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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

**GEOLOGICAL SURVEY OF CANADA
BULLETIN 22**

**DEEP WELLS AND
SUBSURFACE STRATIGRAPHY OF PART
OF THE ST. LAWRENCE LOWLANDS, QUEBEC**

**BY
Helen R. Belyea**



**EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1952**

Price, 50 cents



A. Cliffs of Utica shale along the south shore of the St. Lawrence River near Point Platon, Lotbinière county, Quebec. (Page 21.)



B. Interbedded shales and siltstones, *Proetus-Leptaena* Zone of the Lorraine, Nicolet River formation, on east bank of Nicolet River about 3 miles southwest of St. Monique station, Nicolet county, Quebec. (Page 22.)

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PREFACE

The St. Lawrence Lowlands in the province of Quebec are underlain by a broad syncline of early Palæozoic sedimentary formations. Gas seeps originating in these Palæozoic strata have long created an interest in the oil and natural gas possibilities of this area, particularly in view of the proximity of many centres of population, and several deep wells have been drilled in search for commercial production. Other deep wells have been drilled for water.

The present report is an attempt to describe and correlate the sections of Palæozoic strata penetrated by the deep wells. Diagrams to illustrate stratigraphic and general structural relationships are included, and an appendix provides detailed logs of the twenty-four wells for which samples were available for study.

GEORGE HANSON,
Chief Geologist, Geological Survey of Canada

OTTAWA, December 12, 1951

DEEP WELLS AND SUBSURFACE STRATIGRAPHY OF PART OF THE ST. LAWRENCE LOWLANDS, QUEBEC

INTRODUCTION

GENERAL STATEMENT

This report is based on a detailed study of samples from deep wells drilled in the St. Lawrence Lowland between Montreal and Three Rivers in the province of Quebec. Most of the holes were drilled for oil and gas, but some were drilled for water. Figure 1 shows the location of the wells studied and also the location of a few older wells drilled to a depth of more than 1,000 feet but for which no samples are available for study.

The wells studied were all drilled in the southwestern part of the Quebec basin, a generally synclinal structure containing sediments of Ordovician and Upper Cambrian age that occupies the St. Lawrence Lowlands in the province of Quebec. This basin has a general north-easterly trend, but to the southwest swings southerly into the Lake Champlain area. Its northwestern margin is along the border of the Canadian Shield, and to the southeast it extends to the thrust zone known as "Logan's Line", which separates the St. Lawrence Lowlands from the Appalachian region of folded and faulted strata. The southwestern border is the axis named by Logan (1863)¹, the "Beauharnois anticline", which extends from the Canadian Shield near St. Jerome south-southeast to the Adirondack Mountains, passing west of Montreal near the mouth of the Ottawa River. It separates the Quebec basin from the Ottawa-St. Lawrence Lowlands of Ontario and southwestern Quebec, and is composed of Precambrian rock overlain in most parts by a veneer of Potsdam sandstone. To the northeast, the Quebec basin extends a short distance beyond Quebec city along the north shore of the St. Lawrence River, but that part dealt with in this report reaches only to Three Rivers.

All available samples have been studied under the binocular microscope, and descriptive logs of the wells from which they were obtained are appended to this report. From this study, an attempt has been made to determine the formations represented, their stratigraphic relationships, their thicknesses, and any changes in facies. Correlations of formations have been made from well to well and, so far as possible, with exposed sections. Changes that occurred in this basin of deposition during Ordovician time are recorded in the sediments, and afford the principal data from which to interpret the history of the basin. As all of the formations encountered by the drilled wells have been studied from exposures, no new formational names have been introduced in this report.

¹ Dates in parentheses are those of references listed in Bibliography, p. 33.

The present work is a continuation of that by D. C. Maddox (1931a, b) who prepared logs of the wells drilled prior to 1930 and estimated the thicknesses of the formations penetrated.

HISTORY OF DRILLING

Drilling for gas and oil commenced before 1880 in that part of the St. Lawrence Lowlands that lies in the province of Quebec. Gas seeps are common over the entire region, and early led to a search for commercial production of gas and oil. Most of the gas has been obtained from shallow holes in the drift, and some of these, such as those in the Louiseville area, have supplied small but steady flows of gas for years. Showings of gas have also been obtained at various horizons in formations of Lorraine and Richmond age. An outline of the history of the natural gas industry in the province of Quebec and a list of the principal wells drilled for gas in various districts were published by W. A. Parks in the Annual Report of the Quebec Bureau of Mines for 1929. This report was amplified and additional wells listed in the Annual Report for the following year, the two reports comprising a complete history up to that time. Since then, several wells have been drilled. In 1931, the Canadian Seaboard Oil and Gas Company drilled the St-Gérard No. 1 well in Yamaska county, and South Shore Oil Lands Limited drilled the South Shore No. 1 well in Nicolet county. In 1932, the South Shore No. 2 well was drilled near the No. 1 well, and the Richelieu Gas Company St. Denis No. 1 well was drilled by the Hope Engineering Company near St. Denis, St. Hyacinthe county. The Canadian Seaboard Ste-Angèle No. 1 well in Nicolet county was drilled in 1933. In the following year, 1934, the Mohr No. 1 and the Cartier Natural Gas No. 5 wells were drilled in Berthier county on the north shore of the St. Lawrence; the St-Grégoire well was drilled in Nicolet county; and the Cartier St. Hubert No. 1 well was drilled in Chambly county. Although some of these wells encountered small showings of gas, none was of commercial importance, and as a result interest in this area declined. Only two other holes have been put down since that time: a diamond drill-hole, the Mallet test hole, was drilled near Ste. Thérèse in 1937, and in 1948 another well was drilled near the Cartier St. Hubert No. 1 well in Chambly county by the St. John's Petroleum Company. Neither of these wells has encountered gas or oil in commercial quantities.

ACKNOWLEDGMENTS

Outcrops in the area south of the St. Lawrence were examined in the summer of 1947 in company with Dr. T. H. Clark of the Quebec Department of Mines, who has mapped and studied this area intensively for that Department. The writer wishes to thank Dr. Clark for his co-operation in the field, and for helpful discussions on stratigraphic problems, and expresses due acknowledgment of her indebtedness to the provincial Depart-

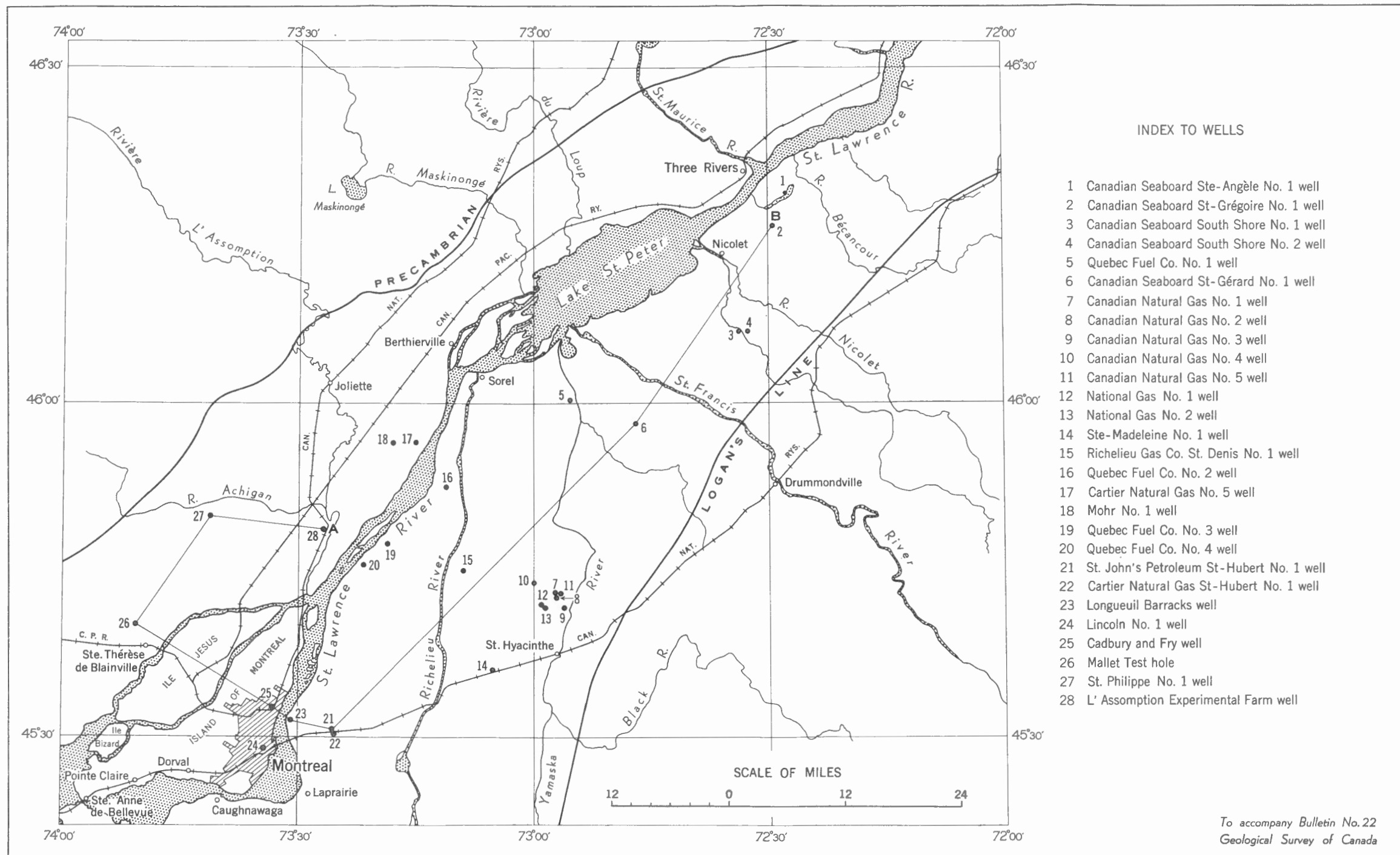


Figure 1. Index map showing location of wells referred to in this report. Line A-B follows in order the succession of wells (Nos. 1 to 8) illustrated in columnar section in Figure 3.

ment of Mines for making this co-operation possible. Fossils from the wells studied have been identified by Dr. Clark and by Dr. Alice E. Wilson of the Geological Survey of Canada.

STRATIGRAPHY

The following table lists the formations that occur in the Quebec basin of the St. Lawrence Lowlands. These formations were deposited during Upper Cambrian and Ordovician time.

Table of Formations

	Surface formations (T. H. Clark, 1944, 1947)	Units distinguished in subsurface	Lithology	Thickness in wells
Richmond	Bécancour River	Bécancour River	Red and green shale and sandstone	Feet 1,200+
	Pontgravé River	Pontgravé River	Calcareous shale, limestone, siltstone	240
Lorraine	Nicolet River		Greenish grey to grey shale, siltstone, fine sandstone	
	Leclercville	Utica-Lorraine	Dark grey shale	2,900-4,200+
Utica	Lachine (Lotbinière)		Black shale	
Trenton	Terrebonne	Terrebonne-Tetreauville and/or equivalents	Dark, fine, argillaceous limestone and shale	
	Tetreauville			
	Montreal	Montreal-Mile End and/or equivalents	Finely crystalline to coarsely crystalline limestone	700 ± - 1,100
Black River	Mile End			
	Leray	Leray-Lowville	Cryptocrystalline limestone	
	Lowville			
	Pamelia	Pamelia	Sandy limestone, dolomite, sandstone, shale	50-70
Chazy Western part of basin	Laval formation Caughnawaga member Ste-Thérèse member	Laval	Crystalline limestone Sandstone, limestone, shale	380

Upper Cambrian	Chazy Eastern part of basin	St-Dominique (may be equivalent to Laval)	St-Dominique	Limestone, dolomite, sandstone	90
		'Beldens'	'Beldens'	Dense limestone, dolomite, in part sandy, and sandstone	230-320
	Beekmantown	Beauharnois	Beekmantown	Dolomite, silty dolomite, siltstone, shale	1,055-1,423
		Theresa		Dolomite, in part silty	
	Potsdam	Potsdam	Potsdam	Dolomitic sandstone and sandy dolomite	
				Sandstone	0-1,700

¹T. H. Clark, personal communication and unpublished manuscript.

Precambrian

The only well that has reached the Precambrian basement is the Canadian Seaboard Ste-Angèle No. 1 well, south of the St. Lawrence River in Nicolet county. Crystalline limestones of the lower part of the Trenton rest on the Precambrian at an elevation of about 4,975 feet below sea-level. Beekmantown, Chazy, Black River, and the lower part of the Trenton strata penetrated in the Canadian Seaboard St-Grégoire No. 1 well, about 5 miles to the southwest, are missing in the Ste-Angèle well, which appears to have encountered a buried knob or ridge on the Precambrian erosion surface. The cuttings from the Precambrian rocks suggest a variety of schists and granitic intrusions.

Cambrian

POTSDAM FORMATION

Distribution and Thickness

The oldest Palæozoic sediments penetrated in that part of the St. Lawrence Lowlands in the province of Quebec consist of a series of sandstones, which overlie the Precambrian basement rocks. These have all been referred to the Potsdam formation of Upper Cambrian age. Exposures of these sandstones on the islands, and to the south, of Lake St. Louis, on the St. Lawrence River, have been mapped by Clark (1944, p. 29), and are also described by him in an unpublished report¹ on the Laval-Lachine map-area.

Neither the total thickness nor the extent of the Potsdam in the St. Lawrence Lowlands in Quebec is known. Surface mapping (Logan, 1863, pp. 87-96; Ells, 1895) has shown the occurrence of Cambrian sandstone on the western margin of the Quebec basin from the International Boundary north along the Beauharnois axis, thence following the border of the Precambrian north of the St. Lawrence as far east as St. Maurice River.

The thickness of the Potsdam as recorded from exposed sections appears to vary greatly. In places, it is very thin, and in other places is missing. On Covey Hill, near Hemmingford, near the International Boundary, Logan (1863, p. 88) measured 540 feet, with the base of section not exposed. Only two wells have been drilled to sufficient depth to reach the Potsdam—the Mallet test hole and the St. John's Petroleum St. Hubert No. 1 well—neither of which penetrated the total thickness of Potsdam. The Mallet test hole drilled through 1,700 feet of sandstones without reaching the Precambrian basement. This thickness appears to be excessive as compared with exposed sections and probably represents beds that filled a channel or depression on the Precambrian erosion surface. At St. Hubert, although the total depth of the St. John's Petroleum St. Hubert No. 1 well is not known, the well passed through at least 120 feet of Potsdam. South of the St. Lawrence, opposite Three Rivers, the Potsdam is missing in the Ste-Angèle well, which bottomed in the Precambrian (See Figure 2).

¹ In the files of the Quebec Department of Mines.

Lithology

As examined in the Mallet test hole, the Potsdam consists for the most part of light grey to white, clean, well-indurated sandstones composed chiefly of quartz. At a depth below 1,900 feet, are scattered pink feldspar grains and other pink and green grains and some mica. Bright pink beds were encountered at 1,970 to 1,990, 2,240 to 2,250, 2,500 to 2,510, 2,950 to 2,960, 2,970 to 2,980, and 3,030 to 3,035 feet. The grains range in size from fine to coarse. Some beds are conglomeratic and contain quartz pebbles. Shale partings occur between some of the beds, and a zone of greenish grey micaceous shales was penetrated between depths of 2,020 and 2,060 feet.

The Potsdam sandstones may represent beds deposited on a relatively stable platform or shelf during the initial marine transgression of the Palæozoic seas over the Precambrian basement. In the Quebec basin they have been referred to the Upper Cambrian. Irregularities in thickness reflect the relief of the erosion surface on which the sandstones rest. The somewhat arkosic nature and poor sorting of the lower part of the Potsdam in the Mallet test hole may reflect rapid deposition of these beds.

Beekmantown

Distribution and Thickness

Sedimentary rocks of Beekmantown age rest on the Potsdam formation. Exposures of these rocks have been described by Logan (1863, pp. 113-115), Ells (1895; 1896, pp. 44-50), and Clark (1944, pp. 29-30). Clark has referred the sandy beds overlying the Potsdam to the Theresa formation and correlated the basal 60 feet of the Beekmantown of the Mallet test hole with this formation. The higher, predominantly dolomitic, beds he has called the Beauharnois formation. As the change from the sandy to the dolomitic phase is gradational and corresponding horizons in the two wells studied could not be determined with certainty this subdivision is not made in this report.

Beekmantown strata have been encountered in seven wells:

	Thickness Feet
Mallet test hole	1,055
St. John's Petroleum St. Hubert No. 1 well	1,400±
Cartier St. Hubert No. 1 well	950
Cadbury and Fry well	855
L'Assomption Experimental Farm well	60
Canadian Seaboard St-Gérard No. 1 well	90
Canadian Seaboard St-Grégoire No. 1 well	350

Of these wells, only the Mallet test hole and the St. John's Petroleum St. Hubert No. 1 well penetrated the complete section of Beekmantown beds. Subsurface information regarding the lower Beekmantown strata and the Beekmantown-Potsdam contact, therefore, applies only to the western part of the basin where these wells are situated.

