Gas No. 2
8. Ste-Rosalie No. 1
9. Ste-Rosalie No. 2

Abbreviations used in logs by Maddox (1931).

S.D. meaning superdominant and constituting 100 to 90 per cent of the minor constituents.

D. meaning dominant and constituting 90 to 50 per cent of the minor constituents.

V.H. meaning very high and constituting 50 to 25 per cent of the minor constituents.

H. meaning high and constituting 25 to 12 1/2 per cent of the constituents.

M. meaning medium and constituting 12 1/2 to 6 1/4 per cent of the minor constituents.

L. meaning low and constituting 6 1/4 to 3 1/3 per cent of the minor constituents.

V.L. meaning very low and constituting 3 1/3 to 1 per cent of the minor constituents.

P. meaning present and constituting less than 1 per cent of the minor constituents.

The numbers in the column under the heading "Rate of Effervescence" refer to the speed of effervescence of the material in dilute hydrochloric acid 1:4.

1 meaning extremely slow.
2 " very slow.
3 " slow.
4 " medium.
5 " fast.
6 " very fast.
7 " extremely fast.

It should be noted that an effervescence of rate 7 with cold acid implies that the rock is a pure limestone, the lower numbers implying a successively lower calcium carbonate content.

Extracted from DeBlois (1959), page 19

Company: Canadian Natural Gas Co.
Well Name: Canadian Natural Gas No. 1

Location:
Lot : 164
Range : St-Amable Nord
Parish : St-Barnabé
County : St-Hyacinthe
Coords : 6 miles N.E. of St-Hyacinthe

Ground Elevation: 115'
RF Elevation: 117'
Spudded: April 1, 1910
Completed: July 15, 1910

Driller: W.H. Lauffen
Type of Rig: Cable
Result: Gas Well
Water
Salty at: 1110'-1267'
Gas at: 1860'
Log:

Formation	Depth interval (in feet)
Overburden	0 - 80
Richmond (Bécancour River)	80 - 980
Richmond (Pontgravé River)	980 - 1880

Extracted from Maddox, 1931. p. 92

Log No. 3, Canadian Natural Gas Company, Well No. 1, Lot 164, St-Amable, North

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Remarks
350	Sandy shale, reddish brown	1	Rounded quartz, P.; fibrous calcite P.
425	" " "	2	Rounded quartz, L.; green shale P.
575	" " "	1	Rounded quartz, H.; green shale, P.
980	Shale, dull green	2	Red shale, L.; rounded quartz, P.
1,106	Igneous, dark grey	1	
1,108	" "	1	
1,265	Shale, dark grey	4	Vein calcite, V.H.; much slickensided
1,285	" "	5	Vein calcite, V.H.; much slickensided
1,860	" medium grey	4	Vein calcite, V.H.
1,860-1,866	" light grey	3	Vein calcite, V.H.
1,860-1,866 (sic)	" dark grey	1	Very well laminated
1,880	" green-grey	3	Fine, calcareous sand-stone, M.

Extracted from Parks (1930), page 96-97

1. Lot 164, range St-Amable North, Parish of St-Barnabé

The first well of the new company was drilled on this property (Jos. Fontaine) in 1910. The log is given as follows:

0 to	100 feet	..... Drift clay, sand and gravel.
100 to	115 feet	..... "Soapy" shales.
115 to	135 feet	..... White sandstone, carrying a little salt.
135 to	935 feet	..... Red shales.
935 to	1108 feet	..... Grey shales.
1108 to	1114 feet	..... Grey granite? (Sandstone).
1114 to	1265 feet	..... Black shale.
1265 to	1280 feet	..... Magnesian rock, carrying salt.
1280 to	1860 feet	..... Black shale.
1860 to	1866 feet	..... Secondary calcite and quartz in shale, which carries or covers the gas.
1866 to	1880 feet	..... Black shale

"In this well, a strong flow of gas was struck at 1860 feet, the well was continued 20 feet further and capped. The rock pressure was measured by an officer of the Mines Branch on November 10, and found to be 275 lbs. per square inch."**

The standpipe is in place but there is no flow of water or gas from the well.

In 1915 the Canadian Natural Gas Co. sank a well on the same lot, 1,000 feet to the southeast of the first well; it reached a depth of 2,700 feet without striking gas. The log indicates that the drill passed out of the red shales at 1,070 ft. "This contact probably corresponds to the one struck at 935 feet in the first well... The two wells are apparently on the east limb of an anticline, the crest of which would lie to the northwest of the first well."* There is no flow from this well at present.

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* G.S.C., Mem. 81, p. 95.
** M. Op., 1914, pp. 64-65.

Quoted paragraph above repeated in Parks 1931, p.64, as Canadian Natural Gas Co., Well No. 1

Extracted from DeBlois (1959), page 20

Company: Canadian Natural Gas Co.
Well Name: Canadian Natural Gas No. 2
Location:

Lot: 164
Range: St-Amable Nord
Parish: St-Barnabé
County: St-Hyacinthe

Ground Elevation: 116'
RF Elevation: 118'

Spudded: Middle of June, 1914
Completed: 1915
Driller: Edmond Côté, Montreal
Type of Rig: Cable
Result: Dry hole
Water
116', 133', 500', 720'
Gas at: 1220', 2900'
Log by Belyea:

Formation	Depth interval (in feet)
Overburden	0 - 98
Richmond (Bécancour River)	98 - 1200
Dark igneous rock	1200 - 1210
Richmond (Bécancour River)	1210 - 1270
Richmond and Lorraine	1270 - 2907

Extracted from Maddox, 100 1931, pp. 93-100

Canadian Natural Gas Company, Well No. 2, Lot 164, St.-Amable, North

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Notes
98	Clay, light grey	3	Surface material
98- 108	Sandy shale, reddish brown	2	Quartz grains 0.2 to 0.5 mm., L.
108- 118	" "	2	" " 2.00 to 1.00 mm., L.
118- 128	" "	2	" " 0.2 to 0.5 mm., V.L.
128- 138	" "	2	" " 0.2 to 0.5 mm., M.; greenish grey and reddish, coarse-grained sandstone L.
138- 148	" "	2	" " 0.2 to 0.5 mm., L.
148- 158	" "	2	" " 0.2 to 0.5 mm., L.
158- 168	Sandstone, green-grey and red .	2	Medium to coarse grained; red-brown shale, P.
168- 178	" " " ..	2	" " " " " V.H.
178- 188	Sandy shale, reddish brown	2	Sandstone, H.
188- 198	.....	.....	Missing
198- 208	Sandy shale, reddish brown	2	Medium to coarse-grained sandstone, V. H.
208- 218	Sandstone, green-grey and reddish	2	Red brown, sandy shale, V.H.
218- 228	Sandy shale, reddish brown	2	Green-grey, fine sandstone, V.L.
228- 238	" " "	2	Medium to coarse sandstone, L.
238- 248	.....	.....	Missing
245- 255	Sandstone, greenish grey	2	Fine to coarse-grained, green-grey shale, H.
255- 265	.....	.....	Missing
265- 275	Sandy shale, reddish brown	2	Green-grey sandstone. Fine to medium grained, M.
275- 285	" "	2	" " " coarse grained, M.
285- 295	" " "	2	" " V.L.
295- 305	Shaly sandstone, reddish brown	2	Fine grained; green-grey sandstone, fine to medium grained, M.
305- 317	Sandstone, reddish brown	2	" " " P.
317- 327	Sandy shale, reddish brown	2	Green-grey, sandy shale, V.L.; fine, red sandstone, M.
327- 337	.....	.....	Missing
337- 341	Sandstone, reddish brown	2	Fine grained; green-grey sandstone, V.L.; rounded quartz grains to 0.5 mm., V.L.
341- 351	" "	3	Fine to medium grained; green-grey sandstone, fine to coarse grained, V.L.; rounded quartz grains to 0.5 mm., V.L.
351- 361	" "	2	Fine to coarse grained; green-grey sandstone, fine to coarse grained, L.; rounded quartz, V.L.
361- 371	" "	2	Fine to medium grained; green grey sandstone, fine to coarse grained, V.L.; rounded quartz, V.L.
371- 381	.....	.....	Missing
381- 391	" brown-red	2	Fine to medium grained; green-grey sandstone, fine to coarse grained, M.; rounded quartz, V.L. Fibrous vein calcite, P.
391- 401	Sandy shale, reddish brown	2	Greenish grey shale, M.; fibrous vein calcite, M.
401- 411	" brownish red	3	" " L.; " " L.
411- 421	" brownish grey	3	" " L.; " " L.
421- 431	" " "	2	Fibrous vein calcite, P.
431- 441	" reddish brown	3	Greenish grey shale, P.; fibrous vein calcite, L.
441- 451	" "	3	" " L.; " " M.
451- 463	Sandstone, greenish grey	3	Very fine grained; fibrous vein calcite, M.; one large fragment shows considerable porosity similar to the weathered surface
463- 475	Sandy shale, reddish brown	3	Fibrous vein calcite, V.L.

Canadian Natural Gas Company, Well No. 2, Lot 164, St-Amable, North (Cont.)

Depth (in feet)	—	Rate of efferves-cence with acid, Cold	Notes
475- 485	Sandy shale, reddish brown	3	Fibrous vein calcite, L.
485- 497	" "	3	" " L.; quartz grains 0.2 to 0.5 mm., L.
497- 500	.....	.....	Missing
500- 510	" "	2	Very fine-grained sandstone, L.
510- 520	" "	2	
520- 530	" "	2	Greenish grey, fine-grained sandstone, L.; fibrous vein calcite, V.L.; quartz grains 0.2 to 1.0 mm., V.L.
530- 540	" "	1	Quartz grains 0.2 to 0.5 mm., L.
540- 550	" "	2	Greenish grey, fine-grained sandstone, L.; fibrous vein calcite, L.
550- 560	" "	2	Fibrous vein calcite, L.
560- 570	" "	3	Greenish grey, fine-grained sandstone, L.; fibrous vein calcite, L.
570- 580	" "	3	Fibrous vein calcite, M.
580- 590	" "	2	Greenish grey, fine-grained sandstone, L.
590- 600	" "	3	Fibrous vein calcite, V.L.
600- 610	" "	2	Greenish grey, fine-grained sandstone, V.L.; fibrous vein calcite, M.; quartz grains 0.2 to 0.5 mm., L.
610- 620	" "	2	Fibrous vein calcite, V.L.
620- 630	" "	2	" " P.
630- 640	" "	1	Greenish grey, fine-grained sandstone, V.H.; fibrous vein calcite, L.
640- 650	" "	2	Fibrous vein calcite, V.L.; white gypsum, P.
650- 660	" "	2	Greenish grey, fine-grained sandstone, V.L.; fibrous vein calcite, P.
660- 670	" "	2	Greenish grey, fine-grained sandstone, fine to coarse grained, L.; fibrous vein calcite, P.; gypsum, P.
670- 680	" "	2	Greenish grey, fine-grained sandstone, fine to coarse grained, V.L.; fibrous vein calcite, V.L.; gypsum, P.
680- 690	" "	3	Greenish grey, fine-grained sandstone, fine to coarse grained, L.; fibrous vein calcite, M.
690- 700	" "	3	Greenish grey sandstone, medium to coarse grained, M.; fibrous vein calcite, L.
700- 712	" brown	1	Greenish grey sandstone, fine to coarse grained, V.L.; fibrous vein calcite, P.; gypsum, P.
712- 724	" reddish brown	2	Fibrous vein calcite, P.
724- 735	" "	3	Rounded quartz sand, L.; fibrous vein calcite, P.
735- 747	" "	3	Rounded quartz sand, P.; greenish grey, fine-grained sandstone, P.; fibrous vein calcite, P.
747- 759	" "	3	Medium sand, M.; greenish grey, fine-grained sandstone, P.; fibrous vein calcite, P.; gypsum, P.
759- 765	" "	2	Rounded medium-grained sand, L.; greenish grey, fine-grained sandstone, P.; fibrous vein calcite, P.; gypsum, P.
765- 778	Shaly sandstone, reddish brown	1	Medium-grained, sandy shale, H.
778- 790	Sandy shale, reddish brown	2	Medium sand, H.; coarse sand, P.; grey, fine-grained sandstone, P.
790- 802	" "	1	Quartz grains 0.2 to 0.5 mm., L.; fibrous vein calcite, L.; gypsum, P.
802- 815	" "	2	Quartz grains 0.2 to 0.5 mm., L.; fibrous vein calcite, L.; gypsum, P.

Canadian Natural Gas Company, Well No. 2, Lot 164, St-Amable, North (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Notes
815- 827	Sandy shale, reddish brown ..	1	Fibrous vein calcite, V.L.; gypsum, V.L.
827- 840	" " ..	1	Quartz grains 0.2 to 0.5 mm., M.; greenish grey sandstone, fine to medium grained; fibrous vein calcite, V.L.; slickensides
840- 862	" " ..	1	Quartz grains 0.2 to 0.5 mm., V.L.; greenish grey sandstone, fine to medium grained, V.H.
862- 867	" " ..	1	Quartz grains 0.2 to 0.5 mm., V.L.; greenish grey sandstone, fine to medium grained, V.H.; gypsum, V.L.
867- 888	" " ..	1	Quartz grains 0.2 to 0.5 mm., L.; gypsum, L.
888- 900	" " ..	1	Quartz grains 0.2 to 0.5 mm., L.; greenish grey sandstone, fine to medium grained; gypsum, M.
900- 912	" " ..	1	Quartz grains 0.2 to 0.5 mm., V.L.
912- 920	" " ..	1	Greenish grey sandstone, fine to medium grained, V.H.; gypsum, V.L.
920- 932	" " ..	1	Greenish grey sandstone, fine to medium grained, V.H.; gypsum, P.
932- 945	" " ..	1	Quartz grains 0.1 mm., V.L.; greenish grey sandstone, fine to medium grained, L.
945- 955	" " ..	1	" 0.1 mm., L.; greenish grey sandstone, " fine to medium grained, L.; gypsum, P.
955- 965	" " ..	1	" 0.1 mm., M.; greenish grey sandstone, " fine to medium grained, L.; gypsum, P.
965- 977	" " ..	1	" 0.1 mm., M.; green-grey, sandy shale, " M.; gypsum, P.
977- 987	" green-grey ..	1	" 0.5 mm., L.; red-brown, sandy shale, V.H.; gypsum, P.
987-1,000	" reddish brown ..	1	" 0.1 mm., M.; green-grey, sandy shale, L.; gypsum, P.
1,000-1,001	" red, brown, and green-grey	1	" 0.1 mm., M.; green-grey sandstone, V.L.
1,001-1,013	" red-brown	1	" 0.5 mm., V.L.; green-grey, sandy shale, L.
1,013-1,026	" "	1	" 0.5 mm., L.; green-grey sandstone, M.; gypsum, P.
1,026-1,035	" red, brown, and green-grey	2	" 0.5 mm., V.L.; brown-red sandstone, V.L.; gypsum, P.
1,035-1,048	" red-brown	1	" 0.5 mm., V.L.; green-grey sandstone, V.L.; green-grey shale, M.; gypsum, P.
1,048-1,053	.....	.....	Missing
1,053-1,063	Sandy shale, red-brown	1	Quartz grains 0.5 mm., M.; green-grey sandstone, V.L.
1,063-1,073	" "	2	" 0.5 mm., V.H.; green-grey, sandy shale, V.L.; gypsum, P.
1,073-1,083	" green-grey	2	" 0.5 mm., V.L.; brown-red, sandy shale, V.H.
1,083-1,093	" red-brown	2	" 0.5 mm., V.L.; green-grey, sandy shale, V.H.; gypsum, V. L.
1,093-1,105	" "	1	" 0.5 mm., V.L.; green-grey, sandy shale, L.; gypsum, V.L.
1,105-1,115	" "	1	" 0.1 mm., V.L.; green-grey, sandy shale, V.L.; gypsum, P.
1,115-1,125	" "	1	" 0.5 mm., V.L.; green-grey shale, V.H.
1,125-1,135	" "	1	" 0.5 mm., V.L.; green-grey shale, V.L.; gypsum, P.
1,135-1,145	" "	1	" 0.5 mm., V.H.; green-grey shale, P.; gypsum, P.

Canadian Natural Gas Company, Well No. 2, Lot 164, St-Amable, North (Cont.)

Depth (in feet)	—	Rate of effervescence with acid, Cold	Notes
1,145-1,150	Sandy shales, red brown ...	1	Quartz grains 0.5 mm., V.L.; green-grey, sandy shale, V.L.; gypsum, P.
1,150-1,160	" "	1	" 0.5 mm., V.L.; green-grey, sandy shale, V.H.
1,160-1,170	" red-brown and green-grey	1	" 0.1 mm., V.L.
1,170-1,180	" red-brown ...	2	Rounded quartz grains to 0.5 mm., L.; green-grey sandy shale, V.H.
1,180-1,190	" "	1	" " 0.5 mm., V.L.; green-grey sandy shale, V.H.
1,190-1,200	" "	1	" " 0.1 mm., V.L.; green-grey sandy shale, V.H.
1,200-1,210	Igneous dark grey	1	Red-brown shale H.
1,210-1,220	Sandy shale, reddish brown	1	Rounded quartz grains to 0.5 mm., V.L.; greenish grey sandy shale, H.
1,220-1,230	" greenish grey	2	" " 0.5 mm., V.L.
1,230-1,240	" "	2	" " 0.5 mm., V.L.; reddish brown, sandy shale, L.
1,240-1,250	" "	1	" " 0.5 mm., L.; reddish brown, sandy shale, V.L.
1,250-1,260	" "	1	" " 0.5 mm., L.; reddish brown, sandy shale, V.L.
1,260-1,270	" "	2	" " 0.5 mm., V.L.;
1,270-1,280	Shale, dark grey	3	Brownish grey limestone, M.
1,280-1,290	" "	3	Impure limestone, L.
1,290-1,300	" "	3	" " H.; fibrous vein calcite, P.
1,300-1,310	" "	3	" " L.
1,310-1,320	" "	3	" " H.; fibrous calcite, P.; fossils
1,320-1,330	" "	3	" " H.
1,330-1,340	" "	3	" " H.
1,340-1,350	" "	3	" " grading to calcareous shale, V.H.
1,350-1,360	.....	.....	Missing
1,360-1,370	Limestone, dark grey	4	Dark grey shale, V.H.; dark grey limestone, grading to calcareous shale, V.H.
1,370-1,380	Shale, dark grey	4	Very impure limestone, V.H.; slickensides
1,380-1,390	Impure limestone, dark grey	4	Grading to calcareous shales; slickensides
1,390-1,400	Shale, dark grey	3	Very impure limestone, M.
1,400-1,410	" "	3	" "
1,410-1,420	" "	3	Impure limestone, L.
1,420-1,430	" "	4	" " L.
1,430-1,440	" "	3	" " L.
1,440-1,450	" "	3	" " M.
1,450-1,460	" "	3	" " M.
1,460-1,470	" "	4	" " H.
1,470-1,480	" "	3	" " M.
1,480-1,490	" "	3	" " M.
1,490-1,500	" "	3	Dark grey limestone, M.
1,500-1,510	" "	2	Impure limestone, V.L.
1,510-1,520	" "	2	" " V.L.
1,520-1,530	" "	2	" " L.
1,530-1,540	" "	2	" " L.
1,540-1,550	" "	2	" " L.
1,550-1,560	" "	2	Fine calcareous sandstone, H.

Canadian Natural Gas Company, Well No. 2, Lot 164, St-Amable, North (Cont.)

Depth (in feet)		Rate of efferves-cence with acid, Cold	Notes
1,560-1,570	Shale dark grey	3	Fine, calcareous sandstone, M.
1,570-1,580	" "	2	" " " L.
1,580-1,590	" "	1	" " " P.
1,590-1,600	" "	3	" " " M.
1,600-1,610	" "	3	" " " M.
1,610-1,620	" "	2	" " " M.
1,620-1,630	" "	3	" " " H.
1,630-1,640	" "	3	" " " H.
1,640-1,650	" "	3	" " " H.
1,650-1,660	" "	4	" " " H.; vein calcite, H.
1,660-1,670	" "	4	" " " V.H.; " " H.
1,670-1,680	" "	4	" " " V.H.; " " H.
1,680-1,690	" "	4	" " " V.H.; " " H. Distinctive from
1,690-1,700	" "	4	" " " V.H.; " " H. previous samples;
1,700-1,710	" "	3	" " " V.H.; " " M. slickensides 1,670-
1,710-1,720	" "	3	" " " V.H.; " " L. 1,680 feet
			Note: From 1,650-1,700 feet, samples form a distinctive horizon. Possibly due to faulting
1,720-1,730	" "	3	Fine, calcareous sandstone, L.
1,730-1,740	" "	3	" " " L.
1,740-1,750	" "	2	" " " L.; vein calcite P.
1,750-1,760	" "	3	" " " L.; " " P.
1,760-1,770	" "	3	" " " L.
1,770-1,780	" "	3	" " " L.
1,780-1,790	" "	3	" " " H.
1,790-1,800	" "	3	" " " H.
1,800-1,810	" "	3	" " " H.
1,810-1,820	" "	3	" " " H.
1,820-1,830	" "	3	" " " H.
1,830-1,840	" "	3	" " " H.
1,840-1,850	" "	3	" " " H.; fibrous calcite, P.
1,850-1,860	" "	2	" " " H.
1,860-1,870	" "	3	" " " M.
1,870-1,880	" "	3	" " " M.
1,880-1,890	" "	2	" " " M.
1,890-1,900	" "	2	" " " L.
1,900-1,910	" "	3	" " " L.
1,910-1,920	" "	3	" " " H.
1,920-1,930	" "	3	" " " L.
1,930-1,940	" "	3	" " " M.
1,940-1,950	" "	2	" " " L.
1,950-1,960	" "	2	" " " M.
1,960-1,970	" "	3	" " " M.
1,970-1,980	" "	2	" " " H.
1,980-1,990	" "	3	" " " M.
1,990-2,000	" "	3	" " " H.
2,000-2,010	" "	3	" " " L.
2,010-2,020	" "	3	" " " L.
2,020-2,030	" "	3	" " " M.
2,030-2,040	" "	3	" " " M.
2,040-2,050	" "	2	" " " L.

Canadian Natural Gas Company, Well No. 2, Lot 164, St.-Amable, North (Cont.)

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Notes
2,050-2,060	Shale, dark grey	2	Fine, calcareous sandstone, M.
2,060-2,070	" "	3	" " " L.
2,070-2,080	" "	3	" " " L.
2,080-2,090	" "	3	" " " M.
2,090-2,100	" "	3	(Limestone), P.; shell impression ?
2,100-2,110	" "	3	Impure limestone, P.
2,110-2,115	" "	3	" " P.
2,115-2,120	" "	2	Fine, calcareous sandstone, P.
2,120-2,130	" "	3	" " " P.; impure limestone, P.; green shale, P.
2,130-2,140	" "	3	Impure limestone, P.
2,140-2,150	" "	3	" " L.; green shale, P.
2,150-2,160	" "	3	" " P.
2,160-2,170	" "	3	" " L.; " P.; white, granular calcite
2,170-2,180	" "	3	" " L.; " L.
2,180-2,190	" "	3	Fine, calcareous sandstone, P.; impure limestone P.
2,190-2,200	" "	3	" " " P.; " " P.; green shale P.
2,200-2,210	" "	3	" " " P.
2,210-2,220	" "	3	Impure limestone, P.; green shale P.
2,220-2,230	" "	3	Fine, calcareous sandstone, P.; impure limestone, P.; green shale, P.; 1 piece of green shale, slickensides
			The green shale in general is soft and shiny and suggests fault infilling; slickensides
2,230-2,240	" "	3	Fine calcareous sandstone P.; impure limestone, P.; green shale, P.
2,240-2,250			Fine " " P.; " " P.; " " P.
2,250-2,260	" "	3	Impure limestone, P.; green shale, P. The green shale referred to above strongly suggests a chloritoid mineral
2,260-2,270	" "	3	Fine, calcareous sandstone, P.
2,270-2,280	" "	3	" " " P.; impure limestone, P.; green shale P.
2,280-2,290	" "	3	" " " P.
2,290-2,300	" "	3	" " " P.; " " P.; green shale P.
2,300-2,310	" "	3	
2,310-2,320	" "	3	Sandy shale, P.
2,320-2,330	" "	3	
2,330-2,340	" very dark grey .	2	Fossils
2,340-2,350	" dark grey	3	Fine-grained sandstone, L.
2,350-2,360	" very dark grey .	3	
2,360-2,370	" dark grey	3	" " L.; fossils
2,370-2,380	" "	2	Fossils
2,380-2,390	" very dark grey .	3	"
2,390-2,400	" "	3	A little veining. Grey limestone, L.; fossils
2,400-2,410	" "	2	Grey limestone, P.
2,410-2,420	" "	3	" " P.
2,420-2,430	" "	3	Grey, calcareous sand P.; fossils
2,430-2,440	" "	2	Grey limestone, P.; grey, calcareous, fine sand, P.; fossils
2,440-2,450	" "	3	" " P.; grey, calcareous sand, V.L.; fossils
2,450-2,460	.....	.....	Missing
2,460-2,470	Shale, very dark grey	3	Grey, calcareous, fine sand, P.; fossils
2,470-2,480	" "	3	Grey limestone, P.; grey, calcareous, fine sand, L.

Canadian Natural Gas Company, Well No. 2, Lot 164, St.-Amable, North (Cont.)

Depth (in feet)	-	Rate of effervescence with acid, Cold	Notes
2,480-2,490	Shale very dark grey	2	Grey, calcareous, fine sand, V.L.
2,490-2,500	" dark grey	2	Grey limestone, P.
2,500-2,510	" very dark grey	4	White vein calcite, V.L.; grey limestone, V.L.
2,510-2,520	" dark grey	3	Grey limestone, V.L.
2,520-2,530	Impure limestone, medium grey	4	Grey shale, H.
2,530-2,540	Shale dark grey	3	Grey, impure limestone, M.
2,540-2,550	" "	3	Grey limestone, P.
2,550-2,560	.....	.....	Missing
2,560-2,570	Shale, dark grey	3	Vein calcite, P.; grey limestone, P.
2,570-2,580	" "	3	Grey limestone, P.
	Missing, from 2,590 to 2,800		
2,790-2,800	Shale very dark grey	3	Fine, grey, calcareous, M.; vein calcite, P.
2,800-2,810	" "	2	" " " L.
2,810-2,820	" "	3	" " " P.; vein calcite, P.
2,820-2,830	" "	2	" " " P.; " P.
2,830-2,840	" "	2	Vein calcite, P.
2,840-2,850	" "	2	" " P.; very calcareous sandstone, P.
2,850-2,860	" "	1	Grey, calcareous sandstone, P.
2,860-2,870	" "	2	Vein calcite, P.; grey, calcareous sandstone, P.; fossils, P.
2,870-2,880	" "	2	" " P.; " " P.
2,907	" "	2	Grey, calcareous sandstone. H.

Insoluble Residues after Treatment with Hot HCl .

Sample from	Amount of residue Per cent	Character
1,360-1,370	60	Sandy shale, high; dark shale, low
1,370-1,380	68	Fine-grained, with sandstone, high; dark shale, low
1,380-1,390	60	" " " " "
1,650-1,660	80	Sandy shale, low; dark shale, high
1,660-1,670	80	" " "
1,670-1,680	82	" " "
1,680-1,690	68	" " "
1,690-1,700	66	" " "
2,500-2,510	80	" " "
2,520-2,530	62	Fine-grained, white sandstone, high; dark shale, low

The residues in general are either dark shale or very fine sandstone which probably merges into a sandy shale too fine to be a sand, and too gritty to be a shale.

The character of the residues and the carbonate content at 1,360-1,370, 1,380-1,390, and 2,520-2,530 suggest a very fine-grained, calcareous sandstone rather than thin limestone bands.

Extracted from Belyea (1952), pages 40-42

CANADIAN NATURAL GAS No.2 WELL

Location: lot 164, St-Amable North, Parish of St-Barnabé, St-Hyacinthe county, Quebec

Total depth: 2,907 feet Drilled: 1915

Rig: cable

Samples examined by H.R. Belyea, 1946

Depth	Lithology
98- 158	Shale, reddish brown, sandy; with large, rounded quartz grains; some interbedded grey sandstone
158- 178	Sandstone, greenish grey and red, medium- to coarse-grained; chiefly quartz in an argillaceous matrix
179- 238	Shale and sandstone: reddish brown, slightly sandy shale; greenish grey, medium-grained sandstone
238- 248	Missing
248- 255	Sandstone, greenish grey, fine- to coarse-grained
255- 391	Shale, reddish brown; a little greenish grey, fine- to medium-grained sandstone
391- 457	Shale, reddish brown; sandstone, as above; vein calcite
457- 463	Sandstone, greenish grey, fine-grained
463- 640	Shale, reddish brown, sandy; a little greenish grey, fine-grained sandstone; vein calcite in nearly all samples
640- 680	Shale, reddish brown, sandy; spotted with gypsum
680- 700	Shale, reddish brown, sandy, spotted with gypsum; a little red sandstone; vein calcite
700- 830	Shale, reddish brown, sandy, as above; spotted with gypsum; a little green-grey sandstone; vein calcite
830- 840	Shale and a little sandstone, as above; slickensides
840- 867	Sandstone, greenish grey, fine- to medium-grained; a little red shale and sandstone; gypsum; vein calcite
867- 977	Shale, reddish brown, sandy; with large, rounded quartz grains; grades to shaly sandstone; some greenish grey, fine-grained sandstone; gypsum
977- 989	Shale, greenish grey, sandy; a little red shale and gypsum
989-1,200	Shale, sandy, reddish brown and greenish grey; grey shale contains large, rounded, frosted sand grains; grades to shaly sandstone; red shales are spotted with gypsum
1,200-1,210	Dark igneous rock
1,210-1,220	Shale, reddish brown, sandy; a little grey, sandy shale
1,220-1,270	Shale, greenish grey, sandy

Richmond and Lorraine

Pontgravé River Formation and Older

Depth	Lithology
1,270-1,290	Shale, limestone, and siltstone: greenish grey to grey shale; blue-grey finely crystalline, silty limestone, grading to grey, very calcareous siltstone
1,290-1,300	Shale, limestone, and siltstone, as above; slickensides; vein calcite
1,300-1,320	Shale, limestone, and siltstone; brachiopod fragments
1,320-1,390	Shale, limestone, and siltstone, as above
1,390-1,440	Poor samples: shale, grey, with some limestone
1,440-1,600	Poor samples: shale, greenish grey, in part fissile; a little limestone, light grey, silty; siltstone, grey, calcareous
1,600-1,650	Shale, greenish grey, silty, micaceous; breaks into rounded fragments; grey fissile, micaceous, slightly silty shale; siltstone, greenish grey, calcareous
1,650-1,710	Shale and siltstone, as above: much fractured; slickensides and vein calcite
1,710-1,740	Shale, greenish grey, as above; lighter grey, calcareous siltstone, as above
1,740-1,800	Shale, greenish grey, as above; more, darker grey, fissile, micaceous, slightly silty shale; siltstone, light grey, calcareous
1,800-1,950	Shale and siltstone, grading to fine-grained sandstone; numerous fossil fragments-brachiopods, crinoids, bryozoa, in part crystallized and forming sandy shell limestone
1,950-1,990	Shale, siltstone, and fine sandstone, as above
1,990-2,020	Shale, medium grey, in part fissile, in part irregularly fractured, usually micaceous and finely silty; siltstone, light grey, calcareous, in part interlaminated with shale; a few fossil fragments
2,020-2,120	Shale and siltstone, as above; bryozoa
2,120-2,130	Shale and siltstone: much pale greenish grey metabentonite
2,130-2,150	Shale and siltstone, as above; bryozoa
2,150-2,907	Shale, medium grey, fissile, silty, micaceous; siltstone, medium grey, calcareous; a few fossil fragments

Note. In this well it is not possible to separate the lower Richmond marine shales from the Lorraine. The samples to about 1,390 feet appear to be Richmond; those below 1,600 feet, Lorraine. The samples between 1,390 and 1,600 feet are too poor to be of use. Slicing and crumpling of the strata in this section muy have been responsible for the recovery of such poor material.

Extracted from DeBlois (1959), page 21

Company: Canadian Natural Gas Co.

Well Name: Canadian Natural Gas No. 3

Location

Lot: 227
Range: St-Amable Sud
Parish: St-Barnabé
County: St-Hyacinthe

Ground Elevation : 112'
RF Elevation: 114'

Spudded: May 11, 1914

Completed: 1915

Driller: Edmond Côté, Montreal
Type of Rig: cable
Result: Dry hole
Water
Brackish at: 400', 1165'
Gas at: 1600'
Log by Belyea:

Formation	Depth interval (in feet)
Overburden	0 - 79
Richmond (Bécancour River)	79 - 545
Richmond (Pontgravé River)	545 - 835
- - - - -FAULT - - - - - - - - - - -	
Richmond (Bécancour River)	835 - 905
Richmond (Pontgravé River)	905 - 1115
Lorraine	1115 - 3405
Igneous rock	3405 - 3455

(For the writers interpretation based on the data given by Maddox (pp. 107-110) and Belyea (pp.111-113), see p.41 and p.48)

Canadian Natural Gas Company, Well No. 3,Lot 227, St-Amable, North (Cont.)

Depth (in feet)	–	Rate of effervescence with acid Cold	Extracted from Maddox, 1931, pp. 101-109
75 85	Shale, dark grey ...	1	Vein calcite, P.; slickensides; coarse sand P.
85- 95	" "	2	" P.; coarse sand, P.; grey, sandy shale, P.
95- 105	" "	2	" P.; " P.; " " P.; pyrite, P.
105- 115	Sandy shale,dark grey	3	" P.; slickensides; rounded qz. gr. 0.2 to 0.5 mm. P.
115- 125	" "	3	" P.; " " " 0.2 to 0.5 mm. L.
125- 135	" "	3	" P.; " " " 0.2 to 0.5 mm. L.
135- 145	" "	3	" P.; " " " 0.2 to 0.5 mm. H.
145- 155	" "	3	" P.; rounded qz. gr. 0.2 to 0.5 mm., L.; pyrite, P.
155- 165	" "	3	" P.; " " 0.2 to 0.5 mm.; L.; " P.
165- 175	" "	3	" P.; " " 0.2 to 0.5 mm., L.; " P.
185- 195	" "	3	" P.; slickensides; rounded qz. gr. 0.2 to 0.5 mm.,L.
195- 205	" "	3	" P.; " " " 0.2 to 0.5 mm.,L.
205- 215	" "	3	" P.; " " " 0.2 to 0.5 mm., L.; Pi, P.
215- 225	" "	3	" P.; rounded quartz grains 0.2 to 0.5 mm., L.
225- 235	" "	3	" P.; " " 0.2 to 0.5 mm., L.
235- 245	" "	3	" P.; " " 0.2 to 0.5 mm., L.
245- 255	" "	3	" P.; " " 0.2 to 0.5 mm., L.
255- 265	" "	3	" P.; slickensides; rounded qz. gr. 0.2 to 0.5 mm., M.
265- 275	" "	3	" P.; " " " 0.2 to 0.5 mm.,M. pyrite, P.
275- 285	" "	3	" P.; rounded qz. gr. 0.2 to 0.5 mm., M.
285- 295	" "	0	" L.; " " 0.2 to 0.5 mm., M.; pyrite, P.
295- 305	" "	1	" L.; " " 0.2 to 0.5 mm., L.
305- 315	" "	2	" V.L. " " 0.2 to 0.5 mm., V.L.
315- 325	" "	3	" V.L.; " " 0.2 to 0.5 mm., V.L.
325- 335	" "	2	" L.; " " 0.2 to 0.5 mm., V.L.
335- 345	" "	2	" V.L.; slickensides; rounded qz. gr. 0.2 to 0.5 mm., P.
345- 355	" "	3	" V.L.; rounded qz. gr. 0.2 to 0.5 mm., P.
355- 365	" "	4	" L.; " " 0.2 to 0.5 mm., L.
365- 375	" "	3	" M.; " " 0.2 to 0.5 mm., L.
375- 385	" "	3	Rounded quartz grains 0.2 to 0.5 mm., H.
385- 395	" "	2	" 0.2 to 0.5 mm., H.; 1 grey garnet
395- 405	" "	3	Vein calcite, L.; rounded quartz grains 0.2 to 0.5 mm., H.
405- 415	" "	3	Rounded quartz grains 0.2 to 0.5 mm., H.
415- 425	" "	3	Vein calcite, L.; rounded quartz grains 0.2 to 0.5 mm., M.
425- 435	" "	3	
435- 445	" "	3	" V.L.; " " 0.2 to 0.5 mm., L.
445- 455	" "	2	" L.; " " 0.2 to 0.5 mm., L.
455- 465	" "	3	Vein calcite, L.; rounded quartz grains 0.2 to 0.5 mm., L.
465- 475	" "	3	" P.; " " 0.2 to 0.5 mm., L.
475- 485	" "	3	" V.L.; " " 0.2 to 0.5 mm., V.L.
485- 495	" "	3	" V.L.; " " 0.2 to 0.5 mm., V.L.
495- 505	" "	3	" V.L.; " " 0.2 to 0.5 mm., P.
505- 515	" "	3	" V.L.; " " 0.2 to 0.5 mm., V.L.
515- 525	" "	3	" V.L.; " " 0.2 to 0.5 mm., V.L.
525- 545	" "	3	" V.L.; " " 0.2 to 0.5 mm., V.L.
545- 555	" "	4	" L.; " " 0.2 to 0.5 mm., V.L.
555- 565	" "	4	" M.; " " 0.2 to 0.5 mm., P.; pyrite, P.
565- 575	" "	4	" M.; " " 0.2 to 0.5 mm., P.; pyrite, P.
575- 585	" "	4	" M.; " " 0.2 to 0.5 mm., P.

Canadian Natural Gas Company, Well No. 3,Lot 227, St-Amable, North (Cont.)

Depth (in feet)	–	Rate efferves-cence with acid,Cold	Extracted from Maddox, 1931, pp. 101-109
585- 595	Sandy shale, dark grey ...	4	Vein calcite, M.; rounded qz. gr. 0.2 to 0.5 mm., P.; pyrite,P.
595- 605	" "	4	" M.; " " 0.2 to 0.5 mm., P.; slickensides
605- 615	" "	3	" M.; " " 0.2 to 0.5 mm., P.; pyrite,P.
615- 625	" "	4	" M.; " " 0.2 to 0.5 mm., L.; " P. slickensides
625- 635	" "	4	" M.; " " 0.2 to 0.5 mm., V.L.; slickensides
635- 645	" "	4	" M.; " " 0.2 to 0.5 mm., L.; pyrite,P.
645- 655	" "	4	" M.; " " 0.2 to 0.5 mm., L.
655- 665	" "	4	" L.; " " 0.2 to 0.5 mm., L.; slickensides
665- 675	" "	3	" P.;
675- 685	" "	3	" P.
685- 695	" "	3	" P.
695- 705	" "	2	" P.
705- 715	" "	3	" P.; " " 0.2 to 0.5 mm., P.
715- 725	" "	3	" V.L.; " " 0.2 to 0.5 mm., L.; pyrite,P.
725- 735	" "	4	" L.; " " 0.2 to 0.5 mm., V.L.
735- 745	" "	4	" L.; " " 0.2 to 0.5 mm., P.
745- 755	" "	4	" L.; " " 0.2 to 0.5 mm., V.L.; slickensides
755- 765	" "	4	" P.
765- 775	" "	3	" P.; slickensides
775- 785	Shale, dark grey	3	" V.L.
785- 795	" "	3	" V.L.
795- 805	" "	3	" V.L.
805- 815	" "	5	" H.; fine-grained, calcareous sandstone, L.
815- 825	" "	5	" V.H.; " " " " H.
825- 835	" "	5	" H.; " " " " M.; slickensides
835- 845	Sandy shale, dark grey ...	4	" L.; quartz grains 0.2 to 0.5 mm., M.
845- 855	" " ...	4	" L.; " " 0.2 to 0.5 mm., M.
855- 865	" " ...	5	" L.; " " 0.2 to 0.5 mm., L.
865- 875	" " ...	5	" L.; " " 0.2 to 0.5 mm., M.
875- 885	" " ...	4	" P.; " " 0.2 to 0.5 mm., H. Pyrite, P.
885- 895	" " ...	4	" L.; " " 0.2 to 0.5 mm., H.; " P.
895- 905	" " ...	3	" V.L.; " " 0.2 to 0.5 mm., M.
905- 915	Shale, dark grey	3	Fine-grained, grey, calcareous sandstone, M.
915- 925	" "	4	" " " " H.
925- 935	" "	4	Vein calcite, P.; fine-grained, grey, calcareous sandstone,H.
935- 945	" "	4	" P.; " " " " " H.
945- 955	" "	4	Fossils in brown limestone, V.L.; fine-grained, grey calcareous sandstone, H.
955- 965	" "	4	Vein calcite, V.L.; fine-grained, grey, calcareous sandstone, M.
965- 975	" "	3	" P.; fossils in brown limestone, P.; fine-grained, grey, calcareous sandstone, M.
975- 985	" "	4	" P.; fossils in brown limestone, P.; fine-grained, grey, calcareous sandstone, M.
985- 995	" "	4	" P.; fossils in brown limestone, P.; fine-grained. grey, calcareous sandstone,L.