The total thickness of Beekmantown beds increases from north to south, from about 1,050 feet in the Mallet test hole near Ste. Thérèse to 1,400 feet in the St. John's Petroleum St. Hubert No. 1 well. This thickening is probably related to the regional thickening of the Beekmantown from Ontario southerly into New York state. A comparison of the Mallet test

nole with the Cadbury and Fry well and the St. John's Petroleum St. Hubert well is made in Figures 3 and 4. These show the increase in thickness to be in the lower interbedded sandstone-dolomite phase and in the upper, dark, argillaceous, silty dolomite and siltstone phase.

The upper part of the Beekmantown at least appears to extend over most of the Quebec basin between the Beauharnois axis, where it reaches the surface, and Three Rivers. Like the Potsdam formation it must wedge out against the Precambrian buried knob or ridge of the Canadian Seaboard Ste-Angèle No. 1 well, although the upper 350 feet are represented in the Canadian Seaboard St-Grégoire No. 1 well less than 5 miles to the southwest, as shown in Figure 2.

Lithology

In the Mallet test hole and the St. John's Petroleum St. Hubert well, both of which penetrated the whole of the Beekmantown, three general subdivisions may be made on a lithological basis, although, as shown in Figure 4, each subdivision grades into the adjacent one. The lower part of the Beekmantown consists of interbedded sandstones and dolomites and beds showing all gradation between them. It includes Clark's Theresa formation. The sandstones are grey, fine- to coarse-grained rocks, composed mainly of quartz, with dolomitic cement. Some contain a little dark argillaceous material, and some carry dark shale partings, usually pyritic. The dolomites are grey, finely crystalline to medium crystalline, and commonly sandy. Abundant large, rounded, frosted quartz grains are embedded in both the dolomites and sandstones. Glauconite occurs in the Mallet test hole in the basal Beekmantown between depths of 1,320 and 1,334 feet, and glauconite associated with pyrite between 1,200 and 1,209 feet (See Figure 3). Greenish material, which may be glauconite, occurs in the limestone at a depth of 3,930 feet in the St. John's Petroleum St. Hubert well. In the basal part of this division of interbedded sandstones and dolomites in the St. John's Petroleum St. Hubert well, between depths of 3,900 and 3,950 feet is a 50-foot zone of coarse, granular dolomites and coarsely crystalline limestones, with a few sandstone beds; vugs and fractures in one of the dolomite layers have been filled with selenite (See Figure 3). These beds have been placed in the Beekmantown because this type of sedimentation seems more closely allied to the Beekmantown than to the Potsdam. The lower division of the Beekmantown, consisting of interbedded sandstones and dolomites as described above, is about 280 feet thick in the Mallet test hole. In the St. John's Petroleum St. Hubert No. 1 well, including the 50-foot zone of limestone and dolomite between 3,900 and 3,950 feet, it is about 500 feet thick.

The middle division of the Beekmantown is 480 to 500 feet thick in the St. Hubert wells and the Mallet test hole, and forms the lowermost 376 feet of the Cadbury and Fry well. The bottom of the Canadian Seaboard St-Grégoire well may also be in this division, which consists predominantly of clean, crystalline and granular dolomites. In the upper part, these are silty, and grade to dolomitic siltstones. A bed or beds of finely fragmental or nodular, fossiliferous limestone partly replaced by dolomite occurs near the top. Dolomitic limestones in this division of the St. Hubert wells are almost completely replaced by dolomite in the Mallet test hole. The cores of the latter hole show some porosity, and contain

vugs filled with calcite or dolomite at various depths. At least one of these porous zones is, apparently, continuous from the Mallet test hole to St. Hubert. These relationships are shown graphically in Figure 3.

Between the middle division of the Beekmantown, with its relatively pure carbonates, and the top of the Beekmantown is a section 280 feet thick in the Mallet test hole, 480 feet in the Cadbury and Fry well, and 460 feet in the St. John's Petroleum St. Hubert and Cartier St. Hubert No. 1 wells, composed of darker, more argillaceous beds, commonly with shale partings. These carry a higher proportion of silt, and exhibit all gradations from limestones, dolomites, and silty dolomites to dolomitic and limy siltstones. No beds or horizons are sufficiently distinctive to be correlated through all three wells except for a thin sandy limestone zone shown in Figure 4 by a band of sand grains.

Of the other three wells that drilled into the Beekmantown, Canadian Seaboard St-Gérard No. 1 and L'Assomption Experimental Farm wells reached only the dark, silty, argillaceous dolomites and siltstones of the upper part, as shown in Figure 2. The Canadian Seaboard St-Grégoire No. 1 well penetrated the dark upper division and finished drilling in light-coloured, relatively pure dolomite, probably near the top of, or approaching, the middle division of the Beekmantown identified in the Mallet, Cadbury and Fry, and St. Hubert wells.

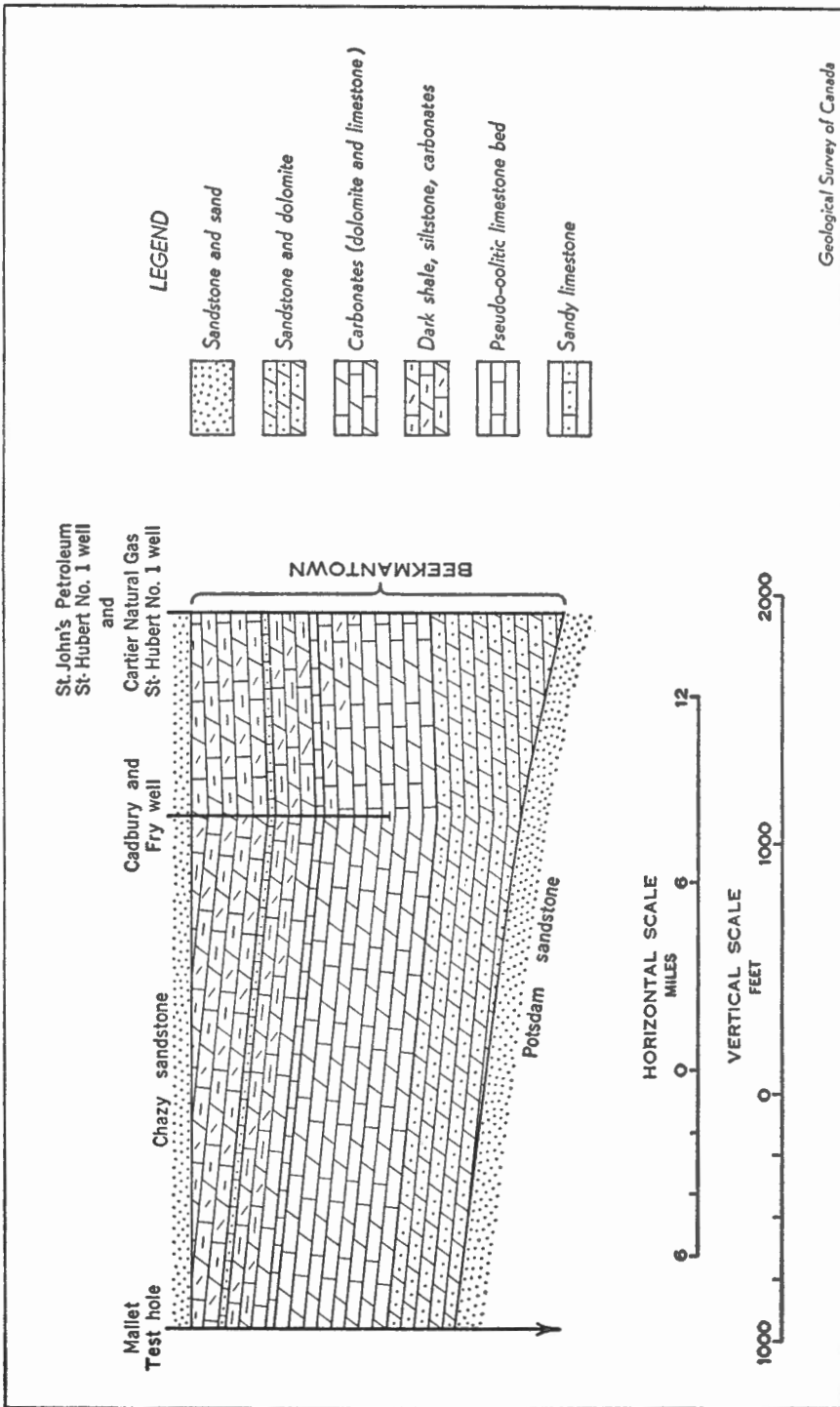
Contact Relations

In the Mallet test hole, the boundary between the Beekmantown and the Potsdam is drawn at a depth of 1,209 feet, where dolomitic sandstones overlie clean quartz sandstones with siliceous cement. In the St. John's Petroleum St. Hubert No. 1 well, carbonate beds, with a thin dolomitic sandstone at the base, occur between dolomitic sandstones and dolomites and clean, coarse, quartz sandstones similar to those of the Potsdam. The samples between the dolomitic sandstone at a depth of 3,950 feet and the quartz sandstone at 3,965 feet are missing, and the Beekmantown-Potsdam contact is believed to lie in this 15-foot interval.

History of Deposition

The Beekmantown sediments probably represent a marine transgressive overlap. Figure 4 is a diagrammatic representation of one set of conditions that may have obtained during the deposition of the Beekmantown, although alternative explanations are possible for the variations in the sequence.

The lowest of the three divisions of the Beekmantown made in this report, consisting of interbedded dolomitic, quartzose sandstones and light-coloured dolomites, appears to represent the transgression of the sea on a stable shelf or foreland. Or, on the other hand, deposition from the Potsdam into the Beekmantown may have been continuous, in which case the lower part of the Beekmantown may represent a transition from the sandstone to the dolomite phase. In either case, the thin section of interbedded sandstones and dolomites at Ste. Thérèse (Mallet test hole) as compared with St. Hubert probably reflects proximity of the Ste. Thérèse area to the shoreline. A longer period of time near the base level of deposition, as compared with the St. Hubert area, and, if the supposition



Geological Survey of Canada

Figure 4. Diagram illustrating marine, transgressive overlap of the lower Beekmantown strata northerly onto the Potsdam sandstone.

that the sea transgressed from the south over the Potsdam is correct, a shorter period during which sand was supplied, may explain the thin section at Ste. Thérèse. Increasing planation of the land and decrease in the volume of sand resulted in the deposition of the carbonate rock sequence, which forms the middle part of the Beekmantown. These carbonate rocks, largely dolomites, suggest the continuation of shallow water conditions, probably in a stable shelf or foreland area, although the black shales and dark, silty carbonate rocks in this part of the section at St. Hubert suggest the encroachment of quieter or deeper water conditions. Such conditions, favourable for the deposition of dark shales, siltstones, and argillaceous, silty limestones and dolomites, appear to have accompanied an advance of the sea from the south over the Quebec basin to form the dark shale-siltstone-carbonate facies preserved in the upper part of the Beekmantown in all of the wells from Ste. Thérèse to St-Grégoire (See Figure 2). The thick section in the Cadbury and Fry, St. Hubert, and St-Grégoire wells as compared with the Mallet test hole may be due in part to thinning of the beds in a shoreward direction or to a shorter period during which deposition of this facies occurred. Thus, in the Mallet test hole, limestones above the nodular or pseudo-oolitic limestone marker bed appear to be represented by the dark shale-siltstone-carbonate facies in the St. Hubert wells. Thinning of the Mallet test hole section has also probably been accentuated by planation of the Beekmantown. These sediments are overlain by quartz sandstone of upper Chazy age. The period of non-deposition or erosion during lower and middle Chazy time and the fact that no sediments characteristic of the regressive phase of the Beekmantown sea are represented, suggest that movements occurring towards the close of Beekmantown time caused the withdrawal of the sea and formed a source for the large supplies of mud and fine silt that entered the Quebec basin at that time.

Chazy

Distribution and Thickness

Sedimentary rocks assigned to the Chazy overlie the Beekmantown. Exposures along the western and northwestern flanks of the Quebec basin have been described by Logan (1863, pp. 125-133) and, near Montreal, by Clark (Laval-Lachine map-area, unpublished manuscript)¹. Chazy strata are also exposed in the St. Dominique thrust slice (Clark, 1947, p. 17), which forms the westernmost ridge to the east of the town of St. Hyacinthe.

Near Montreal, in the western part of the Quebec basin, the Chazy rocks are all represented by the Laval formation, and subdivided into two members, the lower, the Ste. Thérèse, and the upper, the Caughnawaga (Clark, 1944, p. 29). This formation represents only the upper Chazy of the Lake Champlain section (Dresser and Denis, 1944). In the St. Dominique thrust slice, the Chazy beds differ in facies from those near Montreal and have not been correlated with them. Exposures near St. Dominique, on the hill about a mile north of the village of St. Pie, known as the St. Pie Hill section, have been described by J. L. Usher (1947). The lower part of this section has been correlated with the Beldens forma-

¹ Idem, p. 7.

tion of Vermont, described by W. M. Cady (1945, p. 550) and placed in the Chazy¹. The overlying beds of the St. Pie Hill section are Chazy, and the term St. Dominique formation has been suggested for them (T. H. Clark, personal communication).

The Chazy has also been penetrated in six wells:

	Thickness Feet
Cadbury and Fry well	377
L'Assomption Experimental Farm well	260
St. John's Petroleum St. Hubert No. 1 well	378
Cartier St. Hubert No. 1 well	378
Mallet test hole—commenced drilling in Chazy	280
Canadian Seaboard St-Gérard No. 1 well	230
Canadian Seaboard St-Grégoire No. 1 well	410

All of these except the St-Gérard and the St-Grégoire wells are in the western part of the Quebec basin and penetrate the Laval formation.

LAVAL FORMATION

Lithology

As studied in the well cuttings, the lithology of both members of the Laval formation is fairly consistent. The lower, Ste. Thérèse, member consists of fine to coarse, clean, quartz sandstones, usually with a calcareous cement. These grade upwards through calcareous sandstones and interbedded sandstones and limestones, with some interbedded shales, to the overlying Caughnawaga limestone member. There is no sharp break between the two members, but the thickness of the Ste. Thérèse is variable from well to well, as is to be expected in a basal sandstone, thus: 80 to 100 feet in the St. John's Petroleum and Cartier St. Hubert wells; 50 feet in the Cadbury and Fry well; 70 feet in the L'Assomption Experimental Farm well; and 160 feet of sandstones, shales, and limestones in the Mallet test hole.

The Caughnawaga member is composed chiefly of limestones. These are predominantly grey, and vary from finely to coarsely crystalline, the latter appearing to be largely recrystallized coquinoid limestones. These are in some places slightly dolomitic, and in some places silty. A zone about 50 feet thick of finer grained, argillaceous limestone and dark grey shale was penetrated in the Cadbury and Fry well, in the two wells at St. Hubert, and occurs as a sandy limestone with shale in the L'Assomption Experimental Farm well. The top of this zone is about 200 feet above the base of the Chazy. The upper beds in the St. John's Petroleum St. Hubert No. 1 and Cartier St. Hubert No. 1 wells are characterized by shale partings and contain some oolitic zones.

'BELDENS' AND/OR OTHER CHAZY FORMATIONS

Lithology and Correlation

In the eastern part of the Quebec basin, as illustrated by the Canadian Seaboard St-Gérard No. 1 and St-Grégoire No. 1 wells, the series of limestones, dolomites, and sandstones that overlie the typical Beekmantown are

¹ It should be noted that the question of the Chazy or Beekmantown age of the Beldens formation of Vermont is still being discussed.

lithologically dissimilar to the Laval formation, although believed to be of Chazy age. The distance of these wells from the others that penetrate the Chazy, the differences in lithology of the strata they encounter as compared with those penetrated in the other wells, and their distance from outcrops of the Chazy render uncertain the exact correlation of these sediments with any part of the Chazy known in this basin.

In the two wells, certain zones appear to be correlative, although, in general, the whole Chazy section is sandier in the St-Grégoire No. 1 well. These relationships are shown graphically in Figure 3. In both wells the lowest beds of the Chazy are sandstones; the St-Grégoire well encountered 90 feet of sandstone at depths of from 5,580 to 5,670 feet, and the St-Gérard No. 1 well drilled through 50 feet of sandstone and interbedded dolomite and shale, overlain by 20 feet of fine, dense limestone and 20 feet of light grey, coarse, quartz sandstone at depths of from 5,980 to 6,070 feet. These predominantly sandstone sections in both wells are overlain by a zone composed predominantly of dolomites. The dolomites are dark grey, finely crystalline to sugary, silty and sandy, and commonly grade to dolomitic siltstones. Some fine sandstones, fine dense limestones, and shales are interbedded. In the St-Gérard well, the zone is about 100 feet thick (5,880 to 5,980 feet) and in the St-Grégoire well about 170 feet thick (5,410 to 5,580 feet). This zone is succeeded in both wells by grey-brown, cryptocrystalline limestones, which are commonly slightly dolomitic and sandy (5,840 to 5,880 feet in the St-Gérard well, and 5,350 to 5,410 feet in the St-Grégoire well). These limestones are immediately overlain by Black River strata in the St-Gérard well, but in the St-Grégoire well, 90 feet (5,260 to 5,350 feet) of fine- to coarse-grained, calcareous and dolomitic quartz sandstones, interbedded limestones, and dolomites, with a 10-foot zone of finely crystalline dense limestone at the top are found between these and the Black River strata.