Canadian Natural Gas Company, Well No. 3, Lot 227, St-Amable, North (Cont.)

Depth (in feet)		Rate efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 101-109
995-1,005	Shale, dark grey	3	Vein calcite , P.; fossils in brown limestone, V.L.; fine-grained, grey, calcareous sandstone M.
1,005-1,015	" "	3	" " P.; fossils in brown limestone, L.; fine-grained, grey, calcareous sandstone, M.
1,015-1,025	" "	2	" " P.; fossils in brown limestone, P.; fine-grained, grey, calcareous sandstone, M.
1,025-1,035	" "	3	" " P.; fine-grained, calcareous sandstone, M.
1,035-1,045	" "	3	" " V.L.; fossils in brown limestone, P.; fine-grained,grey, calcareous sandstone, M.
1,045-1,055	" "	2	" " V.L.; fossils in brown limestone, P.; fine-grained,grey, calcareous sandstone, L.
1,055-1,075	" "	2	" " V.L.; fossils in brown limestone, P.; fine-grained, grey, calcareous sandstone, M.
1,075-1,085	" "	3	" " P.; fine-grained, grey, calcareous sandstone,L.
1,085-1,095	" "	3	" " L.; fossils in brown limestone, V.L.; fine-grained, grey, calcareous sandstone, M.
1,095-1,105	" "	3	" " V.L.; qz. gr. 0.2 to 0.4 mm., L.; fine-grained, grey, calcareous sandstone, L.
1,105-1,115	" "	3	Fossils in brown limestone, V.L.; fine-grained, grey, calcareous sandstone, L.
1,115-1,125	" "	3	Qz. gr. 0.2 to 0.5 mm., V.L.; fine-grained, grey, calcareous sandstone, H.
1,125-1,135	" "	3	Fossils in brown limestone, P.; fine-grained, grey, calcareous sandstone, M.
1,135-1,145	" "	3	Fine-grained, grey, calcareous sandstone, M.
1,145-1,155	" "	3	" " " M.
1,155-1,165	" "	3	" " " L.
1,165-1,175	" "	3	" " " M.
1,175-1,185	" "	2	" " " H.
1,185-1,195	" "	3	" " " M.
1,195-1,205	" "	2	Vein calcite and slickensides; fine grained, grey, calcareous sandstone, L.
1,205-1,215	" "	2	Fine-grained, grey, calcareous sandstone, M.
1,215-1,225	" "	3	" " " M.
1,225-1,235	" "	3	" " " M.
1,235-1,245	" "	3	" " " H.
1,245-1,255	" "	2	" " " L.
1,255-1,265	" "	2	" " " L.
1,265-1,275	" "	1	" " " P.
1,275-1,285	" "	1	" " " P.
1,285-1,295	" "	2	" " " P.
1,295-1,305	" "	2	" " " P.
1,305-1,315	" "	1	" " " P.
1,315-1,325	" "	2	" " " P.
1,325-1,335	" "	2	" " " P.
1,335-1,345	" "	2	" " " P.
1,345-1,355	" "	3	" " " P.
1,355-1,365	" "	2	" " " L.
1,365-1,375	" "	2	" " " L.; white calcite, P.
1,375-1,385	" "	2	" " " H.
1,385-1,395	" "	3	" " " M.; white calcite,P.

Canadian Natural Gas Company, Well No. 3, Lot 227, St-Amable, North (Cont.)

Depth (in feet)	–	Rate efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 101-109
1,395-1,405	Shale, dark grey	2	Fine-grained, grey, calcareous sandstone, L.
1,405-1,415	" "	2	" " " " L.
1,415-1,425	" "	2	" " " " P.
1,425-1,435	" "	3	" " " " P.; white calcite, P.
1,435-1,445	" "	3	" " " " P.
1,445-1,455	" "	1	" " " " P.
1,455-1,465	" "	2	" " " " P.
1,465-1,475	" "	1	" " " " L.
1,475-1,485	" "	2	" " " " P.
1,485-1,495	" "	2	
1,495-1,505	" "	1	" " " " P.
1,505-1,515	" "	1	" " " " P.
1,515-1,525	" "	1	
1,525-1,535	" "	2	" " " " P.; " P.
1,535-1,545	" "	2	" " " " P.; " P.
1,545-1,555	" "	2	" " " " P.; vein calcite, P.
1,555-1,565	" "	2	" " " " P.
1,565-1,575	" "	1	" " " " P.
1,575-1,585	" "	1	" " " " P.
1,585-1,595	" "	2	" " " " P.; fossiliferous limestone, P.
1,595-1,605	" "	2	" " " " L.; vein calcite, P.
1,605-1,615	" "	2	" " " " M. " P.
1,615-1,625	" "	2	" " " " M.; " P.; slickensides
1,625-1,635	" "	2	" " " " L.; vein calcite, P.
1,635-1,645	" "	2	" " " " M.
1,645-1,655	" "	2	" " " " L.
1,655-1,665	" "	2	" " " " V.L.; fossils
1,665-1,675	" "	2	" " " " V.L.; "
1,675-1,685	" "	2	" " " " P.; "
1,685-1,695	" "	2	" " " " V.L.; "
1,695-1,705	" "	2	" " " " V.L.; "
1,705-1,715	" "	2	" " " " L.; "
1,715-1,725	" "	2	" " " " V.L.; "
1,725-1,735	" "	2	" " " " V.L.; "
1,735-1,745	" "	2	" " " " L.; one crinoid stem; fossils
1,745-1,755	" "	2	" " " " V.L.; fossils
1,755-1,765	" "	2	" " " " V.L.; one crinoid stem; fossils
1,765-1,775	" "	2	" " " " V.L.; fossils
1,775-1,785	" "	2	" " " " L.
1,785-1,795	" "	2	" " " " L.; "
1,795-1,805	" "	2	" " " " L.; shell impression, vein calcite, P.; fossils
1,805-1,815	" "	2	" " " " L.; vein calcite, P.
1,815-1,825	.....	...	Missing
1,825-1,835	" "	2	Fine-grained " " " L.; " P.
1,835-1,845	" "	2	" " " " " L.
1,845-1,855	" "	2	" " " " H.; fossils

Canadian Natural Gas Company, Well No. 3 (Cont.)

Depth (in feet)	–	Rate efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 101-109
1,855-1,865	Shale, dark grey	2	Fine-grained, grey, calcareous sandstone H.; vein calcite, P.
1,865-1,875	" "	2	" " " " L.
1,875-1,885	" "	2	" " " " L.; " P.
1,885-1,895	" "	2	" " " " P.
1,895-1,905	" "	2	" " " " L.
1,905-1,915	" "	2	?Sand grains and sand quartz; vein calcite, V.H.
1,915-1,925	" "	3	Fine-grained, grey, calcareous sandstone, L.; shell impression; vein calcite, H.
1,925-1,935	.....	....	Missing
1,935-1,945	" "	2	Vein calcite, H.
1,945-1,955	" "	3	Fine, calcareous sandstone, L.; vein calcite, H.
1,955-1,965	" "	3	" " " L.; slickensides; vein calcite, P.
1,965-1,975	" "	3	Vein calcite, H.
1,975-1,985	" "	3	" P.;? pink garnet
1,985-1,995	" "	3	" H.; fine, calcareous sandstone, L.
1,995-2,005	" "	3	" L.; " " P.
2,005-2,015	" "	3	" M.; " " L.
2,015-2,025	" "	3	" P.; " " P.
2,025-2,035	" "	4	" M.; " " L.
2,035-2,045	" "	4	" P.; " " P.
2,045-2,055	" "	3	" L.; " " P.
2,055-2,065	" "	4	" P.; fractured garnet grains, P.;? medium sand grains
2,065-2,075	" "	3	" P.; fine, calcareous sandstone, V.L.
2,075-2,085	" "	3	" P.; " " V.L.
2,085-2,095	" "	3	" P.; " " L.
2,095-2,105	" "	3	" P.; " " L.
2,105-2,115	" "	3	" P.; " " V.L. fossils
2,115-2,125	" "	3	" P.; " " L.
2,125-2,135	" "	2	" P.; " " M.; fossils
2,135-2,145	" "	2	Vein calcite, P.; fine, calcareous sandstone, L.; evidences of fracture zone
2,145-2,155	" "	1	" P.; " " L.
2,155-2,165	" "	2	" P.; " " M.; shell impression
2,165-2,175	" "	2	" P.; " " H.; slickensides
2,175-2,185	" "	1	" P.; " " L.; slickensides; shell impression
2,185-2,195	" "	2	" P.; " " L.
2,195-2,205	" "	2	" P.; " " M.; slickensides shell impression
2,205-2,215	" "	2	" P.; " " M.; slickensides shell impression
2,215-2,225	" "	2	" P.; " " L.
2,225-2,235	" "	2	" P.; " " L.
2,235-2,245	" "	2	" P.; " " L.
2,245-2,255	" "	2	" P.; " " L.; "
2,255-2,265	" "	3	" P.; " " L.; "
2,265-2,275	" "	3	" P.; " " L.; "
2,275-2,285	" "	3	" P.; " " L.; "
2,285-2,295	" "	3	" P.; " " L.; "
2,295-2,305	" "	3	" P.; " " L.
2,305-2,315	" "	3	" P.; " " M.

Canadian Natural Gas Company, Well No. 3 (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 101-109
2,315-2,325	Shale, dark grey	3	Vein calcite, P.; fine, calcareous sandstone, L.
2,325-2,335	" "	3	" P.; " " " L.
2,335-2,345	" "	2	" P.; " " " M.; fossils
2,345-2,355	" "	3	" L.; " " " M.
2,355-2,365	" "	3	" V.L.; slickensides; very light grey shale, P.
2,365-2,375	" "	3	" V.L.; fine, calcareous sandstone, L.
2,375-2,385	" "	3	" P.; fine, cal.sandstone,V.L.;very light grey shale, P.
2,385-2,395	" "	3	" L.; fine calcareous sandstone,V.L.; fossils
2,395-2,405	" "	2	" V.L.; fine,cal.sandstone, L.
2,405-2,415	" "	2	" P.; fine calcareous sandstone, L.
2,415-2,425	" "	2	" P.; " " " M.
2,425-2,435	" "	2	" P.; " " " M.
2,435-2,445	" "	2	" V.L.; " " " M.; slickensides
2,445-2,455	" "	2	" V.L.; " " " M.
2,455-2,465	" "	2	" P.; " " " M.
2,465-2,475	" "	2	" P.; " " " M.
2,475-2,485	" "	2	" P.; " " " L.; slickensides
2,485-2,495	" "	2	" P.; " " " L.
2,495-2,505	" "	2	" P.; " " " L.
2,505-2,515	" "	2	" P.; " " " L.
2,515-2,525	" "	2	" P.; " " " V.L.;
2,525-2,535	" "	2	" P.; " " " V.L.
2,535-2,545	" "	1	" P.; " " " V.L.
2,545-2,555	" "	1	" P.; " " " L.
2,555-2,565	" "	1	" P.; " " " L.
2,565-2,575	" "	1	Slickensides ? fossil
2,575-2,585	" "	1	Fine, calcareous sandstone, P.; slickensides
2,585-2,595	" "	1	Vein calcite, P.; fine, calcareous sandstone, P.; slickensides
2,595-2,600	" "	1	Fine, calcareous sandstone, P.
2,600-2,605	" "	1	" " " P.
2,605-2,615	" "	1	" " " P.
2,615-2,625	" "	1	" " " P.
2,625-2,635	" "	1	" " " P.
2,635-2,645	" "	1	" " " P.
2,645-2,655	" "	1	" " " P.
2,655-2,665	" "	2	" " " P.; shell impressions
2,665-2,675	" "	1	" " " P.
2,675-2,685	" "	2	" " " P.
2,685-2,695	" "	2	" " " L.
2,695-2,705	" "	1	" " " P.
2,705-2,715	" "	3	" " " M.
2,715-2,725	" "	2	" " " V.L.
2,725-2,735	" "	2	" " " L.
2,735-2,745	" "	2	" " " L.
2,745-2,755	" "	2	" " " L.
2,755-2,765	" "	2	" " " L.
2,765-2,775	" "	2	" " " L.
2,775-2,785	" "	2	" " " L.
2,785-2,795	" "	2	" " " L.
2,795-2,805	" "	2	" " " L.
2,805-2,815	" "	2	" " " L.
2,815-2,825	" "	2	" " " L.
2,825-2,835	" "	3	" " " P.; white vein calcite, H.
2,835-2,845	" "	3	Fine sandstone, L.; white vein calcite, M.

Canadian Natural Gas Company, Well No. 3 (Cont.)

Depth (in feet)		Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 101-109
2,845-2,855	Shale, dark grey	2	Fine sandstone, L.; white vein calcite, P.
2,855-2,865	" "	2	" " L.; " " P.
2,865-2,875	" "	2	" " L.; " " P.
2,875-2,885	Sandy shale, dark grey	2	" " H.;
2,885-2,895	" "	2	" " H.; " " P.; slickensides
2,895-2,905	" "	2	" " H.; slickensides
2,905-2,915	" "	2	" " H.
2,915-2,925	" "	2	" " H.
2,925-2,935	" "	2	" " H.
2,935-2,945	" "	2	" " H.
2,945-2,955	" "	2	" " H.
2,955-2,965	" "	1	" " H.
2,965-2,975	Shale, dark grey	2	" " M.; slickensides, P.; vein calcite, P.; twinning
2,975-2,985	" "	2	" " L.; " P.;vein cal.,H.;grey limestone,P.
2,985-2,995	" "	2	" " L.; vein calcite, P.; grey limestone, P.
2,995-3,005	Sandy shale, dark grey	2	" " P.; grey limestone, P.
3,005-3,015	" "	2	" " H.; vein calcite, P.
3,015-3,025	Shale, dark grey	2	" " L.; " P.
3,025-3,035	Sandy shale, dark grey	2	" " H.
3,035-3,045	Shale, dark grey	2	" " L.; " P.
3,045-3,055	" "	2	" " L.; slickensides, P.; vein calcite, P.; grey limestone, P.
3,055-3,065	" "	2	" " M.; " P.; " P.
3,065-3,075	" "	2	" " P.; vein calcite, P.; grey limestone, P.
3,075-3,085	" "	2	Vein calcite, P.; grey limestone, P.
3,085-3,095	" "	2	Grey limestone, P.
3,095-3,105	" "	2	Fine sandstone, L.
3,105-3,115	" "	2	" " L.
3,115-3,125	" "	2	" " L.
3,125-3,135	" "	2	" " L.; slickensides
3,135-3,145	" "	2	" " L.; vein calcite, H.
3,145-3,155	" "	2	" " L.; slickensides, vein calcite, L.
3,155-3,165	Sandy shale, dark grey	2	" " H.; vein calcite, P.
3,165-3,185	Shale, dark grey	2	" " L.; " P.
3,185-3,195	" "	2	" " L.
3,195-3,205	Sandy shale, dark grey	2	" " H.; " P.
3,205-3,215	" "	2	" " H.; " P.
3,215-3,225	" "	2	" " H.; " P.
3,225-3,235	" "	2	" " H.; " P.
3,235-3,245	" "	2	" " H.; " P.
3,245-3,255	" "	2	" " H.; " P.
3,255-3,265	Shale dark grey	2	" " L.
3,265-3,275	" "	2	" " L.; " P.
3,275-3,285	" "	2	" " L.; " P.
3,285-3,295	" "	3	" " L.; " P.
3,295-3,305	" "	2	" " M.; " P.
3,305-3,315	.....	...	Missing
3,315-3,325	" "	2	Fine sandstone, L.
3,325-3,335	" "	2	" " L.; " P.
3,335-3,345	" "	2	" " M.; " P.
3,345-3,355	" "	2	" " M.; " P.
3,355-3,365	" "	2	" " L.; " P.

Canadian Natural Gas Company, Well No. 3 (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 101-109
3,365-3,375	Shale, dark grey	2	Fine sandstone, M.; vein calcite, P.
3,375-3,385	" "	2	" " L.; " " P.
3,385-3,395	" "	2	" " M.; " " P.
3,395-3,405	" "	2	" " L.; " " P.
3,405-3,415	Sandy shale, dark grey	2	" " H.; fine, calcareous sandstone, P.; suggests contact rock
3,415-3,425	Altered intrusive, dark grey	.....	Shale, L.; gravity in hand sample greater than foregoing samples
3,425-3,435	" "	.....	" P.
3,435-3,445	" "	.....	" P.
3,445-3,555	" "	.....	" P.

INSOLUBLE RESIDUES AFTER TREATMENT WITH HOT HCl

Sample from	Amount of residue	Sample from	Amount of residue	Sample from	Amount of residue	Sample from	Amount of residue	Sample from	Amount of residue
	Per cent		Per cent		Per cent		Per cent		Per cent
145-155	40	495-505	85	795- 805	75	1,145-1,155	80	2,045-2,055	80
205-215	75	545-555	70	845- 855	75	1,235-1,245	80	2,095-2,105	80
315-325	75	595-605	75	895- 905	80	1,345-1,355	75	2,295-2,305	80
345-355	90	645-655	75	945- 955	85	1,385-1,395	75	2,355-2,365	80
395-405	80	705-715	70	995-1,005	80	1,445-1,455	90		
455-465	70	745-755	70	1,105-1,115	75	1,945-1,955	80		

With the exception of the residue from the sample obtained from 145 to 155 feet, the residues are mainly shaly and nearly always contain rounded and angular, coarse sand. There appears to be very little sand of medium or coarse grains in the samples examined from 945 to 1,455 feet (8 samples). The residue for the sample from 145 to 155 feet contains much secondary silica in the form of well-developed quartz crystals.

Extracted from Belyea (1952), pages 42-44

CANADIAN NATURAL GAS No. 3 WELL

Location: lot 227, St. Amable South, Parish of St. Barnabé, St.Hyacinthe county, Quebec
Total depth: 3,455 feet Drilled: 1914-15
Rig: cable
Samples examined by H.R. Belyea, 1946

Depth	Lithology
	RICHMOND
	Bécancour River Formation
79- 95	Shale, greenish grey, in part sandy; slickensides
95- 105	Shale, greenish grey; more sandy shale; vein calcite
105- 135	Shale, greenish grey, sandy; quartz grains, large, rounded, frosted, up to 0.5 mm. in shale matrix; varies to shaly sandstone; vein calcite
135- 145	Shale, greenish grey, sandy, as above; slickensides; vein calcite
145- 175	Shale, greenish grey, sandy, as above; vein calcite
175- 185	Shale, greenish grey, sandy; slickensides; vein calcite
185- 235	Shale, greenish grey, sandy, as above; pyrite; vein calcite
235- 245	Shale, greenish grey; a little sand
245- 415	Shale, greenish grey, sandy; with large, rounded quartz grains; vein calcite
415- 455	Shale, dark greenish grey, darker and less sandy than above; some vein calcite
455- 465	Shale, as above; much vein calcite
465- 535	Shale, dark greenish grey as above; with a few quartz grains; some calcite 475 to 495 feet; slickensides 525 to 535 feet
535- 545	Missing
	Pontgravé River Formation
545- 565	Shale, light greenish grey; a little light greenish grey, calcareous siltstone and fine sandstone; a few fragments of fine limestone; vein calcite common
565- 585	Shale and siltstone, as above; slickensides; vein calcite common
585- 595	Shale and siltstone, as above
595- 605	Shale and siltstone, as above; slickensides and vein calcite common
605- 625	Shale and siltstone, as above; little vein calcite
625- 665	Shale and siltstone, fine limestone as above; slickensides and vein calcite
665- 675	Buff powder
675- 725	Shale, greenish grey; a little grey, fine limestone, in part sandy; some greenish grey, calcareous siltstone
725- 755	Shale, greenish grey, sandy; limestone and calcareous siltstone as above; vein calcite and slickensides
755- 805	Shale, greenish grey; some calcareous siltstone and fine-grained sandstone
805- 815	Shale, greenish grey, in part sandy; much vein calcite; pyrite
815- 835	Shale, as above; brachiopod fragments-Byssonychia identified by T.H. Clark; much vein calcite
835	Fault
	Bécancour River Formation
835- 905	Shale, greenish grey, sandy; large, rounded quartz grains up to 0.5 mm. diameter

Depth	Lithology
Feet	Pontgravé River Formation
905-1,115	Shale, greenish grey; greenish grey, calcareous siltstone and fine-grained sandstone; some limestone, light grey, silty; a few fossil fragments
	Lorraine
1,115-1,245	Shale and siltstone: light greenish grey, micaceous shale, breaks into rounded fragments; light greenish grey, calcareous siltstone, varies to fine-grained sandstone
1,245-1,385	Shale, medium greenish grey, fissile, micaceous, slightly silty; light greenish grey shale, as above; a little greenish grey, calcareous siltstone and fine-grained sandstone
1,385-1,405	Shale, light to medium greenish grey, as above; some siltstone and fine sandstone; bryozoa
1,405-1,455	Shale and siltstone, as above
1,455-1,475	Shale, siltstone, and fine sandstone, as above; abundant crystallized fossil fragments, in part forming a sandy limestone
1,475-1,495	Shale and siltstone, as above
1,495-1,505	Shale, siltstone, and fine sandstone; bryozoa
1,505-1,525	Shale and siltstone, as above; crinoid disks, 1,515 to 1,525 feet
1,525-1,565	Shale, greenish grey, as above; some siltstone and fine, calcareous sandstone; grey, sandy, shell limestone; bryozoa, 1,535 to 1,545 feet
1,565-1,605	Shale, siltstone, and fine sandstone, as above
1,605-1,615	Shale, medium grey, slightly greenish; lighter greenish grey, calcareous siltstone; some sandy shell limestone; bryozoa
1,615-1,625	Shale, medium and light greenish grey, as above; siltstone and limestone as above; slickensides; crinoids
1,625-1,765	Shale, siltstone, and sandy shell limestone, as above; bryozoa 1,675 to 1,705 feet
1,765-1,905	Shale, medium grey to dark grey, micaceous, silty, fissile; lighter grey, calcareous siltstone and fine sandstone, in part with fossil fragments; crinoid disks, 1,775 to 1,795 feet; bryozoa, 1,785 to 1,855 feet; brachiopods, 1,855 to 1,865 feet
1,905-1,915	Shale and siltstone, as above; slickensides
1,915-1,955	Shale, siltstone, and fine sandstone, as above
1,955-1,995	Shale, medium grey, slightly greenish, and darker grey, fissile shale; fine-grained, calcareous sandstone and siltstone; fossil fragments; bryozoa 1,985 to 1,995 feet
1,995-2,055	Shale, as above; fine sandstone and siltstone, as above; brachiopod fragments; crinoids 1,995 to 2,005 feet; vein calcite
2,055-2,065	Shale, siltstone, and fine sandstone, as above; slickensides and abundant vein calcite
2,065-2,135	Shale, siltstone, and fine sandstone, as above; brachiopods, bryozoa, crinoid disks
2,135-2,175	Shale, medium grey, fissile, micaceous, slightly silty; some lighter greenish grey shale, as above; siltstone and very fine sandstone interlaminated with shale; fossil fragments-brachiopods; vein calcite
2,175-2,205	Shale, greenish grey to grey, as above; siltstone and fine sandstone; brachiopod fragments; slickensides; vein calcite
2,205-2,345	Shale, greenish grey to grey, as above; some siltstone and fine-grained, calcareous sandstone, as above
2,345-2,355	Shale, siltstone, and fine sandstone, as above; metabentonite
2,355-2,375	Shale, siltstone, and fine sandstone, as above
2,375-2,385	Shale, siltstone, and fine sandstone; slickensides
2,385-2,565	Shale, greenish grey to grey, fissile, micaceous, slightly silty; siltstone and fine-grained, calcareous sandstone; a few fossil fragments; brachiopods and bryozoa, 2,495 to 2,505 feet
2,565-2,595	Shale, medium grey, fissile, brittle, silty; slickensides; fossil fragments, 2,565 to 2,575 feet
2,595-2,825	Shale, medium grey fissile, brittle, finely silty; much calcareous, fine-grained, sandstone, in part interlaminated with shale; a few fossil fragments
2,825-2,845	Shale and fine-grained sandstone, as above; vein calcite
2,845-2,875	Shale and fine sandstone, as above
2,875-2,915	Shale and fine sandstone; fractures and calcite veins

Depth	Lithology
Feet	Lorraine (Cont.)
2,915-2,985	Shale, medium grey, fissile, as above; fine-grained, grey sandstone, pyritic 2,925 to 2,935 feet
2,985-2,995	Shale and fine sandstone, as above; slickensides; vein calcite
2,995-3,045	Shale and fine sandstone, as above; vein calcite
3,045-3,065	Shale and fine sandstone, as above; slickensides; calcite veins
3,065-3,115	Shale and sandstone, as above; some carbonaceous material; pyrite; vein calcite
3,115-3,185	Shale and some sandstone, as above
3,185-3,195	Shale and some fine sandstone, as above; slickensides and vein calcite
3,195-3,255	Shale and some fine sandstone, as above
3,255-3,275	Shale and some fine sandstone; slickensides and calcite veins
3,275-3,405	Shale and some fine sandstone, as above; slickensides at 3,355 to 3,365 feet
3,405-3,455	Igneous rock, fine-grained, intrusive, possibly syenite; considerable dark grey sandy shale

NOTE. The samples from this well show excessive thickness of the green sandy shale facies of the Bécancour River formation. Slickensides and calcite are associated with these shales, the whole suggesting crumpling and probably drag-folding and thrusting or slicing of the strata. The Pontgravé River formation, from 545 to 835 feet, is also excessively thick, probably for similar reasons.

A repetition of the Bécancour River green shales from 545 to 905 feet, and the presence of abundant calcite in the samples from 815 to 835 feet suggest the presence of a thrust fault at 835 feet.

Extracted from DeBlois (1959), page 22

Company: Canadian Natural Gas Co.
Well Name: Canadian Natural Gas No. 4
Location
Lot: 982
Concession: Ste. Rose
Parish: St. Jude
County: St. Hyacinthe
Ground Elevation: 106
RF Elevation: 108'

Spudded: 1917
Completed: 1917
Driller: Edmond Côté, Montreal
Type of Rig: Cable
Result: Dry hole
Water
125', 350', 1200'
Gas at: unknown depth
Log by Belyea:

Formation	Depth interval (in feet)
Overburden	0 - 160
Richmond (Bécancour River)	160 -2240
Richmond (Pontgravé River)	2240 -2280
---------FAULT ----------	
Richmond (Bécancour River)	2280 -2390

Canadian Natural Gas Company, Well No. 4

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 110-115
120	Shale, green-grey	1	Quartz pebbles and fine sand, P.; red shale, P.
120- 130	" "	1	" " P.; " P.
130- 140	" "	1	" " P.; " P.
140- 150	No sample		
150- 160	"		
160- 170	"		
170- 180	Shale, green-grey and red	2	Quartz pebbles and fine sand, P.
180- 190	" "	2	" " P.
190- 200	" "	2	" " P.
200- 210	" "	2	" " P.
210- 220	" red	1	Green-grey shale, M.
220- 230	Sandy shale, red	1	Quartz pebbles and fine sand, P.; green-grey shale, M.
230- 240	" "	1	Red sandstone, P.; green-grey shale, M.; green-grey, fine sand, L.
240- 250	" "	1	" P.; " M.; green-grey, fine sand, L.
250- 260	" "	2	Pyrite, P.; white quartz pebbles, P.; green-grey shale, P.
260- 270	Sandstone, green, shaly .	2	Fine grained; red, shaly sandstone, L.; green shale, P.; red shale, P.
270- 280	Shale, red	2	Green, sandy shale, P.; white effervescence
280- 290	Sandy shale, red and green	1	" " D.; red, sandy shale, H.
290- 300	" green and red	1	" " D.; " " H.
300- 310	" green, grey, and red	1	Green-grey, sandy shale, D.; red, sandy shale, H.
310- 320	" red	2	" " H.
320- 330	" green-grey and red	2	" " D.; " " H.; medium-grained sandstone, P.
330- 340	" " "	2	" " D.; red, sandy shale, H.; white quartz pebbles, P.
340- 350	" red	2	" " L.
350- 360	" green-grey and red	2	" " D.; red, sandy shale, H.; fine sandstone, L.
360- 370	" red	2	" " M.; fine red sandstone, L.
370- 380	" "	2	" " L.
380- 390	" "	1	" " L.
390- 400	" "	1	" " M.; fine, red sandstone, P.
400- 410	" "	1	" " H.; green-grey sandstone, P.
410- 420	"	1	" " M.; red and green fine sandstone, P.
420- 430	Shaly sandstone, green-grey	2	Red, sandy shale, L.; fine grained
430- 440	Sandstone, green-grey	1	Red sandstone, P.; red sandy shale, L.; fine grained
440- 450	" "	2	Red sandy shale, L.; fine grained coarse sandstone, P.
450- 460	Sandy shale, red	1	Green-grey shale, M.; green-grey sandstone, L.
460- 470	" "	1	" sandy shale, M.; green-grey sandstone, L.
470- 480	" "	1	" " L.; " " L.
480- 490	" "	1	" " L.; " " L.
490- 500	" "	2	" " P.; " " H.
500- 510	" "	1	Grey, sandy shale, H.
510- 520	Shale, red	1	" " H.; greenish grey, fine-grained sandstone, L.
520- 530	Sandy shale, brown-reddish	1	Greenish grey, sandy shale, V.H.
530- 540	" red	1	" " V.H.
540- 550	" greenish grey	2	Reddish brown, sandy shale, V.H.; sand grains average 0.1 mm., M.

Canadian Natural Gas Company, Well No. 4 (Cont.)

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp.110-115
550-560	Sandy shale, greenish grey	2	Reddish brown, H.; sandy shale, V.H.; sand grains average 0.1 mm., M.
560-570	" reddish green	2	Fine sand, H.; green shale, H.; red shale, H.; subangular quartz 0.5 mm.
570-580	" green	2	" H.; red shale, L.
580-590	" mottled green	2	" H.
590-600	" green	2	" H.; grey shale, L.
600-610	" red and green	1	" H.; green shale, H.; red shale, H.; coarse sand, P.
610-620	" "	1	" H.; " H.; " H.; " P.
620-630	" "	1	" H.; " H.; " H.
630-640	" "	1	" H.; " H.; " H.; coarse rounded quartz, P.
640-650	" mottled red	1	" H.; " H.; " H.; coarse rounded quartz, P.
650-660	" mottled green	1	" H.; " H.; " H.; subangular quartz, P.
660-670	" "	1	" H.; " H.; " H.; rounded quartz, P.
670-680	" "	1	" H.; " H.; " H.
680-690	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
690-700	" "	2	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
710-720	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
720-730	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
730-740	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
740-750	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
750-760	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
760-770	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
770-780	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm. fibrous calcite
780-790	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
790-800	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
800-810	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
810-820	" "	1	" H.; " H.; " H.; rounded quartz grains to 0.5 mm.
820-830	" "	1	" H.; " H.; " V.H.; rounded quartz grains to 0.5 mm.
830-840	" "	1	" H.; " H.; " V.H.; rounded quartz grains to 0.5 mm.
840-850	Shaly sandstone, dark red	1	Fine grained; green shale, L.;
850-860	Sandy shale, dark red	1	Green shale, L.; red shale, D.; coarse, rounded quartz, P.

Canadian Natural Gas Company, Well No. 4 (Cont.)

Depth (in feet)	-	Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 110-115
860- 870	Sandy shale, dark red	1	Fine grained; green shale, L.; red shale, D.; coarse rounded quartz, P.
870- 880	" "	1	" " L.; " D.; coarse rounded quartz, P.
880- 890	" "	1	" " L.; " D.; coarse,rounded quartz, P.
890- 900	" "	2	" " L.; " D.; coarse,rounded quartz, P.
900- 910	Sandy shale, mottled red ...	2	Red shale, H.; green shale, L.; fine sandstone, M.
910- 920	" dark red	2	" H.; " P.; " M.; coarse, rounded quartz, L.; some fragments suggest a thin conglomerate bed
920- 930	" mottled red ...	2	Red shale, H.; fine sandstone, L.; coarse sand, L.
930- 940	Sandstone, dark red	2	" M.; green shale, L.; fine sandstone, L.; coarse sand grains
940- 950	Sandy shale, dark red	2	" H.; " P.; " M.; coarse sand, L.
950- 960	" "	2	" H.; " P.; " L.; coarse sand, L.
960- 970	" mottled red ...	2	" H.; " H.; " M.; coarse sand, P.
970- 980	" "	1	" H.; " H.; " M.; coarse sand, P.
980- 990	" "	1	" H.; " H.; " M.; coarse sand, P.
990-1,000	" "	1	" H.; " M.; " M.; coarse sand, P.
1,000-1,010	" "	1	" H.; " L.; " M.; coarse sand, L.
1,010-1,020	" "	1	" H.; " L.; " H.; coarse sand, L.
1,020-1,030	" "	1	" H.; " L.; " M.; coarse sand, P.
1,030-1,040	" "	1	" H.; " L.; " M.; coarse sand, L.
1,040-1,050	" "	1	" H.; " L.; " H.; coarse sand, P.
1,050-1,060	" "	1	" H.; " L.; " H.; coarse sand, P.
1,060-1,070	" "	1	" H.; " L.; " H.; coarse sand, P.
1,070-1,080	" "	1	" H.; " M.; " H.; coarse sand, P.; soft, granular calcite, P.;? calcite associated with barytes
1,080-1,090	" "	1	Red shale H.; green shale, M.; fine sandstone, H.; coarse sandstone, P.
1,090-1,100	" dark red	1	" D.; " P.; fine sandstone, M.; coarse sandstone, P.
1,100-1,110	" "	1	" D.; " P.; coarse sandstone, P.
1,110-1,120	" mottled red ...	1	" H.; " H.; fine sandstone, H.; coarse sandstone, P.

Canadian Natural Gas Company, Well No. 4 (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 110-115
1,120-1,130	Sandy shale, dark red ...	1	Red shale, D.; green shale, P.; fine sandstone, H.; coarse sandstone, P.
1,130-1,140	" mottled red	1	" H.; " H.; " H.; coarse sandstone, L.
1,140-1,150	" red	1	Green sandy shale, H.; coarse sandstone, P.
1,150-1,160	"	1	" " H.; rounded pink quartz, O.
1,160-1,170	"	1	" " H.; rounded pink and white quartz grain
1,170-1,190	" mottled green	1	Red, sandy shale, H.; green, sandy shale, H.; croinoids stem; rounded pink and white quartz grain
1,190-1,200	" green	1	Red, sandy shale, H.; green, sandy shale, H.; medium-grained sandstone, P.; rounded pink and white quartz grain
1,200-1,210	" red	2	Green, sandy shale, H.; rounded pink and white quartz grain
1,210-1,220	" "	1	" " H.; " " "
1,220-1,230	" "	1	" " H.; " " "
1,230-1,240	" "	1	" " H.; " " "
1,240-1,250	" "	1	" " H.; fine sandstone, L.
1,250-1,260	" "	1	" " H.; rounded pink and white quartz grain
1,260-1,270	" "	1	" " H.; " " "
1,270-1,280	" "	1	Cream " H.; pink and white quartz grains to 0.5 mm., biotite flakes
1,280-1,290	" "	1	" " P.; " " grains to 0.5 mm.
1,290-1,300	" "	1	" " H.; " " grains to 0.5 mm.
1,300-1,310	" "	1	" " H.; " " grains to 0.5 mm.
1,310-1,320	" "	1	" " P.; " " grains to 0.5 mm.
1,320-1,330	" "	1	" " P.; " " grains to 0.5 mm.
1,330-1,340	" "	1	" " P.; " " grains to 0.5 mm.
1,340-1,350	" "	1	" " P.; " " grains to 0.5 mm. fine-grained sandstone, H.
1,350-1,360	" "	1	" " P.; " " grains to 0.5 mm.
1,360-1,370	" "	1	" " H.; " " " " "
1,370-1,380	" "	1	" " L.; " " " " "
1,380-1,390	" "	1	" " H.; " " " " "
1,390-1,400	" "	1	" " P.; " " grains to 0.5 mm., fine sand, L.
1,400-1,410	" "	1	" " H.; " " grains to 0.5 mm., fine sand, L.
1,410-1,420	" "	1	" " H.; " " grains to 0.5 mm., fine sand, P.
1,420-1,430	" "	1	" " P.; " " grains to 0.5 mm., fine sand, P.
1,430-1,440	" "	1	" " H.; " " grains to 0.5 mm., fine sand, P.
1,440-1,450	" "	1	" " P.; " " grains to 0.5 mm., fine sand, P.
1,450-1,460	" "	1	" " P.; " " grains to 0.5 mm., fine sand, P.

Canadian Natural Gas Company, Well No. 4 (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 110-115
1,460-1,470	Sandy shale, red	1	Cream, sandy shale, P.; pink and white quartz grains to 0.5 mm., fine sand, P.
1,470-1,480	" green	1	Red, sandy shale, H.; pink and white quartz grains to 0.5 mm., fine sand, P.
1,480-1,490	" red	1	Green " P.; " " to 0.5 mm., fine sand, H.
1,490-1,500	" green	1	Red, " L.; " " to 0.5 mm., fine sand, L.
1,500-1,510	" "	2	" " P.; " " to 0.5 mm., fine sand, P.
1,510-1,520	" "	2	" " P.; " " to 0.5 mm., fine sand, L.
1,520-1,530	" "	2	" " P.; " " to 0.5 mm., fine sand, P.
1,530-1,540	" "	2	" " H.; " " to 0.5 mm., fine sand, L.
1,540-1,550	" "	1	" " L.; " " to 0.5 mm., fine sand, L.
1,550-1,560	" "	2	Green shale, H.; coarse sand, L.; fine sand, H.
1,560-1,570	" "	2	" H.; " L.; " H.
1,570-1,580	" "	2	" H.; " L.; " H.
1,580-1,590	" reddish grey	2	" H.; red shale, M.; coarse sand, P.
1,590-1,600	" mottled green	2	" H.; " L.; " P.
1,600-1,610	" dark green	2	
1,610-1,620	" mottled green	2	" H.; " M.; " P.; fine sand, L.
1,620-1,630	" dark green	2	Coarse sand, P.
1,630-1,640	" "	2	
1,640-1,650	" "	2	Green shale, H.; red shale, P.; coarse sand, P.; fine sand, H.
1,650-1,660	Sandy shale, greenish grey	2	Red shale, L.; quartz grains 0.5 mm., M.
1,660-1,670	" "	2	" P.; " 0.5 mm., M.
1,670-1,680	" "	2	" V.L.; " L.
1,680-1,690	" "	2	" V.L.; " 0.5 mm., L.
1,690-1,700	" "	2	" V.L.; " 0.2 mm., L.
1,700-1,710	" "	2	
1,710-1,720	" "	2	" P.; " 0.2 to 0.5 mm., L.
1,720-1,730	" "	2	" P.; " 0.2 to 0.5 mm. L.
1,730-1,740	" "	2	" P.; " 0.2 to 0.5 mm., L.
1,740-1,750	" "	2	" P.; sand grains 0.1 to 0.3 mm., H.
1,750-1,760	" "	2	" P.; quartz grains 0.2 to 0.5 mm., L.; fibrous gypsum, P.
1,760-1,770	" "	2	Quartz grains 0.2 to 0.5 mm.L.; fibrous gypsum, P.; black, lustrous, bituminous fragments
1,770-1,780	" "	2	Red shale, P.; quartz grains 0.2 to 0.5 mm., V.L.; fibrous gypsum, P.; fibrous gypsum as vein material, P.
1,780-1,790	" "	2	Red shale, P.; quartz grains 0.2 to 0.5 mm., L.; fibrous gypsum, P.
1,790-1,800	" "	2	" P.; " 0.2 to 0.5 mm., L.;
1,800-1,810	" "	2	" L.; " 0.2 to 0.5 mm., L.
1,810-1,820	" "	2	" P.; sand grains 0.2 to 0.5 mm., L.
1,820-1,830	" "	2	" L.; quartz grains 0.2 to 0.5 mm., V.L.
1,830-1,840	" "	2	" M.; " 0.2 to 0.5 mm., V.L.; gypsum, P.