The Chazy sediments in these wells, as described above, resemble the Chazy strata of the St. Dominique thrust slice, as observed in the St. Pie Hill section, more than the Chazy of the Montreal area. However, the distance between the wells and from the wells to the nearest outcrops leaves the question of correlation open to more than one interpretation, of which the following seems the most probable. In the Canadian Seaboard St-Grégoire well, the upper limestones and sandstones of the Chazy at depths of 5,260 to 5,350 feet (See Figure 3) may be equivalent to the higher dolomitic limestones and sandstones of the St. Pie Hill section, that is, the St. Dominique formation. The lower 320 feet, between depths of 5,350 and 5,670 feet (See Figure 3) of finely crystalline, dense limestones, dolomites, and sandstones of the Chazy, in this well might, then, be equivalent to the 'Beldens' formation of the St. Pie Hill section, which comprises beds of the same types. The whole 230 feet of the Chazy section in the Canadian Seaboard St-Gérard No. 1 well, which is similar lithologically to the lower part of the Chazy in the St-Grégoire well, might then, also, be equivalent to the 'Beldens' formation of St. Pie Hill.

Another interpretation of the series of sandstones, dolomites, and limestones, presumably Chazy, between the Black River and Beekmantown formations in the St-Gérard and St-Grégoire wells would correlate these sediments with the somewhat similar Chazy beds of the St. Dominique formation that overlie the supposed Beldens of the St. Pie Hill section, in

which case the Beldens is either missing or may be represented by the limestone and sandstone in the lower 70 feet (from 6,000 to 6,070 feet) of the Chazy in the St-Gérard well. Following this interpretation, the Chazy section in the St-Gérard and St-Grégoire wells may be equivalent in age to the sandstones and limestones of the Laval formation in the Montreal area, but represent a different facies. The environmental conditions that determined this facies cannot be defined from the little evidence available, but appear to have been less stable than those under which the Laval formation was deposited, and may point to deposition in alternating shallow and deeper waters. The higher proportion of sand northeastward in the St-Grégoire well as compared with the St-Gérard well suggests derivation of these sediments from a land mass to the northeast, or east.

There is also the possibility that the Chazy sediments in the Canadian Seaboard St-Gérard No. 1 and Canadian Seaboard St-Grégoire No. 1 wells do not correspond in age with either the 'Beldens' or the Laval formation, but represent another formation of the Chazy or Beekmantown that does not extend to the Montreal-St. Hubert area.

Contact Relations

The contact of the Chazy with the Beekmantown is usually distinct. Dark, silty, argillaceous dolomites and dolomitic siltstones, which form the upper beds of the Beekmantown, are overlain by the clean quartz sandstones of the basal Chazy. In the Canadian Seaboard St-Gérard No. 1 well, the contact is not so distinct as in other wells. Sandstones from 6,030 to 6,040 feet are underlain by dolomites, shales, and sandy beds from 6,040 to 6,070 feet, that is, above the typical Beekmantown. These beds have been placed in the Chazy.

History of Deposition

The following, tentative interpretation of the history of the Chazy in the Quebec basin is based on what appears to be the most probable correlation of the sediments encountered in the wells, that is, the correlation of the sections between the Black River and known Beekmantown in the St-Gérard and St-Grégoire wells with the 'Beldens' and St. Dominique formations. Assuming the Chazy age of the 'Beldens', the earliest Chazy beds deposited in this basin were those of the supposed 'Beldens' formation (See Figure 2). The 320-foot section of the 'Beldens' in the Canadian Seaboard St-Grégoire No. 1 well, with its high proportion of sandstone, thins to 230 feet in the Canadian Seaboard St-Gérard No. 1 well and contains less sandstone. To the south, these beds may be continuous with the 'Beldens' of the St. Dominique thrust slice, and may have formed from a northward extension of the Beldens sea, which spread into this area from Vermont. These beds wedge out to the west towards Montreal and probably do not extend much farther north or northeast than the St-Grégoire well. The thicker, sandier deposits at the St-Grégoire well may be the result of proximity to a source of sediments to the east or northeast. The distribution of the 'Beldens' in the wells and its relation to adjacent formations is shown in Figure 2.

Following the deposition of the 'Beldens' formation, sandstones with interbedded carbonate beds, which may represent the St. Dominique

formation, were deposited. They occur in the St-Grégoire No. 1 well at depths of from 5,270 to 5,350 feet. These beds were not encountered in the St-Gérard No. 1 well, possibly as a result of pre-Black River erosion (See Figure 3).

In the western part of the Quebec basin, sediments of lower and middle Chazy age are lacking, and the basal sandstones of the upper Chazy Laval formation immediately overlie the Beekmantown. These are clean quartz sandstones, which appear to represent the basal sandstones of a marine transgressive overlap (See Figures 2 and 4). They may be equivalent to the sandstones in the upper part of the Chazy (tentatively correlated with the St. Dominique) of the St-Grégoire No. 1 well. Progressive planation of the land and transgression of the sea resulted in a decrease in the amount of clastic material entering this area and a consequent gradation in the sediments deposited from sandstones, through sandy limestones, to limestones. The limestones appear to be predominantly shallow water types; many appear to be calcarenites and calcilutites¹, and some of the coarsely crystalline deposits may represent biohermal and biostromal accumulations. The Laval formation, as a whole, reflects a relatively stable, shelf or platform, shallow water environment.

The upper Chazy sea in which the Laval formation was deposited appears to have followed the Champlain trough northward into Quebec and thence westward and northwestward into Ontario. In the Montreal and St. Hubert areas, the limestones of the Laval formation reach a thickness of 280 feet, but to the north at L'Assomption Experimental Farm they are only 190 feet thick, and to the northeast they are missing in the St-Gérard and Ste-Angèle wells, although they may possibly be represented by 10 feet of limestone overlying the St. Dominique(?) sandstone in the St-Grégoire well. It would appear from this distribution of the Laval formation and the disappearance of these beds in a northeasterly direction in the Quebec basin that the upper Chazy sea did not extend far to the north and northeast and, therefore, that the Laval limestones wedge out in that direction. Alternatively, any beds deposited in the northeast part of the Quebec basin may have been eroded before the deposition of the Black River. Probably both factors played a part in the final configuration of the Chazy surface over which the Black River sea advanced.

Black River

Distribution and Thickness

Sediments assigned to the Black River rest on the Chazy. Exposures in the Montreal area have been described by Logan (1863) and by later workers, including Okulitch (1936) and T. H. Clark (Laval-Lachine map-area, unpublished manuscript)². Okulitch and Clark have recognized three formations in the Black River of Quebec, in ascending order—the Pamelia, Lowville, and Leray.

¹ Calcarenite: rock of sand-grain size ($\frac{1}{16}$ to 2 mm. diameter) composed mainly of carbonate detritus. Finer grain sizes are calcilutites.

² Idem, p. 7.

The Black River strata appear to underlie that part of the Quebec basin included in this report. They have been penetrated in seven wells:

	Thickness Feet
St. Philippe No. 1 well	73
Cadbury and Fry well ¹	29+
L'Assomption Experimental Farm well	60
St. John's Petroleum St. Hubert No. 1 well	48
Cartier Natural Gas St. Hubert No. 1 well	50
Canadian Seaboard St-Gérard No. 1 well	70
Canadian Seaboard St-Grégoire No. 1 well	50

Lithology

The lowest Black River beds, although very thin, are believed to represent the Pamela of eastern Ontario. They consist of grey to dark grey, sugary, silty and sandy dolomites and fine-grained dolomitic sandstones, in places with interbedded green and grey shales and sandy shales. In the Canadian Seaboard St-Grégoire No. 1 well, 10 to 15 feet of sandy limestone and fine calcareous sandstone form the basal beds of the Black River, and may represent the Pamela. In the St. Philippe No. 1 well, the basal Black River is characterized by dark grey shales interbedded with fine limestones.

The sandy and dolomitic beds of the Pamela can be distinguished in the well cuttings from the limestones of the Lowville and Leray, but these latter formations cannot be separated from each other. The Lowville and Leray both consist of brown to brownish grey, cryptocrystalline limestones, which commonly have a semiconchoidal fracture. White calcite aggregates and stringers in some samples suggest the 'birds-eye' structure commonly seen in outcrops of the Lowville. Oolitic limestones are represented in samples from the Cadbury and Fry, St. John's Petroleum St. Hubert No. 1, and L'Assomption Experimental Farm wells.

Contact Relations

The contact of the Black River with the Chazy is generally well defined. The dolomites, sandstones, and shales of the Pamela rest on crystalline limestones of the Chazy. In the two wells near St. Hubert, as in exposures near Montreal (Okulitch, 1936, p. 126), the upper part of the Chazy contains shaly beds. In the Canadian Seaboard St-Grégoire No. 1 well, the contact between the Chazy and the Black River is difficult to distinguish. Sandy limestones and calcareous sandstones from depths of 5,240 to 5,250 feet have been accepted arbitrarily as marking the base of the Black River. These sandy beds rest directly on finely crystalline limestone and fine-grained sandstone, which in turn rest on a zone of limestones, sandstones, and dolomites to a depth of 5,350 feet. Possibly the whole or a part of this zone may represent a thickened section of the Pamela. The most pronounced break appears to be between the top sandy zone and the underlying limestone, at which place the contact has been drawn.

¹ An igneous intrusion cuts off the top of the Black River in this well.

History of Deposition

The basal, sandy, dolomitic and shaly beds of the Black River are a facies suggestive of a shallow water, near-shore environment. They indicate transgressive overlap of the Black River over the Chazy. These beds at the base of the Black River are similar to the Pamela of Ontario, but are much thinner. In the Ottawa Valley, the Pamela is about 70 feet thick, and in New York state 150 feet thick (Wilson, 1936, p. 7). In the Quebec basin, the Pamela beds are between 10 and 20 feet thick, but accurate measurements on such a thin formation cannot be made from the 10-foot well samples available. The sea in which these beds were deposited appears to have advanced from New York state into Ontario and thence into the Quebec basin; the thinning of the Pamela in the St-Grégoire well suggests that the advance may not have extended far to the northeast beyond this well. The eastward advance of the Pamela seas from Ontario, at least as far as the island of Montreal, has been recognized by Okulitch (1936, p. 128). These beds were not encountered in the Ste-Angele No. 1 well, and, like the underlying formations, must abut against the buried Precambrian knob or ridge of this area (See Figure 2). The Pamela, if present, is very thin to the northwest, as shown by the St. Philippe No. 1 well. Possibly the transgressive relationships of the Pamela make it equivalent in time to the upper part of the Pamela of Ontario, or later than these beds. Deposition of the sandy beds was followed by the deposition of dense limestones of the Lowville-Leray, following which, limestone deposition appears to have been continuous into Trenton time.

Trenton

Distribution and Thickness

Trenton limestones rest on Black River strata, and are continuous with similar limestones in Ontario and New York state. In the province of Quebec, they are exposed in the southwestern part of the Quebec basin and along the margin of the basin northeasterly parallel with the border of the Precambrian Shield. In the Montreal area, they have been studied in considerable detail, and have been subdivided by Clark (1944, and Laval-Lachine map-area, unpublished manuscript¹) into the following formations, in descending order:

- Terrebonne formation
- Tetreauville formation
- Montreal formation
 - Rosemount member
 - St. Michel member
- Mile End formation

Although these formations have been described from exposures as lithologic units, it is difficult to distinguish them in the well sections. A division may, however, be made between the lower, predominantly fine to coarse, crystalline limestones and the upper, dark, dense, argillaceous limestones and shales. The latter are probably correlative with the Tetreauville and Terrebonne formations.

¹ Idem, p. 7.

Only five of the deep wells penetrated the complete section of the Trenton from the Utica black shale to the Black River strata:

	Thickness Feet
Cartier St. Hubert No. 1 well	870
St. John's Petroleum St. Hubert No. 1 well	875
L'Assomption Experimental Farm well ¹	645 to 725
Canadian Seaboard St-Gérard No. 1 well	960
Canadian Seaboard St-Grégoire No. 1 well	1,100

Other wells give incomplete sections of Trenton: the Cadbury and Fry well, the Lincoln No. 1 well, and the St. Philippe No. 1 commenced drilling below the top of the Trenton; the water wells² at the militia barracks at Longueuil, the Mohr No. 1, Cartier Natural Gas No. 5, and the Richelieu Gas St. Denis No. 1 finished drilling before the base of the Trenton had been reached; the Ste-Angèle No. 1, although it penetrated 1,080 feet of Trenton, found crystalline Trenton limestone resting directly on the Precambrian.

The Trenton, then, occurs throughout the basin of the St. Lawrence Lowlands in Quebec. Northeast of Montreal, opposite Three Rivers, in the vicinity of Ste-Angèle, it overlaps the Precambrian. Farther down the St. Lawrence Valley, Trenton limestones have been mapped by Clark (1948), but as no wells have been drilled there, that part of the lowlands is not included in this report. The Trenton appears to be thinner (about 700 to 800 feet) on the northwest flank and in the western end of the basin near Montreal and to thicken to 1,100 feet in the deeper axial part of the present basin.

Lithology

The lower part of the Trenton succession consists essentially of finely crystalline to coarsely crystalline limestones. In the wells near the Montreal area these limestones may be correlated with the Montreal and Mile End formations, where both are present. The same formations, or their equivalents, may be represented in the Canadian Seaboard St-Gérard No. 1 and Canadian Seaboard St-Grégoire No. 1 wells, but these wells are too distant from Montreal for this correlation to be definite.

These crystalline limestones vary both in aggregate thickness and lithology. In the St. John's Petroleum St. Hubert No. 1 and Cartier St. Hubert No. 1 wells they are about 450 feet thick; in the L'Assomption Experimental Farm well, about 390 feet; in the Canadian Seaboard St-Gérard No. 1 well, about 380 feet; and in the Canadian Seaboard St-Grégoire No. 1 well about 500 feet thick. The deeper water well at the Longueuil barracks penetrates about 470 feet of these limestones, the bottom of the well probably being only a short distance above the uppermost limestones of the Black River (Leray).

Certain subdivisions of the crystalline limestones of the lower part of the Trenton appear to be continuous from well to well. Three such have been recognized, and are illustrated in Figure 3. Possibly these may prove

¹ Intrusion of igneous rock and missing samples at Trenton-Utica contact.

² Samples from two wells drilled at Longueuil barracks were available. Reference is made to the deeper well, 1,425 feet deep, in the following discussion. The shallow well, 660 feet deep, did not completely penetrate the upper shaly part of the Trenton. As the samples of the two wells are similar, only the log of the deeper well is included in this report.

to be equivalent to the Mile End formation and St. Michel and Rosemount members of the Montreal formation. At the base of the section, a zone of coarsely crystalline limestones consisting largely of bryozoa, crinoids, brachiopods, and other fossil fragments rests directly on the dense Black River limestones. It contains a little black shale, probably as stringers and partings. This zone is about 30 to 50 feet thick in the Cartier St. Hubert No. 1, St. John's Petroleum St. Hubert No. 1, and L'Assomption Experimental Farm wells. A similar coarse zone in the Canadian Seaboard St-Grégoire No. 1 well is about 100 feet thick. These beds are missing or are represented by dense, cryptocrystalline limestones in the Canadian Seaboard St-Gérard No. 1 well. The bottom 30 feet, at depths of from 1,395 to 1,425 feet in the deep water well at the Langueuil barracks, appears to be in this zone. Resting on these basal beds is a zone about 80 to 90 feet thick of darker grey, predominantly finely crystalline, argillaceous limestone and dark grey shale, but with which some crystalline to coarsely crystalline limestone is associated. A layer of metabentonite was encountered in this zone in all wells that penetrate it, except for the two wells near St. Hubert. This zone of fine limestone and shale increases in thickness in the St. Philippe No. 1 well to about 120 feet, possibly at the expense of the underlying coarse limestones, which are there only about 20 feet thick. Overlying this fine, shaly zone, the remainder of the lower part of the Trenton, ranging from 260 feet at L'Assomption to 430 feet at St-Grégoire, consists of light to dark grey, finely to coarsely crystalline limestones, with light-coloured, coarsely crystalline limestones predominant below and finer, darker limestones in general increasing in proportion upwards. The coarse limestones appear to be calcarenites or recrystallized coquinoid limestones. In most wells these limestones are partly dolomitized, though rarely more than 10 per cent; but in the Cartier Natural Gas No. 5 well, two coarse limestone zones at depths of from 2,420 to 2,430 feet and from 2,450 to 2,460 feet may be as much as 40 per cent dolomitized. Chert occurs in the coarse limestones in most of the wells, in some places replacing the calcite in organic remains. The chert varies from milky and smoky to dark brown and almost black. Fossil remains, such as brachiopods, bryozoa, corals, and crinoid disks are common.