Canadian Natural Gas Company, Well No. 4 (Cont.)

Depth (in feet)	—	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 110-115
1,840-1,850	Sandy shale, greenish grey	2	Red shale, P.; sand grains 0.1 to 0.5 mm., L.
1,850-1,860	" " ...	2	" P.; quartz grains 0.2 to 0.5 mm.; V.L.
1,860-1,870	" " ...	2	" P.; " 0.2 to 0.5 mm., L.; fibrous gypsum, P.
1,870-1,880	" " ...	2	Quartz grains 0.2 to 0.5 mm., L.
1,880-1,890	" " ...	2	" 0.2 to 0.5 mm., L.
1,890-1,900	" " ...	2	Red shale, P.; quartz grains 0.2 to 0.5 mm., M.
1,900-1,910	" " ...	2	" P.; " 0.2 to 0.5 mm., M.
1,910-1,920	" " ...	2	" P.; " 0.2 to 0.5 mm., M.
1,920-1,930	" " ...	2	" V.L.; " 0.2 to 0.5 mm., L.
1,930-1,940	" " ...	2	" P.; sand grains 0.2 to 0.5 mm., L.
1,940-1,950	" " ...	2	" P.; coarse sand, rounded, 0.2 to 0.5 mm., L.
1,950-1,960	" " ...	2	" P.; " " 0.2 to 0.5 mm., L.
1,960-1,970	" dark grey ...	2	" L.; " " 0.2 to 0.5 mm., L.
1,970-1,990	" " ...	2	" P.; " " 0.2 to 0.5 mm., P.
1,990-2,000	" " ...	2	" P.; " " 0.2 to 0.5 mm., P.
2,000-2,010	" " ...	2	" P.; " " 0.2 to 0.5 mm., L.
2,010-2,020	" " ...	2	" P.; " " 0.2 to 0.5 mm., L.
2,020-2,030	" " ...	2	" P.
2,030-2,040	" green-grey .	2	" P.
2,040-2,050	" " ...	2	" P.
2,050-2,060	" dark grey ..	2	" P.
2,060-2,070	" " ...	2	" P.; rounded 0.2 to 0.5 mm., sand, P.
2,070-2,080	" " ...	2	" P.; " 0.2 to 0.5 mm., sand, P.
2,080-2,090	" " ...	2	" P.; " 0.2 to 0.5 mm., sand, P.
2,090-2,100	" " ...	2	" P.; " 0.2 to 0.5 mm., sand, P.
2,100-2,110	" " ...	2	
2,110-2,120	Shale, dark grey	2	" P.; medium sandstone, P.
2,120-2,130	" "	3	" P.
2,130-2,140	" "	3	
2,140-2,150	" "	3	
2,150-2,160	" "	3	" P.; " P.
2,160-2,170	" "	3	" P.; " P.
2,170-2,180	" "	3	" P.; " P.
2,180-2,190	" green gre, ...	3	" P.; fine sandstone, P.
2,190-2,200	Sandy shale, dark grey ...	3	" P.; medium sandstone, L.
2,200-2,210	" " ...	3	" P.; " L.
2,210-2,220	" " ...	3	" P.; " L.
2,220-2,230	" " ...	3	" P.
2,230-2,240	" " ...	3	" P.; " L.
2,240-2,250	" green grey ..	3	" P.
2,250-2,260	" dark grey ...	3	" P.; " P.
2,260-2,270	" " ...	3	" P.; " P.
2,270-2,280	" green-grey ..	3	" P.; " P.
2,280-2,290	" dark grey ..	3	" P.; " L.
2,290-2,300	" " ...	3	" P.; " P.
2,300-2,310	" green-grey ..	3	" P.; " P.
2,310-2,320	" " ...	3	" P.; " P.
2,320-2,330	" dark grey ...	3	" P.; " P.
2,330-2,340	" green grey ..	3	" P.; coarse sandstone, P.
2,340-2,350	" dark grey ...	3	" P.; medium sandstone, P.
2,350-2,360	" "	3	" P.; " P.
2,360-2,370	" "	3	" P.; " P.
2,370-2,380	" "	3	" P.; " P.

Extracted from Parks (1930), page 97

3.- Lot 982, concession Ste-Rose, Parish of St-Jude.

A fourth well was drilled by the Canadian Natural Gas Co. near the west side of the southern half of this lot, the property of Joseph Chartier. This well reached a depth of 2,450 feet. Some pockets of gas were struck but no commercial yield is recorded and there is no flow at present.

Referred to by Parks 1931, p. 64, as Canadian Natural Gas Co. Well No. 4

Extracted from Belyea (1952), pages 45-46

CANADIAN NATURAL GAS No. 4 WELL

Location: lot 982, concession Ste-Rose, Parish of St-Jude, St-Hyacinthe county, Quebec
Total depth: 2,380 feet Drilled: 1917
Rig: cable
Samples examined by H.R. Belyea, 1946

Depth	Lithology
Feet	Richmond
	Bécancour River Formation
160- 210	Sandstone and shale: green to red, medium- to fine-grained sandstone, chiefly quartz; green and red, micaceous shale
210- 250	Shale, red, sandy; a little green shale
250- 260	Sandstone, greenish grey
260- 320	Shale, greenish grey, minor red, very sandy; thin sandstone layers
320- 330	Sandstone and shale: greenish grey sandstone; red shale
330- 400	Shale and sandstone: red, sandy shale; interbedded greenish grey and red sandstone
400- 410	Sandstone, red
410- 420	Shale, red, sandy; some sandstone, as above
420- 450	Sandstone and shale: greenish grey sandstone; green and red shale
450- 550	Shale and sandstone: chiefly sandy shale and greenish grey and red sandstone; a little green shale
550- 590	Sandstone, greenish grey; a little red and green shale
590- 600	Shale, green, sandy; thin sandstone
600- 610	Sandstone and shale: red sandstone; red and green shale
610- 620	Shale, red, sandy; a little green shale
620- 630	Sandstone and shale: red sandstone; red and green shale
630- 640	Shale and sandstone: red, sandy shale and green shale; some green sandstone
640- 650	Shale, green, sandy; a little red shale
650- 700	Sandstone, chiefly red and green; a little red and green shale layers
700- 730	Missing
730- 740	Sandstone, red
740- 750	Sandstone and shale: green sandstone; green and red shale
750- 760	Shale, red, sandy
760- 780	Sandstone and shale: green sandstone; red shale
780- 790	Missing
790- 810	Sandstone, green; a little red and green shale
810- 840	Shale, red, very sandy, grading to sandstone
840- 860	Shale, red; sandstone layers, as above; a little green shale
860- 870	Missing

Depth	Lithology
Feet	Richmond
	Bécancour River Formation (Cont.)
870- 930	Shale,red, sandy, grading to sandstone
930- 940	Shale and sandstone, as above; a little green shale
940- 960	Shale, red, sandy
960-1,030	Shale, red, sandy; a little sandstone and green shale
1,030-1,050	Shale, red, sandy; a little sandstone
1,050-1,080	Shale, red, sandy; green shale
1,080-1,090	Shale, green, sandy; a little red shale
1,090-1,110	Shale, red, sandy
1,110-1,120	Shale, green, sandy; a little red shale
1,120-1,170	Shale, red, sandy; a little green, sandy shale
1,170-1,180	Shale, green, sandy; minor red shale
1,180-1,190	Shale, red, sandy
1,190-1,200	Shale, red and green, sandy; sandstone bands
1,200-1,240	Shale, red, sandy; with sandstone beds
1,240-1,250	Shale, red and green, sandy
1,250-1,270	Shale, red, sandy
1,270-1,320	Shale, red and green, sandy
1,320-1,340	Missing
1,340-1,390	Shale, red, sandy, grading to sandstone; a little green shale
1,390-1,400	Shale, red, sandy
1,400-1,440	Shale, red; minor, green, sandy shale
1,440-1,470	Shale, red, sandy
1,470-1,490	Shale, red; minor green, sandy shale
1,490-1,510	Shale, greenish grey, sandy, with large, frosted, rounded quartz grains embedded
1,510-1,520	Shale, greenish grey, sandy, as above; a little red shale
1,520-1,530	Shale, greenish grey, sandy
1,530-1,540	Shale, greenish grey, sandy; a little red shale
1,540-1,580	Shale, greenish grey, sandy
1,580-1,620	Shale, greenish grey, sandy; a little red shale
1,620-1,700	Shale, greenish grey, sandy
1,700-1,710	Missing
1,710-1,960	Shale, greenish grey, sandy, same as above
1,960-2,070	Shale, dark grey, slightly green, sandy; carbonaceous material 1,990 to 2,000 feet
2,070-2,080	Shale, light greenish grey, sandy
2,080-2,240	Shale, dark greenish grey, sandy
	Pontgravé River Formation
2,240-2,250	Shale and siltstone: medium grey, greenish, fissile shale; grey calcareous siltstone; little limestone, grey, very silty, finely crystalline
2,250-2,260	Shale, dark greenish grey, sandy; resembles Bécancour River type shales. Possible fault at 2,250 feet
2,260-2,280	Shale, medium grey, greenish, fissile, micaceous; siltstone, grey, calcareous; little limestone, grey, very silty, finely crystalline; fossil fragments 2,260 to 2,270 feet
2,280-	Fault
	Bécancour River Formation
2,280-2,360	Shale, greenish grey, very sandy; with large quartz grains

Note. The Bécancour River formation is extraordinarily thick, 2,240 feet, as compared with 1,280 feet in the St. Gérard No. 1 well and 1,270 feet in the Canadian Natural Gas No. 2 well, which, other than this well, has the thickest section of the Bécancour River formation in this area. Moreover, the lower 750 feet consists largely of the sandy green shale facies, which is normally not more than 70 feet thick (cf. National Gas No. 2 well).

Samples from 2,240 to 2,250 and 2,260 to 2,280 feet are typical Pontgravé River shales in type and from 2,250 to 2,260 feet and 2,280 to 2,360 feet are typical Bécancour River green sandy shales.

This thick section of the Bécancour River formation may be caused by repetition of beds by slicing, drag-folding, and crumpling of the soft shales. The apparent repetition of the Pontgravé River and Bécancour River formations is probably also to be explained by slicing associated with low-angle thrust faulting in this area. Similar thickening of the green shale facies and repetition of strata occur in the Canadian Natural Gas No. 3 well.

Although slicing and crumpling of the shales may be responsible for an extraordinarily thick section of Richmond strata, it is also possible that the samples from this well were not collected methodically. Too great reliance should not be placed on them for the interpretation of structure.

Extracted from DeBlois (1959), page 23

Company: Canadian Natural Gas Co.; Well Name: Canadian Natural Gas No. 5; Location:- Lot: 160; Range: St-Amable Nord; Parish: St-Barnabé; County: St. Hyacinthe,
Ground Elevation: 116'; RF Elevation: 118'; Spudded: 1914; Completed:1915; Driller: Edmond Côté, Montreal; Type of Rig: Cable; Result: Dry hole.
Water:-
Brackish at: 125', 440'; Gas at: 1600'; Log by Belyea:-

Formation	Depth interval (in feet)
Overburden	0 - 110
Richmond(Bécancour River)	110 - 900
Igneous intrusive	900 - 920
Richmond (Bécancour River)	920 - 1110
Richmond (Pontgravé River)	1110 - 1360
Lorraine	1360 - 2508

CANADIAN NATURAL GAS COMPANY, WELL No. 5

Depth (in feet)		Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 116-122
110- 120	Shaly sandstone, reddish brown	1	Fine grained; shale, H.; subangular and rounded quartz grains 0.2 to 0.5 mm., L.
120- 130	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
130- 140	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
140- 150	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
150- 160	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
160- 170	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
170- 180	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
180- 190	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
190- 200	Sandstone, reddish brown	1	" " H.; " " " 0.2 to 0.5 mm., L.
200- 210	Shaly sandstone, reddish brown	1	" " H.; " " " 0.2 to 0.5 mm., L.
210- 220	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
220- 230	" "	1	" " H.; " " " 0.2 to 0.5 mm., L.
230- 240	" "	1	Coarse grained shale, L.; " " " 0.2 to 0.5 mm., H.
240- 250	" "	1	" " M.; " " " 0.2 to 0.5 mm., H.
250- 260	Sandstone, reddish brown	1	Fine grained shale, L.; " " " 0.2 to 0.5 mm., H.
260- 270	Shaly sandstone, reddish brown	1	Coarse grained shale, H.; " " " 0.2 to 0.5 mm., L.
270- 280	" "	1	" " H.; " " " 0.2 to 0.5 mm., H.
280- 290	" "	1	" " H.; " " " 0.2 to 0.5 mm., H.
290- 300	Sandstone reddish brown	1	Fine grained; shale, L.; " " " 0.2 to 0.5 mm., H.
300- 310	" "	1	" " M.; " " " 0.2 to 0.5 mm., L.
310- 320	Missing		
320- 330	Sandstone, reddish brown	1	" " L.; " " " 0.2 to 0.5 mm., L.
330- 340	" "	1	" " M.; " " " 0.2 to 0.5 mm., L.
340- 350	" "	1	" " L.; " " " 0.2 to 0.5 mm., L.
350- 360	" "	1	Coarse grained, shale L.; " " " 0.2 to 0.5 mm., L.
360- 370	" "	2	Fine grained, shale, M.; " " " 0.2 to 0.5 mm., L.
370- 380	" "	1	" " M.; " " " 0.2 to 0.5 mm., L.
380- 390	" "	1	" " M.; " " " 0.2 to 0.5 mm., L.
390- 400	" "	1	Medium to coarse grained shale, L.; subangular and rounded quartz grains 0.3 to 0.8 mm.H.
400- 410	" "	1	Fine grained, shale, L.; subangular and rounded quartz grains 0.3 to 0.8 mm., L.
410- 420	" "	1	" " L.; " " " 0.2 to 0.5 mm., L.
420- 430	" "	1	" " L.; " " " 0.2 to 0.5 mm., L.

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 116-122
430- 440	Sandstone, reddish brown	1	Fine grained, shale, M.; subangular and rounded quartz grains 0.2 to 0.9 mm., L.
440- 450	" "	1	" " L.; " " " 0.2 to 0.5 mm., L.
450- 460	" "	1	" " L.; " " " 0.2 to 0.5 mm., L.
460- 470	Shaly sandstone, reddish brown	1	Subangular and rounded quartz grains 0.2 to 0.5 mm., L.
470- 480	Sandy shale, reddish brown	1	" " " 0.1 to 0.3 mm., V.L.
480- 490	" "	1	" " " 0.1 to 0.3 mm., V.L.
490- 500	Shaly sandstone, reddish brown	1	" " " 0.1 to 0.4 mm., H.
500- 510	Sandy shale, reddish brown	1	" " " 0.1 to 0.5 mm., M.
510- 520	" "	2	" " " 0.1 to 0.3 mm., L.
520- 530	" "	1	" " " 0.2 to 1.0 mm., H.; greenish grey, sandy shale, M.
530- 540	" red-brown, green-grey ..	2	" " " 0.1 to 0.5 mm., V.H.; gypsum, P.
540- 550	" " " " ..	2	" " " 0.1 to 1.0 mm., V.H.
550- 560	" " " ..	2	" " " 0.1 to 0.5 mm., V.H.; " P.
560- 570	" " " ..	2	" " " 0.1 to 1.0 mm., V.H.; " P.
570- 580	" " " ..	2	" " " 0.1 to 0.5 mm., V.H.; " P.
580- 590	" " " ..	2	" " " 0.1 to 1.0 mm., V.H.; " P.
590- 600	" " " ..	2	" " " 0.1 to 0.5 mm., H.; " P.
600- 610	" " " ..	2	" " " 0.1 to 0.5 mm., V.H.; " P.
610- 620	" " " ..	2	" " " 0.1 to 0.5 mm., H.; " P.
620- 630	" " " ..	2	" " " 0.1 to 0.5 mm., H.; " P.
630- 640	" " " ..	3	" " " 0.2 to 1.0 mm., M.
640- 650	" " " ..	2	" " " 0.2 to 1.0 mm., M.; " P.
650- 660	" " " ..	2	" " " 0.2 to 0.7 mm., L.; " P.
660- 670	" " " ..	2	" " " 0.2 to 0.7 mm., L.; " P.
670- 680	" " " ..	2	" " " 0.2 to 0.5 mm., H.; " P.
680- 690	" " " ..	2	" " " 0.2 to 0.5 mm., H.; " P.
690- 700	" " " ..	2	" " " 0.2 to 0.5 mm., H.; " P.
700- 710	Shaly sandstone, red brown, green grey	1	" " " 0.2 to 1.0 mm., H.; fine to coarse grain
710- 720	" " "	2	" " " 0.2 to 1.0 mm., H.; " "
720- 730	" " "	2	" " " 0.2 to 1.0 mm., H.; " "
730- 740	" " "	2	" " " 0.2 to 0.5 mm., H.; " "
740- 750	" " "	2	" " " 0.2 to 0.8 mm., H.; " "
750- 760	" " "	2	" " " 0.2 to 0.5 mm., H.; " "
760- 770	Sandy shale, red-brown, green-grey	3	" " " 0.2 to 0.5 mm., H.; gypsum, P.

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 116-122
770- 780	Shaly sandstone, red-brown, green-grey	3	Subangular and rounded quartz grains 0.2 to 1.0 mm., H.; fine to medium grain
780- 790	" " "	2	Fine to coarse grained: subangular and rounded quartz grains 0.2 to 0.5 mm., H.
790- 800	" " "	3	" " " " 0.2 to 0.5 mm., H.
800- 810	" " "	3	" " " " 0.2 to 0.5 mm., H.
810- 820	" " "	2	" " " " 0.2 to 0.5 mm., H.
820- 830	" " "	2	" " " " 0.2 to 1.0 mm., H.
830- 840	" " "	2	" " " " 0.2 to 0.5 mm., H.
840- 850	" " "	2	" " " " 0.2 to 0.5 mm., H.
850- 860	" " "	2	" " " " 0.2 to 0.5 mm., H.
860- 870	" " "	2	" " " " 0.2 to 0.5 mm., H.
870- 880	" " "	2	" " " " 0.2 to 0.5 mm., H.
880- 890	" " "	3	" " " " 0.2 to 0.5 mm., H.
890- 900	" " "	3	" " " " 0.2 to 0.5 mm., H.
900- 910	Igneous, dark grey	1	Dyke rock; red, shaly sandstone, L.
910- 920	" "	1	" " " L.
920- 930	" "	1	" " " L.
930- 940	Shaly Sandstone, dark red-brown and green-grey	2	Fine to coarse grained subangular and rounded quartz grains 0.2 to 0.5 mm., H.
940- 950	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
950- 960	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
960- 970	" " " "	2	" " " " " 0.2 to 0.5 mm., L.
970- 980	" " " "	2	" medium grained " " " 0.2 to 0.5 mm., H.
980- 990	" " " "	2	" coarse grained " " " 0.2 to 0.5 mm., H.
990-1,000	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
1,000-1,010	" " " "	3	" " " " " 0.2 to 0.5 mm., H.
1,010-1,020	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
1,020-1,030	" " " "	3	" " " " " 0.2 to 0.5 mm., H.
1,030-1,040	" " " "	3	" " " " " 0.2 to 0.5 mm., H.
1,040-1,050	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
1,050-1,060	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
1,060-1,070	" " " "	2	" " " " " 0.2 to 0.5 mm., H.
1,070-1,080	" " " "	3	" " " " " 0.2 to 0.5 mm., H.
1,080-1,090	Sandstone, brown-red	2	Fine grained; subangular and rounded quartz grains 0.2 to 0.5 mm., P.

Note: The above samples are represented by a very small quantity, most of the material being washed through 200-mesh sieve.

Depth (in feet)	–	Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 116-122
1,090-1,100	Sandstone, brown-red	1	Fine grained; subangular and rounded quartz grains 0.2 to 0.5 mm., P.
1,100-1,110	Shale green-grey	1	
1,110-1,120	" "	2	Red sandstone, P.
1,120-1,130	Shale dark grey	2	Grey limestone, P.
1,130-1,140	" "	2	Red shale, P.
1,140-1,150	" green-grey	2	Red sandstone, P.
1,150-1,160	" dark grey	2	" P.; green shale, L.
1,160-1,170	" "	3	" P.; " P.
1,170-1,180	" "	2	" P.; " L.
1,180-1,190	" "	2	" P.; " L.
1,190-1,200	" green-grey	3	Grey limestone, P.; red sandstone, P.
1,200-1,210	" "	3	Red sandstone, P.; shell fragment, P.
1,210-1,220	" dark grey	3	Grey limestone P.; red sandstone, P.; green-grey shale, M.
1,220-1,230	" green-grey	3	" P.; " P.; dark grey shale, P.
1,230-1,240	" "	3	" P.; " P.; " " P.
1,240-1,250	" dark grey	3	" P.; green-grey shale, P.
1,250-1,260	" "	3	" P.; red sandstone, P.; green-grey shale, P.
1,260-1,270	" green-grey	3	" P.; dark grey shale, P. " " P.
1,270-1,280	" dark grey	3	" P.; green-grey shale, P.
1,280-1,290	" green-grey	3	" P.; dark grey shale, P.
1,290-1,300	Missing		
1,300-1,310	Shale, green-grey	2	" P.; dark grey shale, P.
1,310-1,320	" "	3	" P.; " " P.; " " P.
1,320-1,330	" "	3	" P.; " " P.
1,330-1,340	" "	3	" P.; " " P.
1,340-1,350	" "	3	" P.; " " P.
1,350-1,360	" "	3	" P.; " " P.
1,360-1,370	" "	3	" P.; " " P.
1,370-1,380	" "	3	" P.; " " P.
1,380-1,390	" "	3	" P.; " " P.
1,390-1,400	" dark grey	3	Grey fossiliferous limestone, P.
1,400-1,410	" "	3	Grey limestone, P.
1,410-1,420	" "	3	" P.
1,420-1,430	" "	3	" P.

Canadian Natural Gas Company, Well No. 5 (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid; Cold	Extracted from Maddox, 1931, pp.116-122
1,430-1,440	Shale, dark grey	3	Grey limestone, P.
1,440-1,450	" "	3	" " P.; quartz grains 0.1 to 0.2 mm., V.L.
1,450-1,460	" "	2	" " P.
1,460-1,470	" "	3	" " P.
1,470-1,480	" "	3	" " V.L.
1,480-1,490	" "	3	" " P.; shell fragment, P.
1,490-1,500	" "	3	" " P.
1,500-1,510	" "	3	" " P.
1,510-1,520	" "	2	" " P.; vein calcite, P.
1,520-1,530	" "	2	" " P.
1,530-1,540	" "	3	" " P.
1,540-1,550	" "	3	" " P.
1,550-1,560	" "	2	" " P.; grey, fine-grained sandstone, P.
1,560-1,570	" "	2	Grey, fossiliferous limestone, L.
1,570-1,580	" "	2	" " " L.
1,580-1,590	" "	2	Brown, fossiliferous limestone, V.L.
1,590-1,600	" "	2	" " " V.L.
1,600-1,610	" "	2	Grey limestone, V.L.; shell impression, P.
1,610-1,620	" "	3	" " P.
1,620-1,630	" "	3	" " P.; fragment of crinoid stem
1,630-1,640	" "	3	" " P.; some fossiliferous
1,640-1,650	" "	3	" " V.L.; fossils, P.
1,650-1,660	" "	3	" " L.
1,660-1,670	" "	3	" " L.; some fossiliferous
1,670-1,680	" "	3	" " L.; "
1,680-1,690	" "	3	" " P.; fine to medium sand, P.
1,690-1,700	" "	3	Grey limestone, L.; fine sand, P.
1,700-1,710	" "	3	" " P.
1,710-1,720	" "	3	" " P.
1,720-1,730	" "	2	" " P.
1,730-1,740	" "	3	" " P.
1,740-1,750	Missing		
1,750-1,760	"		
1,760-1,770	Shale, dark grey	2	" " P.
1,770-1,780	" "	2	" " P.
1,780-1,790	" "	2	" " P.
1,790-1,800	" "	2	" " P.
1,800-1,810	" "	3	" " L.; shell impression
1,810-1,820	" "	3	" " P.
1,820-1,830	" "	3	" " P.
1,830-1,840	" "	3	" " P.
1,840-1,850	" "	2	" " L.
1,850-1,860	" "	3	" " P.
1,860-1,870	" "	3	" " L.
1,870-1,880	" "	2	" " P.
1,880-1,890	Sandy shale, dark grey	2	Shale, H.; fine sand, H.
1,890-1,900	" "	2	" H.; " L.
1,900A	Massive shale, dark grey	0	Very slightly calcareous; bit sample
1,900B	Slickensides?, green-grey	4	Mainly sheared calcite
1,900-1,910	Sandy shale, dark grey	2	Shale, H.; fine sand, M.

Canadian Natural Gas Company, Well No. 5 (Cont.)

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 116-122
1,910-1,920	Sandy shale, dark grey ..	1	Shale, H.; fine sand, M.
1,920-1,930	" "	1	" H.; " M.
1,930-1,940	" "	1	" H.; " M.
1,940-1,950	" "	1	" H.; " M.
1,950-1,960	" "	1	" H.; " M.
1,960-1,970	" "	1	" H.; " M.
1,970-1,980	" "	2	" H.; " M.
1,980-1,990	" "	1	" H.; " L.
1,990-2,000	" "	2	" H.; " L.
2,000-2,010	" "	2	" H.; " M.
2,010-2,020	Shale, dark grey	1	Fine sand, P.
2,020-2,030	"	2	" L.
2,030-2,040	Sandy shale, dark grey	2	Shale, H.; fine sand, M.
2,040-2,050	" "	2	" H.; " M.
2,050-2,060	Shale, dark grey	3	Fossiliferous limestone, P.
2,060-2,070	"	3	Fine sand, L.
2,070-2,080	" "	2	" L.
2,080-2,090	" "	2	" L.; one slickenside fragment
2,090-2,100	" "	1	Brown calcite, P.
2,100-2,110	" "	2	Grey limestone, P.
2,110-2,120	Sandy shale, dark grey	2	Shale, H.; fine sand, M.; brown calcite, P.
2,120-2,130	" "	2	Fine sand, L.
2,130-2,140	" "	3	Shale, H.; fine sand, M.
2,140-2,150	Shale, dark grey	3	Grey limestone, P.
2,150-2,160	" "	3	Fine sand, L.
2,160-2,170	" "	2	" P.
2,170-2,180	Sandy shale, dark grey ..	2	Shale, H.; fine sand, M.
2,180-2,190	Shale, dark grey	3	Fine sand, L.
2,190-2,200	" "	3	Grey limestone, P.
2,200-2,210	" "	3	Fine sand, L.
2,210-2,220	" "	3	" L.
2,220-2,230	" "	3	" L.
2,230-2,240	" "	3	" L.
2,240-2,250	" "	3	" L.
2,250-2,260	" "	3	" L.
2,260-2,270	" "	3	" L.
2,270-2,280	" "	3	" L.; brown calcite, P.
2,280-2,290	" "	3	Grey fossiliferous limestone, P.
2,290-2,300	" "	2	Fine sand, L.; brown calcite, P.
2,300-2,310	" "	3	" L.; " P.
2,310-2,320	" "	3	" P.
2,320-2,330	" "	3	" P.; " P.
2,330-2,340	" "	3	Grey, fossiliferous limestone, P.
2,340-2,350	" "	2	Grey limestone, M.
2,350-2,360	" "	3	" L.
2,360-2,370	" "	3	" L.
2,370-2,380	" "	3	" L.
2,380-2,390	" "	3	" L.
2,390-2,400	" "	3	Brown calcite, P.

Note. The above samples are represented by a very small quantity, most of the material being washed through 200-mesh sieve.

Canadian Natural Gas Company, Well No. 5 (Cont.)

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 116-122
2,400-2,410	Shale, dark grey	3	Grey limestone, L.
2,410-2,420	" "	3	" M.
2,420-2,430	Calcareous shale, dark grey		
2,430-2,440	Shale, dark grey	3	" M.
2,440-2,450	" "	3	" M.
2,450-2,460	" "	3	" L.
2,460-2,470	" "	3	" L.
2,470-2,480	" "	2	
2,480-2,490	" "	4	Brown calcite, L.
2,490-2,500	" "	3	Grey limestone, L.

INSOLUBLE RESIDUE AFTER TREATMENT WITH HOT HCl

Samples iron	Amount of residue	Samples from	Amount of residue	Samples from	Amount of residue	Samples from	Amount of residue	Samples from	Amount of residue
Feet	Per cent	Feet	Per cent	Feet	Per cent	Feet	Per cent	Feet	Per cent
630- 640	80	1,340-1,350	90	1,790-1,800	90	2,050-2,060	95	2,280-2,290	85
770- 780	90	1,390-1,400	85	1,840-1,850	95	2,090-2,100	95	2,390-2,400	95
860- 890	85	1,490-1,500	80	1,940-1,950	95	2,140-2,150	95	2,400-2,410	85
1,030-1,040	90	1,560-1,570	95	2,000-2,010	85	2,190-2,200	90	2,420-2,430	90
1,190-1,200	75	1,690-1,700	85	2,040-2,050	90	2,240-2,250	95		

The residues are mainly sandy shale. Below 1,700 feet the residues are probably more sandy than shaly. Nearly all samples contain angular and rounded sand grains, but the bulk of the material is a fine sand from which the carbonate content has been removed by the acid.

Extracted from Belyea (1952), pages 47-48

CANADIAN NATURAL GAS No. 5 WELL

Location: lot 160, St-Amable North, Parish of St-Barnabé, St-Hyacinthe county, Quebec
Total depth: 2,508 feet Drilled: 1917
Rig: cable
Samples examined by H.R. Belyea, 1946

Depth	Lithology
Feet	
	Richmond Bécancour River Formation
110-520	Shale, reddish brown, sandy, varying to reddish brown, shaly sandstone
520-900	Shale, reddish brown and greenish grey in about equal amounts, sandy; with quartz grains up to 0.5 mm. in diameter

Depth	Lithology
Feet	Richmond
	Bécancour River Formation (Cont.)
900- 920	Igneous intrusive rock
920-1,110	Shale, reddish brown, sandy, and greenish grey, sandy
	Pontgravé River Formation
1,110-1,320	Shale, grey, slightly green, fissile; siltstone, light grey, calcareous, grading to light grey, silty limestone; brachiopod (possibly Catazyga) 1,110 to 1,120 feet; other brachiopods from 1,130 to 1,170 and 1,200 to 1,210 feet
1,320-1,330	Shale, siltstone, and silty limestone, as above; light green waxy shale (metabentonite?); calcite replacing organic fragments in shale
1,330-1,360	Shale, siltstone, and silty limestone, as above
	Lorraine
1,360-1,510	Shale, grey to greenish grey, flaky, breaks into rounded fragments; and medium grey, fissile, micaceous, finely silty shale; siltstone, light grey, calcareous; brachiopod fragments; crinoid disks 1,480 to 1,490 feet
1,510-1,530	Shale and siltstone, as above; in part with calcite replacing fossil fragments; crinoid disks; light green waxy shale (metabentonite?) 1,510 to 1,520 feet
1,530-1,600	Shale and siltstone, as above; brachiopod fragments
1,600-1,850	Shale and siltstone, as above; with numerous, highly fossiliferous lenses making shaly, silty, coquina-like limestones; bryozoa and brachiopods common
1,850-1,900	Shale, darker grey than above, fissile, in part brittle and silty; siltstone, light grey, calcareous
1,900-1,910	Shale and siltstone, as above; slickensides; vein calcite; core sample shows light green, slickensided material
1,910-2,050	Shale and siltstone, as above; vein calcite 1,950 to 1,960 feet; sandy shell limestone 1,960 to 1,990 feet
2,050-2,120	Shale and siltstone, as above; brachiopod fragments, crinoid disks in some samples
2,120-2,130	Shale and siltstone, as above; calcite replacing fossil fragments; almost a sandy limestone
2,130-2,190	Shale and siltstone, as above; bryozoa 2,150 to 2,160 feet
2,190-2,280	Shale and siltstone, as above; calcite replacement of fossils 2,190 to 2,200 feet
2,280-2,290	Shale and siltstone, as above; pale green, slickensided, waxy shale
2,290-2,380	Shale and siltstone, as above; calcite veins 2,290 to 2,310 feet
2,380-2,460	Shale and siltstone, as above; crinoids 2,410 to 2,420 feet
2,460-2,470	Shale and siltstone, as above; pale green, slickensided, waxy shale
2,470-2,508	Shale and siltstone, as above; calcite veins 2,470 to 2,480 feet

Extracted from DeBlois (1959), page 76

Company: National Gas Co.
Well Name: National Gas No. 1
Location

Lot: 1319
Range: St. André
Parish: St. Thomas d'Aquin
County: St. Hyacinthe
Coords.: Northern end of lot

Ground Elevation: 114'
RF Elevation: 116'

Spudded: Nov. 11, 1914

Completed: Jan. 20, 1915

Driller: Mr. Tripplehorn (Capital Trust Co.)

Type of Rig: Cable

Result: Dry Hole

Water

120', 170', 250'

Gas at: 1510'-1520', 1940'-1950'

Log by Belyea:

Formation	Depth interval (in feet)
Overburden	0 - 110
Richmond (Bécancour River)	110 -1000
Igneous rock	1000 -1040
Richmond (Bécancour River)	1040 -1060
Richmond (Pontgravé River)	1060 -1300
Lorraine	1300 -2050

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 123-127
110-120	Sandstone, green-grey	2	Red shale, P.; coarse grained
120-130	Shaly sandstone, green-grey	2	" P.; "
130-140	" "	2	" P.; fine to coarse grained
140-150	" "	2	" P.; " "
150-160	" "	2	" P.; " "
160-170	" "	2	" P.; " "
170-180	" "	2	" P.; " "
180-190	" "	2	" P.; " "
190-200	" "	3	" P.; " "
200-210	" red-brown, green-grey	3	Fine to coarse grained
210-220	" " "	2	" "
220-230	" " "	3	" " green-grey, shaly sandstone, H.
230-240	" " "	2	" " " " H.
240-250	" " "	2	" " " " H.
250-260	" " "	2	" " " " P.
260-270	" " "	2	" " " " P.
270-280	" " "	3	" " " " P.
280-290	" " "	2	" " " " P.
290-300	" " "	2	" "
300-310	" " "	2	" "
310-320	" " "	2	" "
320-330	" red-brown	2	" " " " P.
330-340	" "	2	" " " " P.
340-350	" "	1	" " " " H.
350-360	" "	1	" " " " M.
360-370	" "	2	" " " " M.
370-380	" "	2	" " " " P.
380-390	" "	2	" " " " P.
390-400	" "	2	" " " " P.; medium round sandstone, P.
400-410	" "	2	" " medium round sandstone, P.
410-420	" "	2	" " " " L.
420-430	" "	2	" " " " P.

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 123-127
430-440	Shaly sandstone, red-brown	2	Fine to coarse grained medium round sandstone, L.
440-450	Sandy shale, green grey	1	Red brown, shaly sandstone, H.
450-460	" "	1	" " H.
460-470	" "	1	Brown red sandstone, P.
470-480	Sandy shale, green-grey	0	Red-brown sandstone, H.; medium rounded sandstone, L.
480-490	" "	0	" " M.; " " " L.
490-500	Shaly sandstone, red-brown	1	Fine grained; medium rounded sandstone, L.; green-grey, sandy shale, H.
500-510	Sandy shale, red-brown	1	Medium rounded sandstone, P.; gypsum, P.
510-520	" "	2	Fine-grained, medium rounded sandstone, P.; gypsum, P.
520-530	Shaly sandstone, red-brown	1	Fine to coarse grained, medium rounded sandstone, P.; gypsum, P.
530-540	" "	1	" " " " P.; " P.
540-550	" "	1	" " " " P.; " L.
550-560	" "	2	" " " " M.; " P.
560-570	" "	1	" " " " H.; " P.
570-580	" "	1	Fine to coarse grained rounded sandstone, M.; gypsum, P
580-590	" "	1	" " " H.; " " P.
590-600	" "	1	" " " H.; " green-grey sandstone, H.; gypsum, P.
600-610	" "	2	" " " H.; " " sandstone, H.; gypsum, P.
610-620	" "	1	" " " L.; " " sandstone, M.; gypsum, P.
620-630	" "	1	" " " L.; " " sandstone, L.
630-640	" "	1	" " " L.; " " " L.
640-650	" "	1	" " " L.; " " " L.
650-660	" "	1	" " " L.; " " " L.
660-680	" "	2	" " " L.; " " " L.
680-690	" "	2	" " " L.; " " " L.
690-700	" "	2	" " " L.; " " " L.
700-710	" "	2	" " " L.; " " " L.
710-720	" "	1	" " " L.; " " " L.
720-730	" "	1	" " " L.; " " " L.
730-740	" "	1	" " " P.; " " " L.
740-750	" "	1	" " " L.; " " " L.

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 123-127
750- 760	Shaly sandstone, red-brown	1	Fine to coarse grained, rounded sandstone, L.; green-grey sandstone, L.
760- 770	" "	1	" " " " L.; " " L.
770- 780	" "	1	" " " " L.; " " L.; gypsum, P.
780- 790	" "	1	" " " " L.; " " L.
790- 800	" "	1	" " " " L.; " " L.
800- 810	" "	1	" " " " L.; " " L.
810- 820	" "	1	" " " " L.; " " L.
820- 830	" red-brown, green-grey	1	" " " " L.; " " L.
830- 840	" brown, green-grey .	2	" " " " L.; gypsum, P.
840- 850	" " "	2	" " " " L.; " P.
850- 860	" " "	1	" " " " L.; " P.
860- 870	" " "	1	" " " " L.
870- 880	" " "	1	" " " " L.; " P.
880- 890	" " "	1	" " " " L.; " P.
890- 900	" " "	1	" " " " L.
900- 910	" " "	1	" " " " L.
910- 920	" " "	1	" " " " L.
920- 930	" " "	1	" " " " L.
930- 940	" " "	1	" " " " L.
940- 950	" " "	1	" " " " L.
950- 960	" " "	2	" " " " L.
960- 970	Sandy shale, green grey	2	Rounded sandstone, L.; red-brown, sandy shale, H.
970- 980	" "	2	" " L.; " " M.
980- 990	" "	2	" " L.; " " M.
990-1,000	" "	2	" " L.; " " H.
1,000-1,010	Intrusive, dark-grey	2	Red and green shale, P.
1,010-1,020	" grey	0	
1,020-1,030	" light-grey	0	
1,030-1,040	" "	1	
1,040-1,050	Shale, green-grey	2	Red shale, P.; coarse sandstone, P.
1,050-1,060	" "	2	Medium grit, P.
1,060-1,070	" "	3	Fine-grained, gritty sandstone, P.
1,070-1,080	Shale, green-grey	2	Medium-grained, gritty sandstone, P.

Depth (in feet)	-	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 123-127
1,080-1,090	Shale, green-grey	4	Fine grained, gritty sandstone, P.; fibrous calcite, P.; slickensides, P.
1,090-1,100	" "	3	Fine-grained, gritty sandstone, L.; vein calcite, P.
1,100-1,110	" "	3	Fine, calcareous sandstone, M.; micaceous shale, P.
1,110-1,120	Calcite, green-grey	3	
1,120-1,130	" medium grey	4	
1,130-1,140	" "	4	
1,140-1,150	" "	4	Probably slickensides, P.
1,150-1,160	" "	4	
1,160-1,170	" "	4	
1,170-1,180	" "	4	
1,180-1,190	" "	4	
1,190-1,200	" "	4	
1,200-1,210	Calcareous shale, medium grey	4	
1,210-1,220	" " "	4	Calcite vein 5.00 mm. width, pyrite nodule 2.00 mm. diameter
1,220-1,230	" " "	4	
1,230-1,240	" " "	4	
1,240-1,250	" " "	4	Pyrite, P.
1,250-1,260	" " "	4	
1,260-1,270	" " "	4	
1,270-1,280	" " "	4	Thin bands of non-calcareous shale, P.
1,280-1,290	" " "	4	" " P.
1,290-1,300	" " "	4	" " L.
1,300-1,310	Shale, medium grey	3	Vein calcite, H.; calcareous shale, H.
1,310-1,320	" "	3	" L.; " " P.
1,320-1,330	Missing		
1,330-1,340	Shale, dark grey	3	" P.; " " L.
1,340-1,350	" medium grey	4	" H.; " " H.
1,350-1,360	" dark grey	4	" P.; " " L.
1,360-1,370	" green-grey	4	Calcareous shale, L.
1,370-1,380	" "	3	Vein calcite, L.; calcareous shale, P.
1,380-1,390	" "	3	" P.; " " H.
1,390-1,400	" "	3	Calcareous shale, L.
1,400-1,410	" "	3	" " H.
1,410-1,420	" "	3	" " L.