The upper part of the Trenton is probably correlative with the Tetreauville and Terrebonne formations described by Clark (1941, 1944) in the Montreal area. It consists essentially of dark grey to dark brownish grey, finely crystalline, dense, muddy limestones and dark grey shales. The limestones are also commonly silty, the silt resembling quartz dust. Most of the limestones give a large, dark brown, insoluble residue after treatment with acid, and show gradation into limy shales. Few fossil fragments were seen in the well cuttings in this part of the Trenton section.

The relative proportions of shale and limestone vary from well to well in the upper part of the Trenton. As shown in Figures 2 and 3, limestone commonly predominates over shale in the L'Assomption Experimental Farm well, the Mohr No. 1, Cartier Natural Gas No. 5, St. John's Petroleum St. Hubert No. 1, and Cartier St. Hubert No. 1 wells, and in the Longueuil barracks water wells, that is, in the wells on the northwest flank and western end of the Quebec basin. Shales predominate in the Richelieu Gas Company St. Denis No. 1, Canadian Seaboard St-Gérard No. 1, Canadian Seaboard St-Grégoire No. 1, and Canadian Seaboard Ste-Angèle No. 1

wells, this group being generally down dip towards the axis of the basin from the first group of wells listed. Sections of calcareous shale, with little limestone, occur in these wells; in the St-Gérard well, at depths of from 4,810 to 4,930 and from 5,040 to 5,210 feet; in the St-Grégoire well, from 4,110 to 4,270 and from 4,410 to 4,600 feet; and in the Ste-Angèle well, from 4,020 to 4,120 and from 4,400 to 4,890 feet. As illustrated in Figure 2, this zone of argillaceous limestones and shales appears to be continuous in that part of the basin penetrated by the deep wells and to show an increase in shale content in the central or axial part of the basin. Because of the shaly nature of the Trenton in this part of the basin, it is difficult to determine the contact between the Trenton and overlying Utica shales in the St-Gérard, St-Grégoire, and Ste-Angèle wells.

This upper part of the Trenton increases in thickness from the western end and northwestern flank of the basin towards the axial part of the basin to the east and southeast. In L'Assomption Experimental Farm well, although samples at the contact of the Utica and Trenton are missing and there is an intrusion of igneous rock at this horizon, the maximum possible thickness is 330 feet. In Mohr No. 1 well, the thickness is about 380 feet; in the wells at St. Hubert and the Cartier Natural Gas No. 5 well, about 410 to 430 feet; in the deeper Longueuil barracks water well, about 500 feet; in the Canadian Seaboard St-Gérard No. 1 well, about 580 feet; and in the Canadian Seaboard St-Grégoire No. 1 well, about 600 feet. The Canadian Seaboard Ste-Angèle well penetrated 940 feet of calcareous shales and shaly limestones that may be of Trenton age, but, in view of the proximity of this well to the St-Grégoire well, such a thickness seems excessive, and the possibility of careless sampling must be taken into consideration.

Contact Relations

In exposures near Montreal the upper part of the Black River is a fine, dense limestone (Okulitch, 1936). In the wells examined, limestones of this type are overlain by coarsely crystalline fossiliferous limestones such as are common in the Trenton. This horizon is taken as the Trenton-Black River contact. Whether this change in the character of the limestone corresponds with a change in the fauna, which may distinguish the Trenton from the Black River, is not known, but it forms a consistent and easily defined horizon to use as the contact. Only in the Canadian Seaboard St-Gérard No. 1 well is it difficult to recognize this horizon; in this well the lower beds of the Trenton are very fine, dark, cryptocrystalline limestones resembling those of the Black River.

History of Deposition

Deposition of the Trenton limestones followed the deposition of the Black River limestones. Except for a sandy limestone and thin sandstone at the base of the Trenton in the St-Gérard No. 1 well, in which the Trenton limestone section is thin, no indication of a significant interval of non-deposition is observable in the well samples. Most of the limestones of the lower part of the Trenton appear to have been deposited in a relatively clear, shallow water environment favourable for the existence of organic life, although variations to more shaly facies occur. They

appear to be largely stable foreland or shelf deposits. An increase in the amount of mud and fine silt deposited in this area resulted in the formation of the shaly limestones and calcareous shales of the upper part of the Trenton. As noted above, and as illustrated in Figures 2 and 3, both the proportion of shale in the shale-shaly limestone sequence and the total thickness of this sequence increase down dip from the west end and north-western flank towards the deeper part of the basin, into which the St-Gérard, St-Grégoire, and Ste-Angèle wells have been drilled. In this connection it may also be noted that the Senigon No. 1 diamond drill-hole, on Missisquoi Bay of Lake Champlain, about 40 miles southeast of Montreal, drilled through 1,750 feet of interbedded shales and shaly limestones before reaching the Trenton limestones. This shale-shaly limestone sequence appears to be a deeper water facies transgressing the earlier shallow water limestone facies of the Trenton as a result of a gradual deepening of the basin. Greater subsidence in easterly to southerly directions from the margin of the basin as compared with the marginal parts of the basin may explain the greater proportion of shale and the greater thickness of the shale-shaly limestone facies in this direction. These strata may be transitional into the Utica, possibly both vertically and laterally. The continued sinking of this basin while the Utica and Lorraine sediments were being deposited allowed the accumulation of the great thicknesses of shales and siltstones in post-Trenton time.

Utica

Distribution and Thickness

The black shales that rest on the Trenton strata throughout the Quebec basin in the St. Lawrence Lowlands have been referred to the Utica. These shales grade upwards, apparently without a break, into the Lorraine shales, and probably represent the early part of a long period of continuous deposition in this area during Upper Ordovician time. Because of the gradational nature of the upper contact, no estimate of the thickness of the Utica can be made from the well cuttings.

In the vicinity of Montreal and in the Lachine map-area, exposures of these dark shales have been named the Lachine formation (Clark, 1944). Similar shales forming cliffs along the south shore of the St. Lawrence near Pointe Platon in Lotbinière county, illustrated in Plate I A, have been called the Lotbinière shales (Clark, 1947, pp. 7-8) and correlated with the Lachine formation. Wells drilled between these exposures show their continuity.

The following wells have penetrated the complete Utica section: the water wells at Longueuil barracks and the St. John's Petroleum St. Hubert No. 1, Cartier St. Hubert No. 1, L'Assomption Experimental Farm, Mohr No. 1, Cartier Natural Gas No. 5, Richelieu Gas St. Denis No. 1, Canadian Seaboard St-Gérard No. 1, Canadian Seaboard St-Grégoire No. 1, and the Canadian Seaboard Ste-Angèle No. 1 wells. Also many shallow test holes drilled by the Department of Transport on the south shore of the St. Lawrence opposite Montreal penetrate the Utica shales.

Lithology

The Utica shales are dark grey to black, and give a dark brown streak. Most of them are slightly silty, finely micaceous, and slightly calcareous. Pyrite is abundant as nodules, or is finely disseminated through the shale. Fine veins of white calcite are common. Small quantities of dark brownish grey or brown dolomitic siltstone, fine sandstone, and fine silty dolomite probably represent the concretions and fine sandstone bands commonly seen in exposures. A zone 40 to 70 feet thick at the base of the Utica is highly calcareous, and has a micro-granular texture.

Contact Relations

The contact of the Utica and the Trenton strata, as these terms are used in this report, is usually distinct. The base of the Utica shales is drawn above the highest occurrence of limestone. On the west end and northwestern flank of the basin, as shown in L'Assomption Experimental Farm well, Mohr No. 1, Cartier Natural Gas No. 5, the deeper Longueuil barracks well, St. John's Petroleum St. Hubert No. 1, Cartier St. Hubert No. 1, and Richelieu Gas St. Denis No. 1 wells, the contact is sharply defined by a change from limestone to shale probably due to a period of non-deposition. Deeper in the basin, in the Canadian Seaboard St-Gérard No. 1, Canadian Seaboard St-Grégoire No. 1, and Canadian Seaboard Ste-Angèle No. 1 wells, the same criterion is used, but there the limestone in the upper part of the Trenton is less abundant than shale, and appears to form relatively thin beds in the dark calcareous shales. As shown in Figure 2, this increase in shale content appears to be a facies change in the upper part of the Trenton, possibly with the higher beds representing part of the assumed interval of non-deposition to the north-west and west. This shale-limestone facies of the Trenton probably represents a transition from the Trenton to the Utica and may have been deposited contemporaneously with the Utica of New York.

Lorraine

Distribution and Thickness

The Lorraine grades upward from the Utica to form a thick succession of shales with interbedded siltstones and fine sandstones. Exposures have been described by Logan (1863) and Ells (1896, 1900). Foerste (1916) described many of the sections in detail and subdivided them into faunal zones. Clark (1947, pp. 9-12) divided the Lorraine into two formations, the lower, Leclercville formation, composed of shales, and the upper, Nicolet River (Plate I B), consisting of interbedded shales and sandstones. The latter formation has been subdivided into three zones, based on faunal content. These subdivisions have not been made in the subsurface, as they are not distinctive lithologically, and as the fossil remains in the drill cuttings are not adequate to separate them. A gradual change, over an interval of approximately 100 feet, from a predominantly shale section to one with a higher sand content occurs in the wells examined. This may correspond roughly with the change from the Leclercville to the Nicolet

River formation, and occurs at depths of approximately 2,750 feet in the St. Denis well, 2,500 feet in the St-Grégoire No. 1, 3,450 feet in the St-Gérard No. 1, and 2,100 feet in the Ste-Angèle No. 1 well.

Although most of the wells have encountered Lorraine beds, only four have penetrated the complete section, namely, the Richelieu Gas Company St. Denis No. 1, Canadian Seaboard St-Gérard No. 1, Canadian Seaboard St-Grégoire No. 1, and Canadian Seaboard Ste-Angèle No. 1 wells. The South Shore Nos. 1 and 2 wells penetrated most of the Lorraine, but neither appears to have reached the Utica. The lower part of the Lorraine was encountered in the Mohr No. 1 and Cartier Natural Gas No. 5 wells, the Longueuil barracks water wells, and the St. John's Petroleum St. Hubert No. 1 and Cartier Natural Gas St. Hubert No. 1 wells. Other wells, including the National Gas Nos. 1 and 2 and the Canadian Natural Gas Nos. 1, 2, 3, and 5, bottomed in the Lorraine, and the Quebec Fuel Company's wells Nos. 1, 2, 3, and 4, drilled in 1909 and 1910, for which no samples are available, are reported to have drilled through the Lorraine. Some shallow test holes drilled by the Department of Transport along the St. Lawrence opposite Montreal also encountered Lorraine shales.

Because of the difficulty of separating the Lorraine from the Utica in the wells, the thickness of the Lorraine shales has to be considered in conjunction with the Utica. Clark (1947, pp. 10-11) has measured 2,357 feet of Nicolet River formation, 1,000 feet of Leclercville formation, and 300 feet of Lotbinière formation, of which the base is not exposed, making a total of 3,657 feet. In the Richelieu Gas St. Denis No. 1 well, the Lorraine-Utica section is 2,885 feet thick; in the Canadian Seaboard St-Gérard No. 1 well, 3,310 feet; in the Canadian Seaboard St-Grégoire No. 1 well, 3,400 feet; and in the Canadian Seaboard Ste-Angèle No. 1 well, 3,800 feet. The South Shore No. 1 well commences in the Lorraine and continues in it to a depth of 3,200 feet, the shales in the lower 35 feet having a brownish streak. The nearby South Shore No. 2 well, with 4,200 feet of Lorraine, apparently bottomed above the zone with the brownish streak.

Lithology

The lower part of the Lorraine appears to be transitional upwards from the Utica. The black Utica shales, with a dark brown streak, are gradually replaced upward by black shales with a lighter brown streak and dark grey shales with a grey streak. Where the exact boundary lies between the Utica and Lorraine cannot be determined in the wells.

The shales of the lower part of the Lorraine in the wells are probably correlative with the Leclercville formation. These are dark, fissile, splintery shales, usually finely silty and finely micaceous. Some contain small pyrite nodules. Fine sandstones and siltstones interbedded with the shales are commonly brownish and dolomitic. Few fossil remains were observed.

There is a gradual change upward from predominantly shale beds of the lower part of the Lorraine to interbedded shales, siltstones, and fine sandstones that probably correspond with the Nicolet River formation. Although the change from one division to the other is gradual, the two

divisions may be roughly separated in the wells. Including the Utica, the lower, shaly facies in the Canadian Seaboard St-Gérard No. 1 well is approximately 1,350 feet thick; in the Canadian Seaboard St-Grégoire No. 1 well, it is about 1,550 feet thick; and in the Canadian Seaboard Ste-Angèle No. 1 well, about 1,800 feet. In the Richelieu Gas St. Denis No. 1 well to the southwest, there is less sand in the section as a whole, and the subdivision is not so easily made. A lower section about 1,000 feet thick, consisting of shales, with minor siltstones and fine, slightly dolomitic and non-calcareous sandstones, may correspond with the shaly zones in the other wells.

The dark grey shales of the lower part of the Lorraine are replaced upwards by shales that gradually become lighter in colour to where, in the upper 700 to 1,000 feet, they are light greenish grey. This change in colour is coincident with a change from the more splintery and fissile shales to shales that tend to drill into rounded fragments. Most of the shales are finely micaceous and finely silty, the upper lighter shales being generally softer and less silty than those below. Some of the dark silty shales are brittle, and have a rough, irregular fracture. All gradations from shale to silty shale and siltstone are represented and, particularly about midway of the Lorraine section, fine interlaminae of shale and siltstone are common.

Siltstones and fine-grained sandstones in variable amounts are interbedded with the Lorraine shales. The siltstones are usually greenish grey, composed of variable quantities of angular quartz in a greenish matrix. They are micaceous, and commonly contain numerous small black specks, which are probably carbonaceous. In the upper part of the Lorraine they are more calcareous than lower in the section. The siltstones vary in grain size to fine-grained sandstones. The coarser beds are commonly cleaner than the others, but all are probably closely allied to sub-greywackes. A few limestone beds occur with the sandy beds, especially in the upper 1,000 feet. These are composed largely of recrystallized shell fragments in a sandy, shaly matrix. The sandstones and limestones are lenticular and cannot be traced from well to well. In the upper sandier division of the Lorraine three broad zones, the lower and upper characterized by a high sand content, the middle largely shale, may be traced from the St-Gérard No. 1 well through the St-Grégoire No. 1 well to the Ste-Angèle No. 1. The Richelieu Gas St. Denis No. 1 well encountered less sand, and these subdivisions cannot be made. These relationships are shown in Figure 2.

Fossil fragments are fairly common in cuttings from the wells. In the lower, shaly part of the Lorraine a few brachiopod imprints, crinoid disks, and graptolites were noted. Higher in the Lorraine, in the sandier members, fossils such as brachiopods, bryozoa, and crinoids are abundant, and pelecypod and trilobite fragments are also present. Metabentonite layers are common through the Lorraine, but because of their tendency to cave in drilling little reliance can be placed on them for purposes of correlation.

The thickness of the upper part of the Lorraine, as determined from well sections¹ (as listed below), is somewhat less than that of the measured section on the north bank of Nicolet River about 10 miles upstream from the town of Nicolet (Clark, 1947, p. 9).

	Thickness Feet
Measured section (Clark, 1947)	2,357
Richelieu Gas St. Denis No. 1 well	±1,900
Canadian Seaboard St-Gérard No. 1 well	±1,950
Canadian Seaboard St-Grégoire No. 1 well	±1,900
Canadian Seaboard Ste-Angèle No. 1 well	±2,000
South Shore No. 2 well	±2,200

The South Shore No. 2 well lies about on the strike of the Nicolet River section; the other wells listed above are all to the north and north-west of the measured section, and possibly nearer the edge of the basin of deposition.

The Utica-Lorraine section as a whole thickens to the northeast from the Richelieu Gas St. Denis No. 1 well to the Ste-Angèle No. 1 and southward to the South Shore Nos. 1 and 2 wells and the Nicolet River section. If the distinction made here between the lower shaly zone and the upper sandier zone is significant, most of this thickening has occurred in the lower part of the section. It would appear that the greatest deepening of the basin in which these sediments were deposited was to the south or southeast of the axis of the present syncline.²

History of Deposition

In the Quebec basin, the predominantly limestone facies of the Trenton was replaced by the shale-sandstone facies of the Utica and Lorraine. This clastic facies is represented by a succession of black, pyritic, bituminous shales (Utica) succeeded by the dark grey, then light grey to green shales and sub-greywackes of the Lorraine. This succession seems to indicate continuous deposition from Utica through Lorraine, as suggested by Clark (1947). The proportion of silt and sand increases in the upper part of the Lorraine section where a thick sequence of shales with interbedded shaly siltstones, fine sandstones, and occasional beds of limestone composed of fossil fragments occur. The increase in sand upwards suggests a rising land mass, which supplied the detrital material. As the proportion of sand in the section also increases from the Richelieu Gas St. Denis No. 1 to the Canadian Seaboard St-Gérard No. 1 and St-Grégoire No. 1 wells and the South Shore Nos. 1 and 2 wells, it is probable that the source of the sediments was from an easterly or southeasterly direction.

¹ No allowance can be made from the well cuttings for dip or structural irregularities in the sedimentary beds.