Depth (in feet)		Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 123-127
1,420-1,430	Shale, green-grey	3	Calcareous shale, H.
1,430-1,440	" "	3	" " H.
1,440-1,450	" "	3	" " L.
1,450-1,460	" "	3	" " H.
1,460-1,470	" "	4	" " H.
1,470-1,480	" "	3	Calcareous, sandy shale, H.
1,480-1,490	" "	3	" " H.
1,490-1,500	" "	3	Vein calcite, P.; calcareous, sandy shale, H.; fossils, P.
1,500-1,510	" "	3	" P.; " " H.; " P.
1,510-1,520	" "	4	" L.; " " M.; hand specimens showing slip
1,520-1,530	" "	3	Calcareous, sandy shale, H.;
1,530-1,540	" "	3	" " M.; fossils, P.
1,540-1,550	" "	3	" " M.; " P.
1,550-1,560	" "	3	" " M.; limestone, P.; slickensides
1,560-1,570	" "	2	" " M.
1,570-1,580	" "	2	Vein calcite, P.; calcareous, sandy shale, H.
1,580-1,590	" "	2	" P.; " " H.
1,590-1,600	" "	2	Calcareous, sandy shale, H.; vein calcite, P.
1,600-1,610	" "	3	" " H.
1,610-1,620	" "	2	" " L.; " P.
1,620-1,630	" "	2	" " L.; " P.
1,630-1,640	" "	2	" " M.
1,640-1,650	" "	2	" " M.
1,650-1,660	" "	3	" " H.; " L.
1,660-1,670	" "	2	" " H.; " L.
1,670-1,680	" "	2	" " H.
1,680-1,690	" "	1	" " L.
1,690-1,700	" "	2	" " M.
1,700-1,710	" "	2	" " M.; fossils, P.
1,710-1,720	" dark grey	1	" " H.; vein calcite, L.; fossils, P.
1,720-1,730	" "	2	" " M.; one large fragment of vein calcite
1,730-1,740	" "	2	" " H.; fossils, P.
1,740-1,750	" "	3	" " M.; vein calcite, L.
1,750-1,760	" "	2	" " M.; " L.; fossils, P.

Depth (in feet)	–	Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 123-127
1,760-1,770	Shale, dark grey	3	Calcareous, sandy shale, H.; vein calcite, V.L.; fossils, P.
1,770-1,780	" "	2	" " L.; fossils, P.
1,780-1,790	" "	2	" " M.; " P.
1,790-1,800	" "	3	" " L.; " P.
1,800-1,810	" "	3	" " M.; vein calcite, L.; fossils, P.
1,810-1,820	" "	3	" " M.; " L.
1,820-1,830	" "	3	" " L.; " P.; " P.
1,830-1,840	" "	3	" " L.; " L.; " P.
1,840-1,850	" "	3	" " L.; fossils, P.; numerous
1,850-1,860	" "	3	" " M.
1,860-1,870	" "	2	" " L.
1,870-1,880	" "	3	" " L.
1,880-1,890	" "	1	" " L.
1,890-1,900	" "	2	" " L.; vein calcite, P.; fossils, P.
1,900-1,910	" "	2	" " L.
1,910-1,920	" "	3	" " L.; " P.
1,920-1,930	" "	2	" " H.; fossils, P.
1,930-1,940	" "	2	" " L.
1,940-1,950	" "	2	" " L.; " P.
1,950-1,960	" "	2	" " L.; " P.
1,960-1,970	" "	2	" " L.
1,970-1,980	" "	2	" " L.; " P.
1,980-1,990	" "	2	" " H.
1,990-2,000	" "	2	" " H.; " P.
2,000-2,010	" "	2	" " L.; calcite, P.
2,010-2,020	" "	2	" " L.
2,020-2,030	" "	2	" " L.
2,030-2,040	" "	2	" " L.; fossils, P.
2,040-2,050	" "	2	" " L.; " P.

Extracted from Parks (1930), page 97

2. Lot 1319, range St. André, Parish of St. Thomas d'Aquin.

The National Gas Company acquired rights in St. André, Pointe du Jour, St. Roch, and Michaudville. A well was sunk in 1914-15, near the road about midway of this lot, the property of Alberic Leblanc (now Thomas Leblanc). The log of this well follows:

0 to 110 feet	Surface deposits.
110 to 140 feet	Bluish shale.
140 to 190 feet	Grey shale.
190 to 290 feet	Red shale.
290 to 320 feet	Brown shale.
320 to 440 feet	Red shale.
440 to 500 feet	Grey rock.
500 to 960 feet	Red shale.
960 to 1020 feet	Black shale
1020 to 1500 feet	Grey shales.
1500 to 2050 feet	No report.

There seems to be some difference of opinion regarding this well as I was told on the ground that it had been drilled by the owner in search of water, that gas was encountered and that an explosion of some violence occurred. The standpipe is still in place but there is no flow at present.

On the same lot a second well (N.G.C. Well No. 2) was drilled by the National Gas Co. At a point 1800 feet north of the old well but without results. The standpipe is in place but there is no flow. It may be that the log given above refers to this well.

Referred to by Parks 1931, p. 64 as

National Gas Company, Well No. 1
National Gas Company, Well No. 2

Extracted from Belyea (1952), pages 88-89

NATIONAL GAS COMPANY No. 1 WELL

Location: lot 1319, range St.-André, parish of St.-Thomas d'Aquin, 3 1/2 miles west of St.-Barnabé, St.-Hyacinthe county, Quebec
Total depth: 2,050 feet Drilled: 1914-15
Rig: cable
Samples examined by H.R. Belyea, 1946

Depth	Lithology
Feet	Richmond Bécancour River Formation
110- 190	Sandstone, greenish grey; shale, greenish grey, sandy, with large, rounded quartz grains
190- 210	Shale, greenish grey, sandy; much red shale
210- 290	Shale, red, with a few large, rounded quartz grains; a little greenish grey, sandy shale
290- 320	Shale, greenish grey, sandy; a little reddish brown shale
320- 440	Shale, reddish brown, with a few quartz grains; a little greenish grey shale
440- 490	Shale, grey, sandy; a little red shale

Depth	Lithology
Feet	Richmond
	Bécancour River Formation (Cont.)
490- 500	Shale, grey, sandy; much reddish brown shale
500- 600	Shale, reddish brown, spotted with gypsum
600- 640	Shale, reddish brown, sandy; a little grey, sandy shale
640- 820	Shale, reddish brown, sandy; a little greenish grey, sandy shale
820- 960	Shale, sandy, reddish brown and grey in about equal amounts
960-1,000	Shale, greenish grey, sandy; a little red shale
1,000-1,040	Igneous rock, dark, fine-grained
1,040-1,060	Shale, greenish grey, sandy; a little red shale; a little sandstone, with large quartz grains
	Pontgravé River Formation
1,060-1,070	Shale, greenish grey, in part sandy; brachiopod fragment
1,070-1,080	Shale and limestone; greenish grey to grey shale and blue-grey, silty, finely crystalline limestone about equal in amount; bryozoa
1,080-1,110	Shale,grey; limestone, blue-grey, sandy, grading to calcareous siltstone; a little vein calcite
1,110-1,140	Limestone, blue-grey, finely crystalline, sandy, grading to calcareous siltstone; some grey shale
1,140-1,170	Limestone and shale, as above; vein calcite
1,170-1,300	Limestone and siltstone, as above; some grey shale
	Lorraine
1,300-1,310	Shale, grey; a little sandy limestone; vein calcite
1,310-1,320	Shale, grey, soft, and medium grey , fissile; siltstone, light grey, calcareous, grades to fine-grained sandstone; fractures and vein calcite
1,320-1,340	Missing
1,340-1,350	Shale, grey, soft, breaks into rounded fragments; much slightly darker grey, fissile, micaceous, slightly silty shale; some siltstone and fine-grained calcareous sandstone; fractures and vein calcite
1,350-1,360	Shale and siltstone as above
1,360-1,400	Shale and siltstone, as above; a few fossil fragments; brown carbonate and calcite veins;pyrite; solid bituminous material 1,370-1,380 feet
1,400-1,420	Shale, grey, silty; a little darker, fissile shale; siltstone and lighter grey, calcareous sandstone, as above; calcite and brown carbonate veins; pyrite, bryozoa
1,420-1,430	Shale and siltstone, as above; vein calcite
1,430-1,440	Shale, siltstone, and fine sandstone, as above; fractures and vein calcite
1,440-1,480	Shale and siltstone, as above; vein calcite
1,480-1,490	Shale, grey, but with more,darker grey, fissile shale; a little fine-grained sandstone; fossil fragments in part crystallized brachiopod fragments, bryozoa; slickensides; fractures; vein calcite
1,490-1,520	Shale, grey, with more, darker grey, fissile shale; some siltstone and fine sandstone in part interlaminated; fossil fragments bryozoa and brachiopods; vein calcite; gas reported at 1,520 feet
1,520-1,590	Shale, grey, grading to darker grey, fissile, finely silty shale; some light grey, fine-grained sandstone; fossil fragments, in part recrystallized bryozoa 1,520 to 1,570 feet, brachiopods 1,570 to 1,590 feet
1,590-1,600	Shale, siltstone, and fine sandstone, as above; fractures and calcite veins; slickensides
1,600-1,650	Shale, siltstone, and sandstone, as above; some calcite replacing organic remains; brachiopods 1,600 to 1,620 feet

Depth	Lithology
Feet	Lorraine (Cont.)
1,650-1,670	Shale, siltstone, and fine sandstone, as above; fractures and calcite veins
1,670-1,720	Shale, siltstone, and fine sandstone, as above; calcite replacing fossil fragments; brachiopods fragments 1,680 to 1,700 feet
1,720-1,740	Shale, siltstone, and fine sandstone, as above; fossil fragments - bryozoa; fractures and calcite veins; slickensides 1,730 to 1,740 feet
1,740-1,780	Shale, siltstone, and fine sandstone; fossil fragments forming sandy shell limestone; bryozoa; brachiopods 1,750 to 1,770 feet
1,780-1,840	Shale, siltstone; and fine sandstone, as above
1,840-1,850	Shale, siltstone, and fine sandstone, as above; fossil fragments - brachiopods
1,850-1,920	Shale, siltstone, and fine sandstone; in part, with recrystallized fossil fragments
1,920-1,930	Shale, siltstone, and fine sandstone; brachiopods
1,930-2,050	Shale, siltstone, and fine sandstone; fossil fragments

Note. The section in this well appears to be a normal section for the Bécancour River and Pontgravé River formations. Some zones in the Lorraine, with fractures, vein calcite, and slickensides, may be faulted or crumpled, but no definite evidence of repetition has been found.

Extracted from DeBlois (1959), page 77

Company: National Gas Co.
Well Name: National Gas No. 2 Well
Location
Lot: 1319
Range: St-André
Parish: St-Thomas d'Aquin
County: St-Hyacinthe
Coords.: 1800' North of National Gas No. 1 Well
Ground Elevation: 113'
RF Elevation: 115'
Spudded: 1916
Completed: 1916
Driller: Mr. Tripplehorn (Capital Trust Co.)
Type of Rig: Cable
Result: Dry Hole
Water
Slightly salty at: 133', 500'
Brackish at: 720'
Gas at: 1720'
Log by Belyea:

Formation	Depth interval (in feet)
Overburden	0 - 120
Richmond (Bécancour River)	120 - 720
Richmond (Pontgravé River)	720 - 730
Richmond (Bécancour River)	730 - 770
Richmond (Pontgravé River)	770 - 1040
Lorraine	1040 - 1300
Igneous rock	1300 - 1320
Lorraine	1320 - 1826

Depth (in feet)	—	Rate of efferves-cence with acid,Cold	Extracted from Maddox, 1931, pages 128-131
120-130	Shaly sandstone, dull red ..	1	Fine grained; shale, H.; fine sand, H.; coarse sand, L.; well rounded
130-140	Sandy shale, dull red	1	" " H.; " H.; " L.; " green sand, P.
140-150	" brownish red ..	1	A little surface material
150-160	" "	1	Rounded quartz grains 0.2 to 0.5 mm., M.; a little surface material
160-170	" "	1	" " 0.2 to 0.5 mm., M.; greenish grey shale, V.L.
170-180	" reddish brown	1	" " 0.2 to 0.5 mm., L.; greenish grey sandstone, fine to medium grained
180-190	" "	1	" " 0.2 to 0.5 mm., L.
190-200	" "	1	" " 0.2 to 0.5 mm., M.; greenish grey shale, L.; a little surface material
200-210	" "	1	" " 0.2 to 0.5 mm., L.; a little surface material
210-220	" "	1	" " 0.2 to 0.5 mm., L.; considerable surface material
220-230	" "	1	" " 0.2 to 0.5 mm., L.; greenish grey shale, H.
230-240	" "	1	" " 0.2 to 0.5 mm., L.; greenish grey fine-grained sandstone, H.
240-250	" greenish grey	1	Greenish grey, fine-grained sandstone, L.
250-260	" reddish brown	1	Rounded quartz grains 0.2 to 0.5 mm., L.; greenish grey shale, H.
260-270	" "	1	" " 0.2 to 0.5 mm., L.; green, sandy shale, L.
270-280	" "	1	" " 0.2 to 0.5 mm., L.; greenish grey, sandy shale, some of this showing crystalline gypsum
280-290	" "	1	" " 0.2 to 0.5 mm., V.L.; greenish grey sandstone, fine grained, H.
290-300	" "	1	" " 0.2 to 0.5 mm., L.; greenish grey shale and sandstone, L.
300-310	" "	1	" " 0.2 to 0.5 mm., L.; " " M.
310-320	" "	1	" " 0.2 to 0.5 mm., L.; " " L.
320-330	" "	1	" " 0.2 to 0.5 mm., L.; " " M.
330-340	" "	1	" " 0.2 to 0.5 mm., L.; " " M.
340-350	" "	1	" " 0.2 to 0.5 mm., L.; " " and sandstone L.
350-370	" brownish grey	1	" " 0.2 to 0.5 mm., H.; " " " H.
370-380	" greenish brown	1	Medium sand, M.; red shale, H.; green shale, L.; coarse sand
380-390	" reddish brown	1	" L.; " D.
385-395	Shale, medium grey	1	Grey shale, H.; light and dark brown shale, M.; anhydrite, L.; selenite, P.
390-400	Sandy shale, reddish brown .	1	Medium sand, L.; red shale, D.; coarse sand, P.
400-410	" "	1	" L.; " D.; " P.
410-420	" "	1	" L.; " D.; " P.; green shale, P.
420-430	" "	1	" L.; " H.; " P.; green sand and shale, L.
430-440	" greenish brown	1	" L.; " H.; " P.; " " M.
440-450	" reddish brown	1	" L.; " H.; " P.; " " P.

National Gas Company Well No. 2,Lot 1319 (Cont.)

Depth	–	Rate of effervescence with acid,Cold	Extracted from Maddox, 1931, pp. 128-131
450-460	Sandy shale, reddish brown	1	
460-470	" "	1	Medium sand, L.; red shale, D.; coarse sand, P.; green sand and shale, P.
470-480	" "	1	" L.; " D.; " P.; gypsum, P.; granular and selenite
480-490	" "	1	Red shale, D.; medium sand, L.; coarse sand, P.; gypsum, P.; granular and selenite
490-500	" "	1	" D.; " L.; " P.; green shale,; L.
500-510	" "	1	" D.; " L.; " P.; " L.
510-520	" green and brown	1	" H.; " L.; " P.; " M.
520-530	" "	1	" H.; " P.; green shale, H.; fibrous gypsum, P.
530-540	" greenish brown	1	" H.; " L.; " H.
540-550	" greenish brown	2	" H.; " P.; " H.
550-560	" "	1	" H.; " L.; " M.
560-570	" "	1	Quartz grains 0.2 to 0.5 mm., V.L.
570-580	" reddish brown	1	" 0.2 to 0.5 mm., L.; greenish grey, sandy shale, V.L.
580-590	" "	1	" 0.2 to 0.5 mm., L.; " " L.; white gypsum, P.
590-600	" "	1	" 0.2 to 0.5 mm., L.; " " M.
600-610	" "	1	" 0.2 to 0.5 mm., L.; " " M.
610-620	" "	1	" 0.2 to 0.5 mm., L.; " " L.
620-630	" greenish grey	1	" 0.2 to 0.5 mm., L.; reddish brown, sandy shale, V.H.
630-640	" "	1	" 0.2 to 0.5 mm., L.; " " V.H.
640-650	" "	1	" 0.2 to 0.5 mm., L.; " " V.H.
650-660	" "	2	" 0.2 to 0.5 mm., M.; red shale, P.; calcite, P.
660-670	Shale, dark grey	2	" 0.2 to 0.5 mm., H.; greenish tinge.; selenite, P.
670-680	Sandy shale, dark grey .	1	" 0.2 to 0.5 mm., L.
680-690	" "	1	" 0.2 to 0.5 mm., L.; selenite, P.
690-700	" "	1	" 0.2 to 0.5 mm., V.L.
700-710	" "	1	" 0.2 to 0.5 mm., V.L.
710-720	" "	1	" 0.2 to 0.5 mm., V.L.
720-730	" "	2	" 0.2 to 0.5 mm., V.L.; vein calcite, V.L.; brownish grey, grained shale, L.
730-740	" "	1	Medium round sand, L.; red shale, P.; calcite vein in grey shale
740-750	" "	1	" " P.; " P.; coarse sand, P.
750-760	" "	1	" " P.; " P.
760-770	" "	1	" " L.; " P.
770-780	" "	1	White calcite, P.
780-790	Shale, dark grey	2	Sandy shale, P.; vein calcite, L.

Depth (in feet)	-	Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 128-131
790- 800	Shale, dark grey	1	Sandy shale, P.; vein calcite, P.
800- 810	" "	1	" L.; " L.; some well-laminated shale
810- 820	" "	2	" P.; " M.
820- 830	" "	2	" P.; " M.; pyrite, P.
830- 840	" "	2	" P.; " M.
840- 850	" "	2	" L.; " M.
850- 860	" "	3	Vein calcite, M.
860- 870	" "	3	" M.; one fragment shows shell impression
870- 880	" "	2	Pyrite, P.; brownish grey limestone
880- 890	" "	2	" P.; " " L.; vein calcite, P.
890- 900	" "	3	Brownish grey limestone, V.H.
900- 910	Limestone, dark grey ...	3	Dark grey shale, H.; limestone shows pyrite
910- 920	" "	3	Vein calcite, V.L.; dark grey shale, V.H.
920- 930	Shale, dark grey	3	Pyrite, P.; dark grey limestone, H.
930- 940	" "	3	Dark grey limestone, M.; vein calcite, V.L.
940- 950	" "	3	" " V.H.; one shell impression
950- 960	Limestone, dark grey ...	3	Dark grey shale, M.; vein calcite, V.L.; shows shell impression; slickensides
960- 970	" " ...	2	" " L.; " P.
970- 980	Shale, dark grey	3	" " H.; " L.
980- 990	Limestone, dark grey ...	3	" " L.; " P.
990-1,000	" " ...	3	" " V.L.; " L.
1,000-1,010	" " ...	3	Pyrite, P.; dark grey limestone, L.; vein calcite, V.L.
1,010-1,020	" " ...	3	" P.; " " L.; " P.
1,020-1,030	" " ...	3	Dark grey limestone, V.H.; vein calcite, L.
1,030-1,040	Shale, dark grey	3	" " V.H.; " M.; shell impressions
1,040-1,050	" "	3	" " H.; " L.
1,050-1,060	" "	3	" " M.; " L.
1,060-1,070	" "	3	" " H.; " L.; a little brown, glassy material
1,070-1,080	" "	3	" " L.; " L.
1,080-1,090	" "	3	" " H.; " L.
1,090-1,100	" "	4	Pyrite, P.; dark grey limestone, H.; white calcite, L.
1,100-1,110	" "	3	Grey limestone, H.; white calcite, V.L.
1,110-1,120	" "	3	" M.; white vein calcite, L.
1,120-1,130	" "	3	" M.; " " L.