² Regarding the environmental conditions under which these sediments were deposited, attention might be given by surface workers to the possibility of an environment on the sloping part of the sea floor below wave base. The Lorraine interbedded shales and sandstones appear to have many of the characteristics of the deposits of a sloping sea floor as described recently by Rich (J. L. Rich: Three Critical Environments of Deposition, and Criteria for Recognition of Rocks Deposited in Each of Them; Bull. Geol. Soc. Am., vol. 66, pp. 1-20, January 1951), and their position with reference to the Appalachian geosyncline is compatible with such an interpretation.

Richmond

Richmond strata rest on Lorraine strata. They are enclosed within the synclinal basin in the Quebec part of the St. Lawrence Lowlands south of the St. Lawrence River. Two formations have been recognized in the Richmond, the lower fossiliferous, Pontgravé River formation and the upper, 'red-bed' Bécancour River formation.

PONTGRAVÉ RIVER FORMATION

Distribution and Thickness

The fossiliferous Richmond strata have been described from exposures in Quebec by Foerste (1916, pp. 141-159; 1924, pp. 55-56), and have been correlated by him with the Waynesville of Ohio. These beds lie between the Lorraine and the overlying red and green shale facies of the Richmond. They have been mapped as a narrow belt around the synclinal basin south of the St. Lawrence River and the name Pontgravé River formation applied to them (Clark, 1947).

The Pontgravé River formation has been penetrated by several wells in the central part of the Quebec basin, namely, the Richelieu Gas St. Denis No. 1, Canadian Seaboard St-Gérard No. 1, Canadian Seaboard St-Grégoire No. 1 wells, and by a group of wells near St. Hyacinthe, namely, the National Gas Nos. 1 and 2 and Canadian Natural Gas Nos. 2, 3, and 5 wells. In addition, the South Shore No. 2 and Canadian Seaboard Ste-Angèle No. 1 wells both commence in this formation, and the Canadian Natural Gas No. 4 well has provided some samples of the formation near the bottom of the well.

It is difficult to distinguish the Pontgravé River beds from the Lorraine. Foerste pointed out the similarity in lithology of the strata between his zones T and R and the Lorraine (1916, p. 149) and discussed mingling of fossil forms, which suggested to him a Richmond fauna gradually invading a Lorraine sea. He has referred a thickness of 238½ feet of strata to the fossiliferous lower Richmond, of which the upper 156 feet he "correlated definitely with (the) Waynesville member of the Richmond". Clark (1947) gives 156 feet as the thickness of the Pontgravé River formation, apparently including only the strata that Foerste referred to the Waynesville. In this study, because of the lack of fossil evidence and the similarity of the Lorraine and Richmond shales, the presence of hard, blue-grey, silty, finely crystalline limestone has been used as the basis for separating the Lorraine from the Richmond. These limestones are probably the thin, commonly fossiliferous beds and thin limestones interbedded with shales described by Foerste in his sections. On the basis of this criterion, the thickness of the lower Richmond, as measured in the wells, is fairly consistent, ranging from 210 to 220 feet. It apparently includes beds that Clark has referred to the Lorraine. The appearance of this type of silty limestone may not mark the actual contact between the Lorraine and Richmond, but it seems to be the most useful criterion for subsurface separation of the strata and is of value in that it points, if not to a break in sedimentation, at least to a change of conditions between Lorraine and Richmond environments. The actual thickness of these strata in most of the wells near St. Hyacinthe

cannot be determined because of the thrusting or slicing of the sections, or because of poor samples. However, in the National Gas No. 1 well, in which the section appears to be fairly normal, the Pontgravé River formation is 240 feet thick, and in the Canadian Natural Gas No. 5 it is 250 feet thick.

Lithology

The Pontgravé River formation consists mainly of grey to greenish grey, finely micaceous, calcareous shales similar to those in the upper part of the Lorraine. Where drilled, these tend to break into rounded fragments, although some show good cleavage and fissility. Interbedded with the shales are grey, calcareous siltstones (also similar to those of the Lorraine), and grey and blue-grey, dense, finely crystalline, silty limestones. The siltstones are fairly micaceous and argillaceous towards the base of the section, but become cleaner higher in the section and grade towards pure quartz-calcite mixtures in the silty limestones. In addition to the fine silty limestones, light grey, crystalline, fossiliferous limestones also occur.

Fossils are abundant throughout the formation. There appear to be several zones of ostracods; recrystallized bryozoa are common, and brachiopods, cephalopods, and gastropods were observed.

Contact Relations and History of Deposition

The difficulty in distinguishing between Lorraine and Richmond strata in the Quebec basin has been discussed above. In this study the contact is placed at the lowest occurrence of blue-grey, finely crystalline, silty limestone, although shales and siltstones similar to those in the upper part of the Lorraine form a larger part of the section than the limestones. A general gradation from the Lorraine to the Richmond is shown by the decrease of silt and increase of limestone, and in the lime content of the shales upwards in the section. Deposition may have been continuous in this basin from Lorraine to Richmond.

BÉCANCOUR RIVER FORMATION

Distribution and Thickness

Overlying the lower Richmond Pontgravé River formation, are the red and green shales and sandstones that constitute the youngest Ordovician strata in the St. Lawrence Lowlands. Exposures to the southeast of the St. Lawrence River, where these beds are enclosed in the synclinal basin, have been described by Clark (1947), who has given the name Bécancour River formation to these strata. Although the beds appear to be generally non-fossiliferous in Quebec, their stratigraphic position and similar lithology have led to their correlation with the Queenston formation of Ontario. Possibly, as suggested by Foerste (1916, p. 175), this 'red-bed' facies of the Richmond may be the time equivalent of at least part of the lower fossiliferous Richmond elsewhere.

Considerable information as to the nature and thickness of these beds has been obtained from the deep wells in this area. Varying thicknesses

have been penetrated by the following wells, depending on the position of the well with reference to the deepest part of the basin in which these beds are preserved:

	Thickness Feet
Richelieu Gas Company St. Denis No. 1 well	800
Canadian Seaboard St-Gérard No. 1 well	1,230
Canadian Seaboard St-Grégoire No. 1 well	430
National Gas Co. No. 1 well	965
National Gas Co. No. 2 well	650
Canadian Natural Gas No. 2 well	1,170
Canadian Natural Gas No. 3 well	460
Canadian Natural Gas No. 4 well	2,080
Canadian Natural Gas No. 5 well	1,000

Several deep wells drilled in Nicolet county, including the Trudel and Bergeron wells, penetrated the Bécancour River formation, some of them probably passing through the Richmond into Lorraine strata. These are listed, with driller's logs where available, in the 1930 Annual Report of the Quebec Bureau of Mines.

Lithology

The lowest beds of the Bécancour River formation consist of green, non-calcareous, massive shales or mudstones. In some wells they contain large, subrounded to rounded, frosted quartz grains. These green beds are overlain by a series of predominantly reddish brown shales, with some interbedded green shales. The shales, whether red or green, are massive, usually silty, and in some places slightly calcareous. In most wells, the red shales are flecked with white or pink anhydrite or gypsum. They grade upwards into sandy shales, interbedded sandstones and shales, and, near the top, to fine- to coarse-grained sandstones.¹ These sandstones commonly consist of quartz grains in a red or green argillaceous matrix, the red colour predominating. The Richelieu Gas St. Denis No. 1 well has a more sandy section than the other wells, sandstones apparently replacing the upper part of the red shale sections present in the St-Gérard No. 1, National Gas No. 1, and Canadian Natural Gas No. 2 wells. The gradations of the Bécancour River formation from shales to sandy shales and sandstones are illustrated in Figure 2.

Contact Relations

The base of the Bécancour River formation, where it rests on the Pontgravé River formation, is usually in a zone of green shales. As the Bécancour River beds where exposed in Quebec are not fossiliferous, the contact in exposed sections has been placed at the highest occurrence of fossil forms, *Zygospira kentuckyensis* being the most common at the top of the Pontgravé River (Foerste, 1916, and Clark, 1947). In subsurface studies the shales of the Pontgravé River formation can be readily distinguished from those of the Bécancour River under the binocular microscope; the former are greenish grey, fissile, commonly finely micaceous, finely silty, and calcareous; the latter are green, or grey-green with less

¹ A correlation of this upper sandstone zone with the Medina and Cataract of Ontario has been suggested by Snider and Farish (1935).

grey than the Pontgravé River shales, and are a massive, mudstone type of shale, slightly or non-calcareous, commonly silty or sandy. The sand grains are considerably larger (up to 0.5 mm.) in the Bécancour River formation than in the underlying formation.

History of Deposition

With the advent of Bécancour River time, the Quebec basin of deposition appears to have been gradually isolated from the open sea. The red, sandy, gypsiferous mudstones especially, suggest deposition in a basin at least partly cut off from the sea, possibly estuarine or lagunal. The sea appears to have been retreating from this area and the shoreline nearing it at this time, probably as the result of uplift of an adjacent land mass. The increasing sand content of the shales and the gradation of the red shales upwards to red, argillaceous, generally poorly sorted sandstones suggest a continued rise of the land mass and retreat of the sea, causing the basin to be filled with sediments that appear to be largely continental. This retreat of the sea closed the history of the Ordovician basin of deposition in this area. Increasing sandiness of the sediments in a generally easterly direction points to a land mass lying in that general direction from this area as the source of sediments. The possibility that these strata in part represent a shore facies of Richmond fossiliferous beds elsewhere has been pointed out (page 27).

Summary

In broad outline, and with numerous fluctuations, the sedimentary history of the Quebec basin shows generally shallow water, shelf or fore-land deposits of late Cambrian and early Ordovician time, superseded in late Middle Ordovician time (late Trenton) by deposits characteristic of a subsiding basin. The nature of the later Ordovician sediments and the environments of deposition deduced therefrom seem to indicate a progressive sinking of the basin, possibly due to the migration northwestward of the mobile belt of the Appalachian geosynclinal area. The filling of the basin with sediments, and withdrawal of the Ordovician sea coincident with the uplift of a land mass to the east brought the Ordovician Period to a close.

STRUCTURE

As the wells in the Quebec basin of the St. Lawrence Lowlands are for the most part widely spaced, the information they supply is primarily stratigraphic. However, some major structural features are apparent from a study of sections correlated from well to well. The structural relationships are shown in Figure 2, so far as they could be determined from the well sections, and from the position of formation contacts relative to sea-level between wells. The positions of the formational contacts were determined from published maps. The vertical scale, and, therefore, the dip of the strata, have been greatly exaggerated in this diagram; published data show that the dips are rarely more than 5 or 10 degrees.

The lower Palæozoic rocks of the St. Lawrence Lowlands in Quebec are in contact to the northwest with the deeply and irregularly eroded surface of the Precambrian rocks of the Canadian Shield; to the southeast, the lowlands are limited by the zone of thrusts known as 'Logan's Line' (See Figure 1), which marks the northwestern boundary of the folded and faulted Palæozoic rocks of the Appalachian system. In its northwestern part, the folded belt includes Ordovician rocks overthrust onto the lowlands, but originally deposited continuously with the sediments of the lowlands. The St. Lawrence Lowlands of Quebec pass southward to Lake Champlain, and to the west are separated from the Ottawa-St. Lawrence Lowlands basin of eastern Ontario and western Quebec by the Beauharnois axis, which brings Precambrian rocks to the surface near Rigaud and Lake of Two Mountains.

The structural features of the St. Lawrence Lowlands south of the St. Lawrence have been mapped and described by Clark (1947, pp. 15-17), and in the vicinity of Montreal by the same author (1944, p. 31). The major structural feature of this basin, as may be seen by reference to Figure 2, is the doubly plunging, northeasterly trending Chambly-Fortier-ville syncline (Clark, 1947, p. 15). On the northwest limb of the fold, between the Precambrian Shield and the axis of the fold southeast of the St. Lawrence River, all the formations from the Upper Cambrian Potsdam to the Upper Ordovician Bécancour River are exposed. The southeast limb of the fold is slightly steeper. In part it is overridden and disturbed by the frontal thrusts of the Appalachian Mountain system to form a belt of distorted rocks, called by Clark (1947) the St. Germaine complex. Some repetition of beds, or crumpling associated with folding, may explain the excessive thickness of the Lorraine beds in the South Shore No. 2 well drilled on the southeast limb of the syncline.

Some minor folding on the northwest limb of the syncline is apparent from comparison of well sections. Shallow folds are indicated by the relationships of the strata in the Mallet test hole and the St. Phillippe No. 1 well, and L'Assomption Experimental Farm wells. Small folds between the Longueuil barracks wells and the St. John's Petroleum and Cartier St. Hubert wells are reflected in the relationship between the Utica and Lorraine shales as exposed southwest of the area included in this report (Clark, 1944). A change in dip between the L'Assomption Experimental Farm well and the Richelieu Gas St. Denis No. 1 well may be due either to minor folds or to a fault. Faults and, probably, folds have complicated the structure between the Mallet test hole and the Lincoln No. 1 well at Montreal, and some of this complexity may be related to the intrusive rocks of Mount Royal. A fault that lies between the Cadbury and Fry well and the Lincoln No. 1 and Longueuil barracks wells, brings the Chazy to the surface at the site of the Cadbury and Fry well. This fault may possibly be a continuation of the Ile Bizard fault shown by Clark (1944) as passing from the northern tip of Ile Bizard across the Island of Montreal and along the north side of Mount Royal.

The Precambrian buried knob or ridge encountered at the bottom of the Canadian Seaboard Ste-Angèle No. 1 well may also be an important structural feature. Crystalline limestones of Trenton age rest on Precambrian rocks in this well, whereas 5 miles to the southwest, the Canadian Seaboard St-Grégoire No. 1 well penetrated the rest of the Trenton, the

Black River, Chazy, and 350 feet of Beekmantown, a total of some 1,280 feet of strata, beneath the lowest Trenton of the Ste-Angèle well. As the St-Grégoire well did not reach basement the dip of the Precambrian surface between the two wells must be more than 250 feet to the mile. The dip may be gentle, with overlap of the Potsdam and Lower and Middle Ordovician strata on the Precambrian; or there may be a sharp drop from the Ste-Angèle well due, perhaps, to pre-middle Trenton high-angle normal faulting, with the accumulation of Potsdam and Lower and Middle Ordovician strata in the basin so formed. Why the upper Trenton section of shaly limestone and shale in the Ste-Angèle well over the Precambrian 'high' is so thick as compared with that of other wells cannot be easily explained.

On the southwest limb of the Chambly-Fortierville syncline a group of wells, the National Gas Nos. 1 and 2 wells and the Canadian Natural Gas Nos. 1, 2, 3, 4, and 5 wells, near St. Barnabé in St. Hyacinthe county, penetrated a structurally complex section. Repetition of strata noted in the log of the Canadian Natural Gas No. 3 well at about 835 feet (page 43), in the National Gas No. 2 well at about 730 feet (page 90), and in Canadian Natural Gas No. 4 well at 2,280 feet (page 46), can best be accounted for by southeast dipping thrusts.

These and other thrusts, with associated drag-folds and general crumpling of the strata may account for the irregular and abnormally thick Bécancour River and Pontgravé River sections in several of these wells. Thus, green Bécancour River shales reach a thickness of 535 feet in the Canadian Natural Gas No. 3 well, and 750 feet in the Canadian Natural Gas No. 4 well, whereas they are only 70 feet thick in the National Gas No. 2 well about 20 miles to the southwest. These abnormally thick sections may be partly due to the drill having followed fault zones, but it should be remembered that these are old wells, and that the samples may not be entirely reliable. Snider and Farish (1935, p. 96, fig. 4), have illustrated the relationship of the strata and thrusts in these wells, and their interpretation has been essentially substantiated by the present study.

ECONOMIC GEOLOGY

Petroleum and Natural Gas

Natural gas occurrences are common in the drift overlying the Trenton, Utica, and Lorraine strata where they reach the surface in the Quebec basin of the St. Lawrence Lowlands. Numerous water wells have provided showings of gas, and many shallow wells have supplied individual farms for years with natural gas from pockets in the drift. None of these, however, has proved commercially important. No showings of oil have been reported. None of the deeper tests drilled in search of oil or gas has obtained commercial production but, on the other hand, none has been located with express regard to structural or other conditions that might provide traps for oil accumulation. Most have been drilled in the deeper part of the basin, and few have penetrated all prospective zones.

In spite of its discouraging history, the Quebec basin, marginal to the Appalachian geosynclinal belt, and with a history of slow subsidence

and the accumulation of a variable succession of sediments representing facies that vary from reservoir types to source rock types, may be considered as a potentially favourable area for oil and gas occurrence. Sufficient drilling has not been done to determine definitely the value of any formation with regard to oil and gas accumulation. The clean quartz sandstones of the Potsdam may contain porous zones, although where drilled they have shown a high degree of cementation throughout. The complete section of the Beekmantown has been drilled in only two wells. The most encouraging zones of the Beekmantown are the light dolomites, with crystalline and granular textures, found in the middle and lower part of the section. Some of these dolomites show some porosity. The coarsely crystalline Chazy limestones would form suitable reservoir rocks in which oil might accumulate under favourable conditions, and changes in Chazy sedimentation between the St. Hubert-Montreal area and the St.-Gérard area, caused by wedging out of beds or by facies changes, might result in the formation of traps for the accumulation of oil and gas. The Trenton strata are productive of oil elsewhere, and the coarsely crystalline limestones of the lower part of the Trenton could be potential reservoirs under favourable conditions, although no porous zones have been found in the wells studied. Above the Trenton, the lenticular sandstones of the Lorraine afford the only possibilities for oil accumulation. These sandstones, however, are usually fine grained and argillaceous, so that their porosity is generally poor. No definite trends towards purer or more porous sands could be determined from the well data, but if such sands are present, their lenticular character would provide the conditions for stratigraphic traps that might well be productive in view of their proximity to the black bituminous shales of the Utica and dark shales of the lower part of the Lorraine.

The structural features of the basin that might favour the accumulation of oil and gas have not been fully investigated. Minor folds are known, from both surface and subsurface studies, on the northwest limb of the syncline, and folding has occurred on the southeast limb. Normal faults, several of which are known in this area, might under certain conditions, form traps for oil and gas.

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APPENDIX: LOGS OF WELLS

L'ASSOMPTION EXPERIMENTAL FARM WELL

Location: near bank of river, Dominion Experimental Farm, about
1 mile south of town of L'Assomption, L'Assomption
county, Quebec

Elevation: 25± feet

Drilled: 1929

Total depth: 1,640 feet

Rig: cable

Samples examined by H. R. Belyea, 1946; revised, 1951

Depth	Lithology
Feet	<i>Drift</i>
0-110	Grey mud
110-120	Sand
	<i>Lorraine and Utica</i>
120-135	Shale, grey and dark grey, fissile, finely silty, finely micaceous; in part with irregular fracture; some with brown streak
135-140	Shale, as above; some siltstone, dark grey-brown, dolomitic
140-145	Shale, grey and dark grey, finely silty, micaceous as above
145-175	Shale, as above; dark grey-brown, dolomitic siltstone
175-185	Shale, grey and dark grey as above; metabentonite, olive-green, soapy; with black nodules
185-255	Shale, dark grey, in part with a brownish grey streak; a little brown, dolomitic siltstone
255-265	Missing
265-275	Shale, as above, with a brown streak
275-305	Shale, pyritic; igneous rock
305-375	Igneous rock, light grey, with quartz, feldspar, and amphibole
375-395	Shale, black, with a brown streak; pyritic
395-425	Missing
425-435	Shale, black, with brown streak
435-445	Shale, black, granular, calcareous, pyritic
445-515	Shale, black, with brown streak
515-535	Shale, black, granular texture, calcareous, light brown streak, pyritic
535-580	Missing
580-620	Igneous rock
	<i>Trenton</i>
	Terrebonne and Tetreauville Formations
620-660	Limestone, buff-grey, dense, argillaceous, finely silty; 10 per cent black shale
660-670	Limestone, dark grey, finely crystalline ¹ ; some coarser crystalline limestone
670-710	Limestone, as above; some coarse fragments; brachiopods, crinoids
710-740	Limestone, dark grey and grey, finely to medium crystalline; some coarse, recrystallized fragments; crinoids, brachiopods, ostracods
740-760	Limestone, grey, finely crystalline, argillaceous; crinoids; metabentonite, 740-750 feet
760-770	Limestone, grey, finely crystalline, argillaceous; some coarsely crystalline limestone; black shale partings
770-800	Missing
800-830	Limestone, dark grey, finely crystalline; black shale, 20 per cent; metabentonite, 820 to 830 feet
830-870	Limestone, grey, finely crystalline, argillaceous

¹ The scale of crystal sizes used in this report for describing the carbonate rocks are as follows, all measurements being approximate: cryptocrystalline—up to 0.01 mm.; finely crystalline—0.01-0.1 mm.; medium crystalline—0.1-1.5 mm.; coarsely crystalline—1.5 mm. and up. In describing dolomites the term granular is used for coarsely sugary types.

Depth	Lithology
<i>Montreal and Mile End Formations</i>	
870-925	Limestone, grey-brown, argillaceous, finely crystalline; with some coarsely crystalline fragments, probably recrystallized fossils; dark grey, soapy shale
925-945	Limestone, light grey, finely crystalline; black shale partings
945-955	Limestone, light grey, finely to coarsely crystalline; argillaceous in part; crinoids and other fossil fragments
955-965	Limestone, grey, finely crystalline; dark grey shale
965-975	Limestone, grey, finely to medium crystalline; crinoids
975-985	Limestone, brown, finely to medium crystalline; crinoids and other fossil fragments; chert
985-990	Limestone, grey, finely crystalline; fossil fragments; black shale
990-1,000	Poor sample
1,000-1,010	Limestone, grey, finely to medium crystalline; brachiopods, ostracods
1,010-1,030	Limestone, buff, crystalline, powdered by drill; chert
1,030-1,080	Limestone, buff, coarsely crystalline, dolomitic in part, fossiliferous—bryozoa and coral-like fossil, 1,030 to 1,050 feet; thin shale partings
1,080-1,100	Limestone, buff, slightly dolomitic, crystalline, fossiliferous as above
1,100-1,110	Limestone, same as above; in part siliceous; pyritic
1,110-1,130	Limestone, buff, finely to coarsely crystalline; slightly dolomitic in part; slightly sandy; fossiliferous—crinoid fragments; shale partings common
1,130-1,140	Limestone, grey, finely to medium crystalline; metabentonite, blue-grey, pyritic; crinoids, brachiopods
1,140-1,160	Limestone, buff, finely to medium crystalline; slightly sandy; in part slightly dolomitic; fossiliferous
1,160-1,170	Limestone, brownish grey, finely crystalline, argillaceous; in part buff, coarsely crystalline, dolomitic; shale partings; sand grains
1,170-1,200	Limestone, light buff, crystalline, slightly dolomitic in part; powdered by drill; shale partings
1,200-1,210	Limestone, slightly dolomitic as above; less shale than above
1,210-1,260	Limestone, in part dolomitic, light buff to cream, medium to coarsely crystalline; very fossiliferous—probably coquinoid
<i>Black River</i>	
<i>Leray and Lowville Formations</i>	
1,260-1,270	Limestone, brown, cryptocrystalline, sublithographic, argillaceous; slightly dolomitic, in part; dark grey shale partings; brown chert
1,270-1,280	Limestone, dark brown, cryptocrystalline, sublithographic, argillaceous
1,280-1,290	Limestone, dark brown, cryptocrystalline, sublithographic to finely crystalline, slightly dolomitic, micro-silty; some buff, crystalline limestone; a little indistinctly oolitic limestone
<i>Pamelia Formation ?</i>	
1,290-1,300	Dolomite, creamy grey, saccharoidal, pyritic, sandy, with large, rounded, frosted quartz grains; a little shale, green, soapy; some brownish, oolitic limestone
1,300-1,310	Dolomite, grey, saccharoidal, slightly argillaceous, sandy; light grey, fine sandstone; grey shale partings; slight oil stain
1,310-1,320	Dolomite, grey to cream, saccharoidal, sandy; greenish grey shale partings; sandstone, greenish grey, dolomitic, speckled
<i>Chazy</i>	
<i>Laval Formation</i>	
1,320-1,330	Limestone, buff, medium to coarsely crystalline; dolomitic in part; shale partings
1,330-1,340	Dolomite, limy, brown to grey-brown, crystalline; light grey, crystalline limestone; a little oolitic limestone; a few sand grains; crinoids

Depth	Lithology
<i>Chazy—Con.</i>	
Laval Formation— <i>Con.</i>	
1,340–1,350	Limestone, very dolomitic, brown to buff, crystalline; in part fragmental
1,350–1,370	Limestone, dolomitic, buff to cream, crystalline to coarsely crystalline; fossiliferous
1,370–1,390	Dolomite, grey, sugary, silty; limestone, buff, dolomitic, crystalline; a little oolite; brachiopod, probably <i>Zygospira</i> sp., identified by Alice E. Wilson
1,390–1,430	Limestone, dolomitic, very sandy; large, rounded, frosted quartz grains; shale partings; metabentonite, green, with nodules, 1,410 to 1,420 feet
1,430–1,450	Limestone, buff to grey, finely to medium crystalline, slightly dolomitic, finely silty; shaly in part; fossiliferous; much dark grey, calcareous, silty shale; grey, dolomitic sandstone
1,450–1,480	Limestone, cream to grey, coarsely crystalline, slightly dolomitic; brachiopods; a little grey shale
1,480–1,490	Limestone, grey, dolomitic, fossiliferous, silty, argillaceous; much greyish green shale
1,490–1,510	Limestone, grey to brownish grey, finely crystalline, slightly dolomitic, argillaceous, and buff, crystalline limestone; some shale; a little sandstone
1,510–1,520	Sandstone, light grey, very calcareous, fine-grained; with scattered, large, rounded, frosted quartz grains; ostracods; many hard, shiny, black, irregularly shaped particles, probably trilobite fragments
1,520–1,550	Sandstone, light grey, coarse-grained; a little shale
1,550–1,560	Sandstone, light grey, coarse
1,560–1,580	Sandstone; as above; thin shale partings
<i>Beekmantown</i>	
1,580–1,600	Limestone and shale: brownish grey, argillaceous, finely crystalline limestone; nearly an equal amount of dark grey, silty, dolomitic shale
1,600–1,610	Shale and siltstone: dark grey shale and dark grey, dolomitic siltstone; a little limestone, as above
1,610–1,640	Limestone, brownish grey, dolomitic, finely crystalline; much dark grey, dolomitic shale and siltstone

Note. The Trenton section in this well is thinner than in most wells examined. The upper shaly part is only about 250 feet thick. The crystalline limestones from 870 to 1,260 feet are comparable with the lower part of the Trenton in the Montreal area and in the other wells examined.

CADBURY AND FRY WELL

Location: 2025 Masson Street, Montreal, Quebec

Elevation: 25–50± feet

Drilled: 1939

Total depth: 1,395 feet

Rig: cable

Samples examined by H. R. Belyea, 1946; revised in part, 1950

Depth	Lithology
<i>Trenton</i>	
Montreal and Mile End Formations	
0-30	Limestone, grey, finely crystalline, argillaceous; light grey, medium to coarsely crystalline, fossiliferous limestone; brachiopods, ostracods; some dark grey shale
30-104	Limestone, light grey, medium to coarsely crystalline; brachiopods, ostracods
104-114	Limestone, same as above
114-121	Poor sample—limestone, light grey, crystalline; brachiopods; large pieces dark grey shale with dark brown streak
121-134	Dark igneous rock
<i>Black River</i>	
Lowville and Leray Formations	
134-140	Limestone, dark grey, cryptocrystalline to finely crystalline; pyritic; some dark grey shale and fine, shaly, silty limestone
140-152	Limestone, light brownish grey, cryptocrystalline, sublithographic, slightly silty; some darker grey, finely crystalline, silty limestone; oolitic limestone
Pamelia Formation	
152-163	Sandstone and shale: light greenish grey, fine-grained, dolomitic, argillaceous sandstone; light green and grey, waxy shale, with shiny black fragments, probably trilobite remains; pyrite; some brown and grey, cryptocrystalline limestone as above; a little grey, crystalline, silty dolomite, one fragment with a chert pebble
<i>Chazy</i>	
Laval Formation	
163-181	Limestone, light grey, coarsely crystalline, slightly dolomitic; fossiliferous—composed in part of abundant brachiopod fragments
181-198	Limestone, light grey, coarsely crystalline; in part slightly dolomitic and silty. Probable <i>Camarotoechia</i> identified by Alice E. Wilson
198-208	Limestone, light grey, coarsely crystalline same as above; some grey, silty, fine, sugary dolomite; ostracods
208-215	Limestone, light grey, coarsely crystalline, fragmental in part, with irregular fragments in a finer matrix; brachiopods, crinoid disks; probable <i>Camarotoechia</i> identified by Alice E. Wilson
215-236	Siltstone, dolomite, and shale: dark grey, dolomitic siltstone and granular, silty dolomite; dark grey shale; pyrite; some limestone as above
236-238	Limestone, light grey, coarsely crystalline, slightly dolomitic; larger fragments semi-rounded, clastic
238-275	One sample: limestone, grey, cryptocrystalline, argillaceous; grey calcareous shale
275-280	Limestone and shale, as above
280-324	Limestone, buff, medium to coarsely crystalline, fossiliferous, dolomitic
324-380	Limestone and shale: grey, shaly, dolomitic limestone and dolomitic, fissile shale in about equal amounts
380-420	Limestone, light grey to cream, coarsely crystalline, fossiliferous, dolomitic; probable <i>Camarotoechia</i>
420-445	Limestone, pink, dolomitic, coarsely crystalline; ostracod and other fossil fragments; grey shale partings
445-488	Limestone, light grey, dolomitic, fossiliferous, sandy; in part with black fragments—probably trilobite remains

Depth	Lithology
	<i>Chazy—Con.</i>
	<i>Laval Formation—Con.</i>
488-510	Sandstone, grey, dolomitic, fine-grained; few large, rounded quartz grains; a little grey shale; trilobite fragments
510-515	Limestone, light grey, crystalline, sandy; with large, frosted, rounded quartz grains; grading to fine-grained, calcareous sandstone, with larger quartz grains embedded; small black fragments, probable trilobite remains; brachiopod
515-520	Igneous rock, fine-grained, dark green
520-525	Sandstone and shale: light grey, fine-grained, quartz sandstone with scattered, large, frosted quartz grains; green and dark grey shale
525-540	One sample: sandstone, dark grey, fine-grained, micaceous, argillaceous; dolomitic cement; a few large, frosted quartz grains
	<i>Beekmantown</i>
540-560	Shale, siltstone, and limestone: grey, calcareous shale and silty shale grading to grey, shaly siltstone and silty limestone; some fragments of light grey, cryptocrystalline limestone
560-572	Siltstone, light grey, dolomitic, argillaceous; grading to light grey, fine, silty dolomite
572-575	Siltstone grading to silty dolomite, as above; a little igneous rock
575-580	Siltstone and shale: darker grey, shaly, dolomitic siltstone, and dark grey shale
580-585	Shale and siltstone: dark grey shale; grey, dolomitic siltstone, as above, and lighter grey, fine, silty dolomite
585-599	Siltstone and dolomite: grey, dolomitic, argillaceous siltstone grading to fine, silty dolomite
599-603	Limestone, siltstone, and shale: dark grey, argillaceous, calcareous siltstone grading to grey, silty limestone; some dark grey shale; pyritic 600-603 feet
603-610	Siltstone and dolomite: grey, argillaceous, dolomitic siltstone grading to grey, silty dolomite
610-635	One sample: limestone and siltstone; dark grey, argillaceous, calcareous siltstone and dark grey shale; some grey, finely crystalline limestone
635-645	Limestone and siltstone: light grey, crystalline limestone with fossil fragments and recrystallized calcite rhombs; dark grey, argillaceous, calcareous siltstone
645-660	Missing
660-670	Siltstone and dolomite: grey, dolomitic siltstone grading to grey, silty dolomite; some grey, finely crystalline dolomite
670-680	Missing
680-690	One sample: siltstone and dolomite; grey, dolomitic, argillaceous siltstone, darker than above, and grey, silty dolomite
690-710	Siltstone, grey, dolomitic, grading to fine, silty dolomite
710-725	Siltstone and dolomite: grey, argillaceous, dolomitic siltstone and fine, silty dolomite; pyrite
725-750	Siltstone and dolomite, as above; some fine-grained igneous rock
750-755	Siltstone, dolomite, and shale: dark grey, dolomitic, argillaceous siltstone and silty shale; some grey, silty dolomite
755-760	Limestone, light grey, finely crystalline, dolomitic; dark grey siltstone and shale as above
760-765	Dolomite, calcitic, light grey, crystalline, finely silty, pyritic; a few fragments of feldspathic igneous rock
765-770	Dolomite, calcitic, finely silty; grades to grey, dolomitic siltstone
770-780	Siltstone, dark grey, dolomitic, argillaceous; grades to fine, silty dolomite
780-815	Siltstone, grey, dolomitic, pyritic
815-820	Dolomite, grey, calcitic, finely crystalline, finely silty; some darker grey siltstone