National Gas Company, Well No. 2, Lot 1319 (Cont.)

Depth (in feet)	–	Rate of effervescence with acid, Cold	Extracted from Maddox, 1931, pp. 128-131
1,130-1,140	Shale, dark grey	3	Grey limestone, H.; white vein calcite, L.
1,140-1,150	" "	2	" P.; " " V.L.
1,150-1,160	" "	2	" P.; " " L.
1,160-1,170	" "	2	" M.; " " L.
1,170-1,180	" "	2	" L.; " " P.
1,180-1,190	" "	2	" H.; " " P.
1,190-1,200	" "	2	" H.; " " P.
1,200-1,210	" "	2	" H.; " " V.L.
1,210-1,220	" "	2	" M.; " " P.
1,220-1,230	" "	2	2 L.; " " P.
1,230-1,240	" "	2	" L.; " " V.L.
1,240-1,250	" "	2	" M.; " " V.L.
1,250-1,260	" "	2	White vein calcite, P.; grey limestone, H.
1,260-1,270	" "	3	" " P.; " H.
1,270-1,280	" "	3	White calcite, P.; grey limestone, H.
1,280-1,290	" "	3	Vein calcite, P.; grey limestone, V.H.
1,290-1,300	" "	3	" V.L.; " H.
1,300-1,310	Igneous, medium grey	1	Dyke rock
1,310-1,320	Igneous, dark grey ..	1	"
1,320-1,330	Shale, dark grey	1	Vein calcite, P.; limestone, P.
1,330-1,340	" "	2	" P.; " M.
1,340-1,350	" "	2	" P.; " P.; dyke rock, V.L.
1,350-1,360	" "	1	" P.; " P.; " V.L.
1,360-1,370	" "	2	" P.; " P.; " V.L.
1,370-1,390	" "	2	" P.; grey limestone, L.; dyke rock, V.L.
1,390-1,400	" "	2	" P.; " M.; " L.
1,400-1,410	" "	2	" V.L.; " M.; " L.
1,410-1,420	" "	2	" V.L.; " M.; " V.L.
1,420-1,440	" "	2	Grey limestone, L.; dyke rock, L.
1,440-1,450	" "	2	" M.; " V.L.
1,450-1,460	" "	2	" M.; " V.L.
1,460-1,470	" "	1	" P.; " M.
1,470-1,480	" "	1	Vein calcite, P.; grey limestone, L.; dyke rock, L.

National Gas Company, Well No. 2, Lot 1319 (Cont.)

Depth (in feet)		Rate of efferves-cence with acid, Cold	Extracted from Maddox, 1931, pp. 128-131
1,480-1,490	Shale, dark grey	1	Grey limestone, L.; dyke rock, M.
1,490-1,500	"	1	" P.; " M.
1,500-1,510	" "	2	Vein calcite, P.; grey limestone, M.; dyke rock, L.
1,510-1,520	" "	2	" P.; " M.; " L.
1,520-1,530	" "	2	Grey limestone, H.; dyke rock, L.
1,530-1,540	" "	2	Vein calcite, P.; grey limestone, M.; dyke rock, L.
1,540-1,550	" "	2	Grey limestone, L.; dyke rock, P.
1,550-1,560	" "	2	" V.L.; " P.
1,560-1,570	" "	2	" L.; " P.
1,570-1,580	" "	2	" L.; " P.
1,580-1,590	" "	2	Vein calcite, P.; grey limestone, L.; dyke rock, L.
1,590-1,600	" "	2	Grey limestone, P.; dyke rock, P.
1,600-1,610	" "	2	" P.; " P.
1,610-1,620	" "	2	" P.; " P.
1,620-1,630	" "	2	" P.; " P.
1,630-1,640	" "	2	" P.; " P.
1,640-1,650	" "	2	Vein calcite, P.; grey limestone, L.; dyke rock, L.
1,650-1,660	" "	2	Grey limestone, L.; dyke rock, P.; vein calcite, P.
1,660-1,670	" "	2	" L.; " P.
1,670-1,680	" "	2	" H.; " P.
1,680-1,690	" "	2	" H.; " P.
1,690-1,700	" "	1	" P.; " P.
1,700-1,710	" "	2	" L.; " P.
1,710-1,720	" "	2	" L.; " P.
1,720-1,730	" "	1	" P.; " P.
1,730-1,740	" "	2	" P.; " P.
1,740-1,750	" "	1	" P.; " P.
1,750-1,760	Missing		
1,760-1,770	Shale, dark grey	1	" P.; " P.
1,770-1,780	" "	1	" P.; " P.
1,780-1,790	" "	1	" P.; " P.
1,790-1,800	" "	1	" P.; " P.
1,800-1,810	" "	1	" P.; " P.
1,810-1,820	" "	1	" P.; " P.
1,820-1,826	" "	1	Dyke rock, P.

Extracted from Belyea (1952), pages 89-91

NATIONAL GAS COMPANY No. 2 WELL

Location: lot 1,319, range St.-André, parish of St.-Thomas d'Aquin, St.-Hyacinthe county, Quebec; 1,800 feet north of National Gas Company No. 1 well
Elevation: 112 feet Drilled: 1916
Total depth: 1,826 feet Rig: cable
Samples examined by H.R. Belyea, 1946

Depth (Feet)	Lithology
	Richmond
	Bécancour River Formation
120- 230	Shale, reddish brown, sandy; a little greenish grey, sandy shale; large quartz grains
230- 260	Shale, reddish brown, sandy; much greenish grey shale and sandy shale
260- 350	Shale, reddish brown, sandy; a little greenish grey, sandy shale
350- 360	Missing
360- 370	Sandstone and shale; greenish grey sandstone and sandy shale
370- 380	Shale, reddish brown, sandy; a little greenish grey, sandy shale
380- 390	Dolomite, grey and light brown, finely crystalline and dense, argillaceous
390- 500	Shale, reddish brown, sandy; a little greenish grey, sandy shale
500- 650	Shale, reddish brown, sandy; considerable greenish grey, sandy shale
650- 720	Shale, greenish grey, sandy, with large quartz grains; trace of gypsum
	Pontgravé River Formation
720- 730	Shale and limestone: grey shale; a little blue-grey, silty limestone; fossil fragments replaced by calcite; vein calcite; slickensides
730	Thrust?
	Bécancour River Formation
730- 770	Shale, greenish grey, sandy, with large quartz grains; slickensides 730 to 740 feet; trace of vein calcite
	Pontgravé River Formation
770- 780	Shale and limestone: grey shale; a little blue-grey, finely crystalline, silty limestone; a few fragments show slickensides; vein calcite
780- 850	Shale and limestone: grey shale, same as above; blue-grey, finely crystalline limestone, most of it sandy, grades into calcareous, fine-grained sandstone; a little vein calcite
850- 860	Missing
860- 870	Limestone and shale; blue-grey, sandy limestone and grey shale, as above; considerable calcite
870-1,040	Shale, limestone, and sandstone: grey shale; much blue-grey, sandy limestone and calcareous sandstone; a little calcite
	Lorraine
1,040-1,110	Shale and sandstone: grey shale, with slight greenish tinge, in part fissile, micaceous, slightly silty, in part breaks into rounded fragments; lighter grey siltstone and fine-grained, calcareous sandstone; fossil fragments abundant
1,110-1,140	Shale and siltstone, as above; calcite veins; fractures 1,110 to 1,120 and 1,130 to 1,140 feet

Depth	Lithology
	Lorraine (Cont.)
1,140-1,230	Shale, greenish grey and grey, in part fissile, as above; some darker grey micaceous, silty, brittle shale, with irregular fractures; siltstone, as above, in part interlaminated with shale; vein calcite
1,230-1,240	Shale, as above; some siltstone, as above; vein calcite and slickensides
1,240-1,300	Shale and siltstone: light to medium grey shale, in part fissile, as above; lighter grey, calcareous siltstone and fine-grained sandstone; fossil fragments forming sandy shell limestone; brachiopods 1,260 to 1,270 feet
1,300-1,320	Igneous rock
1,320-1,330	Shale and siltstone: grey shale, as above; some darker grey, fissile shale; lighter grey, calcareous siltstone, as above; fossil fragments numerous; bryozoa; pyrite
1,330-1,360	Shale and siltstone, as above; brachiopod fragments
1,360-1,370	Shale and siltstone, as above; bryozoa
1,370-1,510	Shale, grey, finely micaceous, finely silty, in part darker grey, fissile; lighter grey, calcareous siltstone and fine sandstone, as above; fossil fragments
1,510-1,520	Shale and siltstone, as above; brachiopods
1,520-1,570	Shale and siltstone, as above
1,570-1,590	Shale and siltstone, as above; brachiopods and crinoids
1,590-1,630	Shale and siltstone, as above
1,630-1,640	Shale and siltstone; bryozoa
1,640-1,670	Shale and siltstone
1,670-1,680	Shale and siltstone; crinoid disks
1,680-1,720	Shale and siltstone; brachiopod fragments
1,720-1,826	Shale, as above the darker grey, micaceous, fissile shales more abundant; some calcareous siltstone, as above

Note. The sample from 720 to 730 feet belongs to the Pontgravé River shales and limestones, but it is underlain by Bécancour River shales. This is an old well, and the samples may not have been carefully labelled. Possibly this sample is out of its proper order in the section. On the other hand, if it is in place, there may be a thrust fault at about 730 feet causing repetition of the beds. The presence of calcite and slickensides would support this interpretation. Similar thrusts occur in other wells in this vicinity.

Extracted from DeBlois (1959), page 156
Operator: Yvon L'Heureux
Well Name: Ste.Rosalie No. 1
Location
Lot: 247
Range: IV
Parish: Ste. Rosalie
County: Bagot
Coords: 2.1 miles from Ste. Rosalie church, 100' South (Actually North, T.H.C.)of the C.N.R. line
Ground Elevation: 162'
RF Elevation 164'
Spudded: Oct. 14, 1954
Completed: Feb. 21, 1955
Type of Rig: Diamond Drill
Result: Dry hole
Log by T. H. Clark:

Formation	Depth interval (in feet)
Overburden	0 - ?
St. Germain complex, largely Utica with possibly some Trenton and Lorraine	? 3569

Report by T.H. Clark, Nov. 11, 1955

ON STE. ROSALIE NO. 1 WELL

Very few core samples were received. Two, about six inches in length, were marked 621'; two similar pieces were marked 1090'; the remainder, according to information from the driller, came from near the bottom of the well, and in all made up a length of about 30".

621'. Alternations of black shale and grey, well bedded, fine-grained sandstone, the latter cross bedded on a fine scale. Cleavage very well developed, and at about 45° to the direction of the drilling (i.e., dips 45°).

1090'. Black slaty rock, intensely brecciated, and permeated with abundant calcite. Cleavage present, 45° to core length, not prominent. This rock was considered to be marble by the operators.

Lowest 20'. Same rock as at 621'. Cleavage very prominent, at 45° to core length. In most places cleavage is parallel to the bedding. Slickensided throughout, usually along cleavage/bedding planes. A few poor fossils present, graptolites mostly; probably not identifiable, but resemble Utica forms. Thin calcite veins throughout.

NOTE: Rock similar to that labelled 621' and that said to have come from the bottom of the well outcrops in a railroad ditch 500' S.W. of the well site. There the bedding is vertical.

The formation drilled through is the St. Germain complex, here probably composed largely of Utica shale, with possibly some Upper Trenton and some Lower Lorraine at top and bottom. These are age suggestions. The lithology would probably be the same for all three stratigraphic divisions.

Extracted from DeBlois (1959), page 157

Operator: Yvon L'Heureux

Well Name: Ste. Rosalie No. 2

Location

Lot:249
Range: IV
Parish: Ste. Rosalie
County: Bagot
Coords: 650' from R.R. line along S.W. border of lot 249, and 20' N.E. of LL. 249 and 250

Ground Elevation: 158'
RF Elevation: 160'

Spudded: Nov. 18, 1955
Completed: May 14, 1956
Type of Rig: Diamond Drill
Result: Dry hole
Log by T.H. Clark:

Formation	Depth interval (in feet)
Overburden	0 - 15
Alternation of slate to fine-grained sandstone belonging to the St. Germain complex and being of Utica age	15 - 895
Sludge - No information, but presumably the same formation ..	895 - 2700

LOG OF STE. ROSALIE HOLE NO. 2

by T.H. Clark, December 1959

SUMMARY

0-15 Overburden
15-895 St-Germain complex - probably Breault.

Depth in feet		Description	Diamond Drill core
0- 15		Overburden	
15- 40	ST. GERMAIN COMPLEX PROBABLY LOWER LORRAINE	Black shale and dark grey sandstone, very fine-grained. Shale inconspicuously banded, non-calcareous Sandstone plainly and very finely stratified, faintly calcareous. Cross-bedded in places. Bedding at all angles, but mostly steep, in places vertical. Shale cut by 45^0 cleavage planes (40^0 to 70^0) Slickensides fairly common. Calcite veins common	
40- 65		Ditto.	
65- 90		Ditto	
90- 98		Ditto	
98-103		Shale, black, intensely and irregularly slickensided, giving appearance of anthracite.	
103-115		Missing	
115-120		Missing	
120-124		Missing	
124-131		Shale, as for 98-103	
131-145		Shale and sandstone, strongly cleaved. Sandstone gives slight effervescence	
145-170		Mostly very fine-grained sandstone or sandy shale, with minor amounts of black shale, strongly cleaved as in 15-40 above. Calcite veins common	

LOG OF STE. ROSALIE HOLE NO. 2 (Cont.)

by T.H. Clark, December 1959

Depth in feet		Description Diamond Drill core
170-195	ST. GERMAIN COMPLEX .. PROBABLE LOWER LORRAINE	Mostly highly cleaved black shale. Minor amounts of moderately cleaved sandy shale. Veins, cleavage, and slickensides prominent. Cleavage mostly about 45°
195-220		Ditto, but sandstone and sandy shale less abundant. Cleavage up to 80°
220-245		Shale : sandstone, 75 : 25. Core in long pieces up to 3', Cleavage in shale everywhere, but not prominent.
245-270		Shale : sandstone, 60:40. Sandstone beds up to 8" thick across bedding, which is nearly vertical. Long cores up to 2'. Veins present, not abundant
270-295		Ditto
295-320		295-307 broken up, probably like 307-320. 307-320 Mostly shale. 20% sandstone, in beds up to 8" thick. Cores up to 18". Both bedding and cleavage 45° or more, in places coinciding. Cleavage scarcely noticeable in places.
320-345		320-330 broken up, ? box containing 295-320 may have been reversed. Shale and sandstone as above. Core up to 4' long. Bedding highly inclined, cleavage not well developed. 326-327 1/2 dark igneous rock.
345-370		Ditto. Some sandstone medium-grained. Bedding up to 80°. One 4' length of core
370-395		Shale: sandstone, 80:20. Shale is medium to dark grey, finely color banded. Sandstone is faintly calcareous 375-390 dark igneous rock.
395-420		Ditto.

LOG OF STE. ROSALIE HOLE NO. 2 (Cont.)

by T.H. Clark, December 1959

Depth in feet		Description	Diamond Drill core
420-445	ST. GERMAIN COMPLEX ..... PROBABLY LOWER LORRAINE	Shale and sandstone ditto. Veins abundant, but localized	
445-470		Shale and sandstone as above, sandstone 10%, most of it in one 6" bed. Shale very finely color banded, dark and medium grey. Cleavage, veins, and slickensides present but not prominent. Bedding up to 75°. Sandstone slightly calcareous.	
470-495		Fine-grained sandstone 20%, remainder finely color banded medium to dark grey shale. One 42" bed of sandstone. Bedding up to 75°. Cleavage prominent, 45° to 60°, accompanied by slickensides.	
495-520		Shale and sandstone as above. Cleavage, veins prominent Some veins brecciated. No long cores.	
520-545		Shale and sandstone as above, sandstone 10% or less. Cleavage present but not strong. Slickensides and veins associated in one or two places.	
545-570		Shale 95%, sandstone 5%, in thin bands less than 1", slightly calcareous. Cores fairly long. Cleavage and bedding mostly coincident and up to 45°. Slickensides poor.	
570-595		Rock as before, but sandstone up to 2" beds, still 5%. Sandstone with poor to fair effervescence. Shale very poorly banded. Veins rare. Cleavage and bedding coincident, up to 45°. Cleavage weak, allowing some 18" cores	
595-620		Shale as above. Sandstone 30%, mostly fine to very fine, in some cases grading into shale. Calcite veins present. Cleavage present throughout, but not preventing 1' core lengths.	

LOG OF STE. ROSALIE HOLE NO. 2 (Cont.)

by T.H. Clark, December 1959

Depth in feet		Description Diamond Drill core
620-645	ST. GERMAIN COMPLEX .....PROBABLY LOWER LORRAINE	Shale and sandstone as above, sandstone 5%. Shale broadly color banded. Veins present but rare. Cleavage and bedding coincident, 1' cores.
645-670		Black shale and grey, very fine-grained sandstone as before. Sandstone in beds 1/4" to 20", 64" in all, or 21% crossbedded, bedding irregularly crumpled, Shale dark grey and color banded. All sandstone slightly effervescent. Some sandstone shows graded bedding. Cleavage and bedding uniformly 45°.
670-695		Ditto, but sandstone 37" in all, or 12%, all beds less than 6". Bedding and cleavage parallel or within 5°, 45° to 50°.
695-720		Ditto, but 12" sandstone, or 4%, all beds less than 4", Bedding and cleavage parallel or within 10°, 45° to 50°.
720-745		Shale and sandstone as above, but 8" sandstone, less than 3%, in beds less than 1". Bedding and cleavage parallel, but in places bedding steeper than cleavage by 25°. Cleavage 45°
745-770		Shale and sandstone as above, but 46" sandstone, at one end of box, and a total of 50% sandstone altogether Bedding 0 to 25° steeper than cleavage. Cleavage 45°.
770-795		Shale and sandstone as above. 15" sandstone, 5% of core, in beds 1/2" to 1". All sandstone light grey. Cleavage and bedding 45° .

LOG OF STE. ROSALIE HOLE NO. 2 (Cont.)

by T.H. Clark, December 1959

Depth in feet		Description	Diamond Drill core
795-820	ST. GERMAIN COMPLEX.. PROBABLY LOWER LORRAINE	Mostly shale, probably 2% sandstone Cleavage 45°	
820-845		Shale and light grey sandstone as above. Sandstone 31" , 10% of core. Mostly evenly bedded, but some pronounced local complications. Bedding almost everywhere 60° . Cleavage 10° to 45°	
845-870		Shale and sandstone as above. Sandstone 98" , or 33%. Bedding mostly very complicated, probably plastic flowage. Cleavage and bedding mostly parallel throughout. Calcite veins common.	
870-895		Shale and sandstone as above. 22" light grey sandstone, 7% of core, evenly bedded. Several intensely slickensided zones. Cleavage ranges from horizontal to 45° . In places marked brecciation Bottom of hole.	

APPENDIX B

INFORMATION CONCERNING QUARRIES

Name of Quarry: St-Dominique Quarries Ltd.
Location: St-Dominique, Bagot Co.,
Owner: As above
Operator: As above
Type of Rock: Limestone
Approximate Dimensions: Main quarry 750' x 300' -- Daudelin quarry 700' x 200'
Number of Men Employed: 40
Equipment: Track drills, a primary and a secondary crusher, shovels, 10 trucks. Standard equipment for a large quarry.
Production: Daudelin quarry: Agricultural limestone 150,000 to 250,000 tons/ann.
Main quarry: aggregate stone 250,000 tons/ann.
Analysis of Stone: Daudelin quarry produces high-calcium stone, 90%+ $CaCO_3$.
Remarks: There are other quarries, at present inactive, controlled by this company. The production would be similar to the stone from the two quarries given above.

Name of Quarry: Nouvelles Carrières Ltée
Location: St-Dominique
Owner: Lionel Phaneuf, President) St-Hyacinthe, Que.
Philippe Lafontaine, Secretary)
Operator: Nouvelles Carrières Ltée
Type of Rock: Limestone -- Probably Middle Trenton
Approximate Dimensions: Quarry not yet developed
Number of Men Employed: 5
Equipment: None. All work done so far is by contract.

Production: None yet
Analysis of Stone: Said to be of high quality for lime, agricultural limestone, aggregate.
Remarks:
Two pits, each about 100' x 100', .1 and .9 miles south of the highway, have been dug. Production should begin before the end of the summer of 1961.

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