Depth	Lithology
<i>Beekmantown—Con.</i>	
820-825	Siltstone, dark grey, dolomitic, argillaceous; some dark grey shale
825-830	Dolomite, light grey, calcitic, finely silty, finely crystalline; some dark grey, silty shale
830-840	Dolomite, light grey, silty, calcitic; with few embedded, large, rounded quartz grains; a little dark grey shale
840-845	Igneous rock, light green, dense; siltstone and dolomite, as above
845-850	Dolomite, light grey, finely crystalline, calcitic, finely silty; dark grey shale
850-880	Missing
880-885	One sample: shale, dark grey, calcareous, blocky; some light grey-buff, finely crystalline, sandy, calcitic dolomite, with large, rounded quartz grains
885-900	Siltstone, dark grey, calcareous, argillaceous; grades to dark grey, argillaceous, silty limestone; dark grey shale
900-920	Siltstone and limestone: dark grey, calcareous, argillaceous siltstone grading to dark grey, silty, argillaceous, dolomitic limestone or calcitic dolomite
920-923	Igneous rock, with pink feldspar
923-824	Dolomite, light grey, calcitic, finely crystalline, finely silty, grading to dolomitic siltstone
924-926	Igneous rock, with pink feldspar
926-928	Limestone, dolomitic, light grey, finely crystalline, silty; scattered sand grains; a little dark grey shale
928-937	Igneous rock
937-945	Dolomite and siltstone: dark grey, silty, argillaceous, finely crystalline, calcitic dolomite, grading to dark grey, calcareous, dolomitic, shaly siltstone
945-955	Dolomite and siltstone: dark grey, finely crystalline, silty dolomite grading to dolomitic siltstone
955-965	Limestone, grey, cryptocrystalline to finely crystalline, dolomitic, silty; dark grey shale
965-970	Shale, dark grey, grades to dark grey, argillaceous, calcareous siltstone and grey, finely crystalline, silty, dolomitic limestone
970-980	Missing
980-990	Dolomite, light grey, cryptocrystalline, silty
990-995	Shale, dark grey, pyritic; dolomite, light grey, finely crystalline, silty
995-1,000	Shale and dolomitic siltstone: dark grey, dolomitic shale and greenish grey, dolomitic, shaly siltstone
1,000-1,015	Dolomite, light grey, finely crystalline, silty (30 per cent)
1,015-1,020	Shale and dolomite: dark grey, slightly calcareous shale; dolomite, dark grey, calcitic, silty, argillaceous
1,020-1,025	Dolomite and shale: light grey, finely crystalline, finely silty, calcitic dolomite, with large calcite crystals possibly filling vugs; dark grey, calcareous, silty shale
1,025-1,030	Siltstone, dark grey, dolomitic; a few calcite rhombs
1,030-1,045	Limestone, light grey, dolomitic, finely crystalline, finely silty, and buff-grey, cryptocrystalline, dense; dark grey, calcareous siltstone, as above; black shale
1,045-1,054	Limestone, light grey, crystalline, dolomitic (20 to 30 per cent); slightly silty in part, fragmental, pseudo-oolitic, with rounded fragments; ostracods; some dark grey siltstone and silty shale
1,054-1,060	Dolomite, light grey, finely crystalline, silty, slightly calcareous
1,060-1,075	Siltstone, grey, dolomitic
1,075-1,095	Siltstone and dolomite: light grey, dolomitic siltstone grading to fine, silty dolomite
1,095-1,100	Siltstone, dark grey, shaly, calcareous; some calcite rhombs
1,100-1,105	Limestone, light grey, dolomitic (10 to 20 per cent), crystalline, slightly sandy; with fine sand grains
1,105-1,140	Dolomite, light grey, finely crystalline to finely granular, calcitic
1,140-1,145	Dolomite, grey, cryptocrystalline to finely crystalline, calcitic, slightly argillaceous; ostracods

Depth	Lithology
<i>Beekmantown—Con.</i>	
1,145-1,170	Missing
1,170-1,175	Limestone, light grey, dolomitic (30 per cent), finely crystalline
1,175-1,180	Dolomite, light grey, finely crystalline to granular
1,180-1,185	Dolomite, calcitic, grey, cryptocrystalline, vitreous; a little dark grey shale
1,185-1,190	Dolomite, light grey, sugary, calcitic, slightly silty; grades to dolomitic limestone
1,190-1,210	Dolomite, light grey, finely crystalline to granular
1,210-1,225	Dolomite, grey, cryptocrystalline, vitreous; dark grey shale
1,225-1,240	One sample: dolomite, grey, shaly, dense; in part grey, cryptocrystalline, vitreous
1,240-1,250	Dolomite, grey, cryptocrystalline
1,250-1,274	Igneous rock
1,274-1,280	Dolomite, grey, calcitic, cryptocrystalline, argillaceous; a little grey chert
1,280-1,286	Siltstone, dark grey, dolomitic; grading to dark grey, silty dolomite
1,286-1,294	Dolomite, light grey, finely crystalline, sugary, slightly argillaceous; dark grey shale; pyrite
1,294-1,305	Dolomite, light grey, finely crystalline, sugary
1,305-1,310	Dolomite, light grey, crystalline to granular; some porosity
1,310-1,320	Dolomite, light grey, coarsely granular
1,320-1,325	Dolomite and siltstone: dark grey, silty, sugary dolomite grading to dolomitic siltstone
1,325-1,336	Dolomite, light grey, finely crystalline, sugary
1,336-1,350	Dolomite, grey, finely crystalline, sugary to cryptocrystalline, vitreous
1,350-1,358	Dolomite, grey, granular
1,358-1,368	Dolomite, light grey, medium crystalline, granular; pinpoint porosity; pyrite
1,368-1,380	Dolomite, grey, medium crystalline, granular; pyrite
1,380-1,390	Dolomite, grey, sugary
1,390-1,395	Dolomite, grey, medium crystalline

Note. In this well, the Trenton-Black River contact is hidden by an igneous intrusion, which was sampled from 121 to 134 feet. The sample from 114 to 121 feet is poor, but samples above 114 feet are Trenton in lithology. The samples below 134 feet are Black River. The Black River in the samples is only 29 feet thick, very thin for the Montreal area. The intrusive rock and poor sample may obscure an originally greater thickness of Black River.

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
<i>Richmond</i>	
Bécancour River Formation	
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
<i>Richmond and Lorraine</i>	
Pontgravé River Formation and Older	
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

Depth	Lithology
<i>Richmond and Lorraine—Con.</i>	
Pontgravé River Formation and Older— <i>Con.</i>	
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 may have been responsible for the recovery of such poor material.

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
<i>Richmond</i>	
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

Depth	Lithology
Feet	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— <i>Byssonychia</i> 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
	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

Depth	Lithology
Feet	<i>Lorraine—con.</i>
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
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 Pont-gravé 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.

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	<i>Richmond</i>
	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
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

Depth	Lithology
Feet	<i>Richmond—con.</i>
	Bécancour River Formation— <i>con.</i>
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.

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	<i>Richmond</i>
	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
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 <i>Catazyga</i>) 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
	<i>Lorraine</i>
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

Depth	Lithology
Feet	<i>Lorraine—con.</i>
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

CANADIAN SEABOARD OIL AND GAS

STE.-ANGÈLE NO. 1 WELL

Location: lot 160, Petit Bois Rouge, Parish Ste.-Angèle de Laval,
Nicolet county, Quebec

Elevation: 25± feet

Drilled: 1933

Total depth: 5,260 feet

Rig: cable

Samples examined by H. R. Belyea, 1946

Depth	Lithology
Feet	<i>Richmond</i>
	Pontgravé River Formation
20-40	Shale, light greenish grey, micro-silty, grading to light greenish grey siltstone; limestone, light grey, dense, silty, fossiliferous; brachiopod and crinoid fragments; 20 to 30 feet <i>Holteadahlina</i> ; 30 to 40 feet <i>Zygospira modesta</i> (identifications by T. H. Clark)
40-70	Limestone, grey, silty, as above; about an equal amount of greenish grey shale and siltstone, as above; brachiopods; 50 to 60 feet <i>Zygospira modesta</i> (identified by T. H. Clark)
70-80	Shale and siltstone, as above; 30 to 40 per cent limestone, as above
80-90	Shale, greenish grey as above, silty in part; siltstone same as above; limestone, as above, 20 to 30 per cent
90-100	Missing
100-170	Shale and siltstone, greenish grey as above; about 10 per cent limestone, grey, silty, fossiliferous; ostracods 100 to 110 feet; brachiopod fragments 120 to 170 feet
170-190	Shale and siltstone, greenish grey, same as above; a little limestone, grey, silty; a few fossil fragments
190-220	Shale, siltstone, and much limestone, as above; brachiopod fragments
	<i>Lorraine and Utica</i>
220-240	Shale, light greenish grey, micaceous, breaks into rounded fragments; a little darker greenish grey, micaceous, fissile, finely silty shale; siltstone, light greenish grey, calcareous, micaceous, laminated, fossiliferous—brachiopods, bryozoa, crinoid stems

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
240-250	Shale, greenish grey, as above; about 5 to 10 per cent calcareous, micaceous siltstone
250-260	Same as above, but about 10 to 20 per cent sandy layers
260-310	Shale, same as above; a little calcareous siltstone and fine-grained sandstone; fossil fragments—brachiopods and bryozoa 270 to 280 feet; bryozoa 290 to 300 feet; crinoid fragments in sandstone 300 to 310 feet
310-390	Shale, greenish grey as above; a little siltstone, calcareous, fossiliferous, grading to shell limestone; ostracods in grey shale, 340 to 350 feet; bryozoa, 310 to 350 feet and 380 to 390 feet
390-400	Shale, soft, greenish grey, as above; no fossils
400-410	Shale, as above; a little calcareous siltstone and fine-grained sandstone; a few fossil fragments; a few grains show slickensides
410-550	Shale, greenish grey, fissile; a little lighter grey calcareous siltstone and fine-grained sandstone; a few shell fragments; crinoid stems 460 to 470 feet; bryozoa 420 to 430 feet; vein calcite 510 to 520 feet and 540 to 550 feet
550-560	Shale and siltstone, greenish grey, as above; fractures and vein calcite; trace of metabentonite
560-590	Shale, greenish grey, as above; a little siltstone, calcareous, in part; very fossiliferous, with bryozoa and other fossil fragments forming sandy shell limestone; vein calcite; slickensides
590-660	Shale, greenish grey, as above; a little calcareous siltstone and fine sandstone; fossil fragments, brachiopods, bryozoa; crinoid stems 650 to 660 feet; darker grey, fine, micaceous, fissile shale 640 to 650 feet
660-670	Siltstone, sandstone, and shale: green, calcareous, sandy, micaceous siltstone and fine sandstone; a little grey, calcareous, sandy shale; about 30 per cent green shale
670-690	Shale, green, as above; bryozoa fragments 670 to 680 feet; a little lighter grey siltstone and fine-grained sandstone
690-730	Shale, sandstone, and limestone: greenish grey shale as above; calcareous siltstone and fine sandstone as above; sandy shell limestone; bryozoa; brachiopod fragments 710 to 730 feet
730-750	Shale, siltstone, and fine sandstone, as above; fossil fragments forming sandy shell limestone
750-760	Shale, greenish grey, as above; about 10 per cent lighter green siltstone and fine sandstone
760-770	Shale, siltstone, and sandstone: green shale, as above, and much lighter green, slightly calcareous, sandy siltstone and fine-grained sandstone; crinoid fragments
770-820	Shale and sandstone: green shale as above; light green, calcareous, sandy shale grading to sandstone; brachiopod, bryozoa, and crinoid fragments
820-830	Shale and sandstone, as above; graptolite?, brachiopods, crinoid, and bryozoa fragments; metabentonite
830-850	Shale and sandstone, as above; shell fragments forming sandy limestone; bryozoa, crinoids
850-860	Shale and sandstone, as above; bituminous matter in sandstone; bryozoa
860-900	Shale and sandstone, as above; shell fragments; bryozoa; crinoids 860 to 880 feet
900-930	Shale, sandstone, and shell fragments, as above; brachiopods, crinoids
930-940	Shale and sandstone, as above, in about equal amounts; crinoid fragments; brachiopod imprint
940-970	Shale, siltstone, and sandstone: soft green shale, as above; about 30 to 40 per cent lighter grey, calcareous, sandy shale, siltstone, and sandstone; shell fragments forming sandy limestone; crinoids 930 to 940 feet and 960 to 970 feet; vein calcite 960 to 970 feet

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
970-980	Shale, siltstone, and sandstone, as above; slickensides; calcite veins; graptolite fragments?
980-1,000	Shale, siltstone, and sandstone, as above; crinoids, calcite veins
1,000-1,020	Siltstone, sandstone, and shale: green, calcareous siltstone and fine sandstone as above; about 30 per cent green shale; bryozoa 1,000 to 1,010 feet
1,020-1,090	Shale, siltstone, and sandstone: grey shale; 30 per cent lighter grey, micaceous siltstone, sandstone, and fragmental limestone; a little fissile grey shale; brachiopod fragments 1,020 to 1,070 feet; crinoid stems 1,050 to 1,080 feet; bryozoa 1,080 to 1,090 feet; slickensides 1,070 to 1,080 feet
1,090-1,110	Shale, siltstone, and sandstone, as above, but with fewer fossil fragments
1,110-1,140	Shale and siltstone: soft green shale and micaceous siltstone, as above, in part interlaminated; a little grey, micaceous, fissile shale; some sandy shell limestone
1,140-1,230	Shale, medium grey, silty, irregularly bedded, micaceous; some green shale and a little micaceous, light green siltstone as above; brachiopod fragments 1,150 to 1,160 feet and 1,190 to 1,210 feet; crinoid stems 1,160 to 1,170 feet; vein calcite 1,200 to 1,220 feet
1,230-1,240	Shale, greenish grey; sandy shale and siltstone, as above; a little medium grey, silty shale, as above; brachiopod fragments
1,240-1,260	Shale, medium grey; a little lighter grey, sandy shale, and siltstone
1,260-1,290	Shale, medium greenish grey, fissile, micaceous; some green and grey, silty shale; siltstone as above; crinoid stem 1,260 to 1,270 feet
1,290-1,330	Shale, greenish grey, sandy, and medium grey, fissile, micaceous, silty; a little light green siltstone; a few angular quartz grains 1,300 to 1,310 feet; brachiopods 1,310 to 1,320 feet; pyrite 1,300 to 1,320 feet
1,330-1,340	Shale, greenish grey, fissile; a little siltstone, as above; brachiopod fragment
1,340-1,360	Shale and siltstone: grey, sandy shale and siltstone interlaminated; medium greenish grey, fissile shale; a little soft bentonitic shale; brachiopod fragment
1,360-1,450	Shale, greenish grey, and calcareous siltstone, as above
1,450-1,470	Shale, greenish grey, as above; medium grey, micaceous, silty shale and calcareous siltstone
1,470-1,500	Shale, grey, fissile; a little sandy shale and calcareous siltstone; vein calcite, 1,490 to 1,500 feet
1,500-1,510	Shale and siltstone: grey, sandy shale and shaly, micaceous siltstone; greenish grey, fissile shale; a little medium grey, fissile, micaceous shale
1,510-1,640	Shale, grey, fissile; a little calcareous, shaly siltstone; a few shell imprints 1,560 to 1,570 feet and 1,540 to 1,550 feet; bryozoa and vein calcite 1,580 to 1,590 feet; metabentonite 1,620 to 1,630 feet
1,640-1,660	Shale, medium grey to dark grey, micaceous, in part fissile, in part silty; interlaminated, grey, calcareous, sandy shale and siltstone
1,660-1,670	Shale, grey, micaceous, silty; a little lighter greenish grey siltstone
1,670-1,680	Siltstone, greenish grey; medium grey shale
1,680-1,730	Shale and siltstone: medium grey shale and interlaminated calcareous siltstone; greenish grey, soft shale; metabentonite, greenish, with large mica flakes 1,700 to 1,710 feet; slickensided shale fragments 1,710 to 1,720 feet
1,730-1,740	Shale and siltstone: medium grey, micaceous, silty shale and light greenish grey siltstone
1,740-1,770	Shale and siltstone: dark grey, micaceous, silty shale interlaminated with calcareous, greenish grey siltstone; a little greenish shale; iron stain 1,740 to 1,750 feet
1,770-1,790	Shale, same as above, but with more dark shale and not so much sandy shale

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
1,790–1,820	Shale, dark grey, silty; with interlaminated sandy layers; a little siltstone and light grey, firm, fissile, pencil shale
1,820–1,870	Shale as above; a little siltstone; pelecypod 1,830 to 1,840 feet; vein calcite
1,870–1,900	Shale, dark grey, silty, with interlaminated micaceous siltstone; little light grey shale
1,900–1,930	Shale and siltstone: medium grey to medium dark grey, micaceous, silty shale; calcareous siltstone and fine-grained sandstone
1,930–1,960	Shale and siltstone: dark grey, silty shale and lighter grey siltstone, interlaminated; calcite veins 1,950 to 1,960 feet
1,960–2,030	Shale, medium dark grey, micaceous, sandy; interlaminated fine sandstone layers; a little lighter grey siltstone
2,030–2,040	Siltstone and shale: light grey siltstone and sandy shale; dark grey sandy shale and light grey, fissile, pencil shale
2,040–2,110	Shale, sandstone, and siltstone: dark grey shale and interlaminated light sandstone and siltstone; some light grey shale; vein calcite 2,050 to 2,060 feet
2,110–2,120	Shale, medium grey, micaceous, in part silty; darker grey, sandy shale, with interlaminated sandy layers; metabentonite, silty, greenish
2,120–2,230	Shale and siltstone: medium dark grey, silty shale; light grey, fissile, micaceous shale, with sandy laminae; vein calcite 2,170 to 2,190 feet
2,230–2,290	Shale, medium grey, fissile, smooth, with interlaminated sandy laminae; a little dark grey shale and calcareous siltstone; black carbonaceous streaks 2,260 to 2,270 feet; brown metabentonite-like shale 2,270 to 2,280 feet
2,290–2,300	Shale and sandstone: dark grey, sandy shale, with sandstone laminae; a little siltstone and light grey, fissile, smooth, pencil shale
2,300–2,380	Shale and siltstone: medium grey, sandy shale, with lighter grey siltstone interlaminated; a little dark grey, fissile, silty shale; a little brown, fine, dolomitic sandstone; vein calcite 2,350 to 2,380 feet; graptolite 2,370 to 2,380 feet
2,380–2,520	Shale, medium grey, fissile, smooth, micaceous, with a little interlaminated siltstone; some dark grey, silty, irregularly bedded shale; metabentonite with large, mica flakes 2,430 to 2,440 feet
2,520–2,590	Shale, grey, fine, smooth, fissile, and dark grey, fissile, with interlaminated siltstone; thin dolomite, brownish grey, fine, argillaceous, silty, 2,520 to 2,530 feet and 2,560 to 2,570 feet
2,590–2,650	Shale, dark grey, silty, in part fissile; interlaminated siltstone; smooth, fissile, medium grey shale; dolomite, greyish brown, finely crystalline, argillaceous, silty, 2,590 to 2,600 feet and 2,630 to 2,640 feet
2,650–2,840	Shale, dark grey, sandy, with interlaminated siltstone, cross-laminated, 2,800 to 2,810 feet; some medium grey, fissile shale; dolomite, greyish brown, crystalline, argillaceous, silty, 2,780 to 2,790 feet; vein calcite; slickensides 2,810 to 2,820 feet
2,840–2,880	Shale, dark grey, sandy, with a little interlaminated siltstone; dark grey and medium grey, fissile shale, some with a greyish brown streak
2,880–2,890	Shale, dark grey, sandy; some interlaminated siltstone; a little black shale with a greyish brown streak
2,890–3,020	Shale, black, silty, fissile in part, some with a grey-brown streak; some medium grey shale; a little dolomitic or calcareous siltstone; thin dolomite, grey-brown, argillaceous, silty, finely crystalline, 2,910 to 2,930 feet; slickensides 2,960 to 2,970 feet
3,020–3,120	Shale, black, fissile, sandy; a little medium grey, fine, fissile shale and siltstone; a few fragments black, very fine shale show brownish streak
3,120–3,510	Shale, black, some with a brown streak; dolomite, dark greyish brown, finely crystalline, argillaceous, silty, 3,190 to 3,200 feet, 3,230 to 3,240 feet, 3,280 to 3,300 feet, and 3,330 to 3,340 feet; pyrite 3,230 to 3,240 feet; slickensides 3,370 to 3,380 feet, 3,480 to 3,490 feet; calcite veins 3,430 to 3,440 feet

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
3,510–3,560	Shale, chiefly black, as above, in part with a brown streak; some medium grey shale; a little grey-brown, finely crystalline, argillaceous, silty dolomite
3,560–3,610	Shale, black and dark grey, as above; in part with a brown streak; a little dolomite, same as above at 3,570 to 3,580 feet and 3,590 to 3,610 feet
3,610–3,650	Shale, same as above; most of the black shale with a brownish streak
3,650–3,780	Shale, black, a little with a brown streak; much medium grey shale; a little light grey to brownish grey, dolomitic siltstone; slickensides 3,690 to 3,700 feet; dark brown, argillaceous dolomite 3,700 to 3,720 feet; metabentonite, grey, with dark nodules, 3,750 to 3,760 feet
3,780–3,890	Shale, very dark grey to black, with a brown streak, fissile, pyritic in part, very slightly calcareous
3,890–4,000	Shale, very dark grey to black, as above, most with dark brown streak; some calcareous, and with a lighter brown streak
4,000–4,010	Shale, very dark grey, with grey-brown streak as above; a little limestone, very light grey, micro-silty, finely crystalline
4,010–4,020	Shale, very dark grey, brownish streak as above; no limestone
	<i>Trenton</i>
4,020–4,040	Shale, dark grey, calcareous, with a brownish streak; a little dark brownish grey, argillaceous, silty, finely crystalline to earthy limestone; fractures and calcite veins 4,030 to 4,040 feet
4,040–4,050	Shale and limestone, same as above; a little light grey limestone, finely crystalline, argillaceous
4,050–4,120	Shale, black, very calcareous, with a brown streak, grading to dark brownish grey, shaly limestone; pyritic; metabentonite; vein calcite 4,050 to 4,060 feet
4,120–4,220	Shale and limestone, as above, but with more dark grey-brown, argillaceous limestone
4,220–4,310	Same as above, but with much shaly limestone; calcite veins 4,240 to 4,250 feet; a little light brown, crystalline limestone 4,260 to 4,270 feet
4,310–4,400	Limestone, dark brownish grey to greyish brown, shaly, grading to black, calcareous shale; brown metabentonite 4,310 to 4,320 feet
4,400–4,760	Shale, black, calcareous, with a light brown streak, grading to dark brownish grey, very argillaceous limestone; 4,480 to 4,490 feet, brownish metabentonite with vein calcite; 4,730 to 4,740 feet, light brown metabentonite
4,760–4,770	Shale, same as above; a little limestone, brown, finely crystalline, argillaceous
4,770–4,800	Limy shale, dark grey, same as above 4,760 feet
4,800–4,890	Shale, dark grey, limy, as above; a little dark greyish brown to brownish grey, finely crystalline, argillaceous limestone
4,890–4,920	Same as above, but with more limestone
4,920–4,940	Limestone, dark grey-brown, finely crystalline, argillaceous, as above; much dark grey, calcareous shale, with a brownish streak
4,940–4,960	Shale; minor limestone, as above
	<i>Montreal Formation or Equivalent?</i>
4,960–4,970	Limestone, dark brownish grey, finely crystalline, argillaceous; a little shale, dark grey, slightly calcareous, light brown streak
4,970–5,040	Limestone, dark greyish brown, finely crystalline, slightly dolomitic, argillaceous, with large calcite and dolomite crystals; shale, dark grey, calcareous; milky chert 4,970 to 4,980 feet

Depth	Lithology
Feet	Montreal Formation or Equivalent?— <i>con.</i>
5,040-5,060	Limestone, dark greyish brown, finely crystalline; a little coarsely crystalline limestone, fossiliferous, slightly argillaceous, dolomitic in part; much shale, dark grey, calcareous, slightly soapy; metabentonite 5,050 to 5,060 feet
5,060-5,070	Limestone, as above, but with less shale
5,070-5,100	Limestone, dark greyish brown, dolomitic, as above, and coarsely crystalline dolomitic limestone—probably recrystallized fossil limestone; considerable shale
5,100-5,110	Shale, calcareous, dark greenish grey, veined with calcite; a few rounded quartz grains; possibly some basic igneous rock
	<i>Precambrian</i>
5,110-5,130	Feldspar, quartz, and green chlorite schist, much of it slickensided
5,130-5,140	Grey quartzose rock, with dark greenish grey mineral or rock fragments
5,140-5,260	Quartz, feldspar, hornblende, mica

Note. This well commenced in the Pontgravé River shales and continued through a section composed predominantly of shale to 4,960 feet. The upper 220 feet of shales, siltstones, and limestones have been placed in the Pontgravé River formation. The top of the Lorraine has been placed at 220 feet, below which depth the fine silty limestones of the Pontgravé River formation do not occur.

The Lorraine shales, siltstones, and fine sandstones grade into the black shales of the Utica. The proportion of shale with the dark brown streak of the Utica gradually increases below about 3,120 feet relative to the Lorraine-type shales; consequently, the contact between the Lorraine and the Utica could not be recognized.

The top of the Trenton has been placed at the highest occurrence of finely crystalline limestone, at 4,020 feet. This limestone is very argillaceous, and in the samples above 4,220 feet is less abundant than the dark grey calcareous shales. The section from 4,400 to 4,920 feet also contains more shale than limestone. The first crystalline limestones occur at 4,960 feet. This section of 940 feet of argillaceous limestones and shales is extremely thick in comparison with similar beds in other wells. In stratigraphic position, they appear to be equivalent to the Terrebonne and Tetreauville formations of the Montreal area, and they may represent a thicker and more shaly facies of these formations gradational from the Trenton to the Utica; equivalents of part of the Montreal formation in the Montreal area may be represented here by argillaceous limestones and shales.

The crystalline limestones of the Trenton in this well rest on what appear to be schists and granitic igneous rocks of the Precambrian basement. A thin layer of green calcareous shale with some quartz grains immediately overlies the Precambrian, but no sediments of the Black River or earlier Ordovician formations occur here.

CANADIAN SEABOARD ST-GÉRARD NO. 1 WELL

Location: lot 593, concession St-Antoine, Parish of St-Gérard, Yamaska county, Quebec

Elevation: 90± feet Depth: 6,160 feet

Rig: standard cable to 3,170 feet; rotary, 3,170 to 4,490 feet; and cable, 4,490 to 6,160 feet

Drilling started: November 18, 1931; completed: December 24, 1942

Samples examined by H. R. Belyea, 1946; revised in part, 1950

Depth	Lithology
0-40 40-50	Clay Grey-brown sand
<i>Richmond</i>	
Bécancour River Formation	
Feet	
50-60	Sandstone, reddish brown, coarse-grained
60-90	Sandstone, reddish brown, fine-grained, and about 10 per cent fine-grained, greenish grey sandstone
90-120	Shale, reddish brown, micaceous, and about 10 per cent red and grey sandstone
120-130	Sandstone, greenish grey, fine-grained; some greenish grey shale
130-140	Sandstone, reddish brown; about 10 per cent greenish grey sandstone; trace of red shale
140-150	Sandstone, greenish grey
150-160	Sandstone, fine- to medium-grained, red and greenish grey
160-170	Sandstone, light greenish grey, fine-grained; traces of greenish grey shale
170-180	Shale, dark grey, sandy; about 10 per cent light greenish grey sandstone
180-240	Shale and sandstone: dark grey and light grey sandstone and grey shale, all micaceous
240-250	Shale, dark grey, sandy
250-260	Sandstone, dark grey; grey shale
260-300	Sandstone, mostly light grey; minor light grey sandstone and grey shale studded with pyrite
300-330	Shale, brownish red; a little gypsum in nearly every sample; minor greenish grey sandy shale and sandstone at 310 to 320 feet
330-370	Shale, brownish red, as above; 30 to 40 per cent sandstone, greenish grey, grading to sandy shale; traces of gypsum
370-750	Shale, brownish red, as above; greenish grey, sandy shale and sandstone in small amounts at 380 to 390, 440 to 450, and 470 to 480 feet; spots of white to pink gypsum
750-770	Shale, greyish green, silty, and sandy; trace gypsum
770-790	Shale, grey, silty, slightly calcareous; trace gypsum
790-810	Shale, reddish brown, with about 30 to 40 per cent green, sandy shale, and light grey, calcareous, fine-grained sandstone; trace gypsum
810-980	Shale, reddish brown, with spots of gypsum
980-1,020	Shale, reddish brown, with gypsum, as above; greenish grey, silty, calcareous shale forming nearly 50 per cent of samples
1,020-1,190	Shale, reddish brown, spotted with gypsum
1,190-1,280	Shale, green mudstone; about 20 to 30 per cent red shale, spotted with gypsum
Pontgravé River Formation	
1,280-1,290	Shale, greenish grey, slightly calcareous, more fissile than above, pyritic in part; calcareous siltstone, grey, with calcite and quartz in varying proportions, grading to silty, fine limestone
1,290-1,300	Shale, as above; grey, finely crystalline, very silty limestone; grey, micaceous, argillaceous siltstone; brachiopod fragments

Depth	Lithology
Feet	Pontgravé River Formation— <i>con.</i>
1,300-1,320	Silty limestone, blue-grey, finely crystalline; siltstone and shale as above
1,320-1,330	Shale, grey, calcareous, as above; less limestone and siltstone than above; bryozoa; pyrite
1,330-1,340	Shale, as above; siltstone and blue-grey limestone, as above; a few ostracods
1,340-1,380	Siltstone, limestone, and shale, as above; shale less abundant
1,380-1,390	Shale, as above; a few fragments grey limestone, with ostracods
1,390-1,400	Siltstone grading to limestone, as above; grey shale, as above
1,400-1,410	Shale, siltstone, and limestone, as above; brachiopod fragments
1,410-1,450	Shale, as above; siltstone grading to limestone; scattered fossil remnants
1,450-1,470	Limestone, grey, finely to medium crystalline, silty; grades to calcareous siltstone; shale, as above; brachiopods and ostracods
1,470-1,500	Limestone, grey, finely to medium crystalline; grey, shaly, micaceous siltstone; grey shale; brachiopods, 1,490 to 1,500 feet
	<i>Lorraine and Utica</i>
1,500-1,510	Shale, grey to greenish grey, in part silty; grades to green, micaceous, argillaceous siltstone; some grey, fine, silty limestone; fossil fragments; calcite veins
1,510-1,530	Shale, greenish grey, very slightly calcareous; siltstone, greenish grey, micaceous, calcareous, argillaceous
1,530-1,670	Shale and siltstone: light grey, soft, flaky shale, breaks into rounded fragments, in part micaceous; lighter grey, slightly calcareous, laminated siltstone, with black carbonaceous specks, grades to sandy shale, in part fossiliferous, with fragments of bryozoa, brachiopods, crinoid disks, and secondary calcite forming in places a sandy shell limestone
1,670-1,680	Shale and siltstone, as above; 10 per cent with brown stain
1,680-1,780	Shale and siltstone, as above; fossil fragments; a little medium grey, micaceous, fissile shale
1,780-1,790	Shale and siltstone, as above, but 50 per cent with a brownish stain; bryozoa; greenish metabentonite; slickensides
1,790-1,830	Shale, as above; about 30 per cent siltstone; brachiopods, bryozoa, and crinoid fragments in all samples
1,830-1,870	Shale and siltstone, as above
1,870-1,890	Shale and siltstone, about 10 per cent with brown stain
1,890-1,920	Shale, light grey and medium grey, as above; about 30 to 40 per cent siltstone, as above; fossil fragments, especially bryozoa, in all samples, forming in part a sandy shell limestone
1,920-1,930	Shale and siltstone, as above; 10 per cent with brown stain
1,930-2,050	Shale, light grey, soft, flaky; medium grey, micaceous, fissile, well-laminated shale becoming more prominent with depth; about 30 per cent slightly calcareous siltstone and silty shale; crinoid stems, brachiopods, and bryozoa in all samples
2,050-2,280	Shale and siltstone, as above; a little more medium grey, fissile shale than above; brachiopods and bryozoa in all samples
2,280-2,300	Shale, light grey; a little medium grey, fissile shale; a little light grey, calcareous siltstone; fossil fragments
2,300-2,420	Shale and siltstone: light grey, flaky shales gradually superseded by medium grey, fissile and silty shales; 30 to 40 per cent calcareous siltstone, commonly with secondary calcite forming sandy, shell limestone; brachiopods 2,350 to 2,380 and 2,400 to 2,410 feet
2,420-2,850	Shale, medium grey, irregular partings, micro-silty, micaceous, brittle; 10 to 20 per cent siltstone, light grey, calcareous, with black carbonaceous specks, frequently interlaminated with medium grey shale; cross-lamination at 2,420 to 2,430 and 2,790 to 2,800 feet; pyrite 2,440 to 2,450 feet; metabentonite 2,480 to 2,490, 2,590 to 2,600, 2,720 to 2,730, and 2,840 to 2,850 feet

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
2,850-2,870	Shale and siltstone, as above; about 5 per cent with brown stain
2,870-2,920	Shale and siltstone, as above; about equal in amount
2,920-3,100	Shale, chiefly medium grey to dark grey, micro-silty, brittle, with rough fracture; some medium grey, fissile shale; up to 30 per cent light grey, calcareous, laminated siltstone, commonly interlaminated with shale; cross-lamination of silt and shale at 3,020 to 3,040 feet; metabentonite 2,920 to 2,930 feet
3,100-3,110	Shale and siltstone, as above; about 5 per cent with brown stain
3,110-3,180	Shale, same as above; a little siltstone
3,180-3,450	Siltstone and shale: light grey, variably calcareous, laminated siltstone, with black carbonaceous specks; shale partings; nearly an equal amount of shale, medium to medium dark grey, micro-silty, micaceous, fissile; about 10 per cent of shale, grey to slightly greenish grey, very fine, firm, smoothly fissile; interlaminæ of shale and silt common; crinoid disk 3,180 to 3,190 feet
3,450-3,800	Shale, in part light medium grey, finely micaceous, fissile, with pyrite nodules, and in part micro-silty, medium to dark grey shale; 10 to 20 per cent siltstone, light grey, calcareous, interlaminated with shale; metabentonite 3,570 to 3,580 and 3,730 to 3,740 feet
3,800-3,840	Shale, as above; very little calcareous siltstone; metabentonite 3,810 to 3,820 feet
3,840-3,860	Shale, light medium grey, fine, fissile, commonly with pyrite nodules; medium dark grey, fissile shale; medium grey, silty, rough shale; dolomite, light grey, silty, argillaceous, grading to dolomitic siltstone
3,860-3,880	Shale, light medium grey to dark grey, as above
3,880-3,890	Shale, light medium grey to dark grey, as above; silty, argillaceous dolomite and dolomitic siltstone, as above
3,890-4,010	Shale, light medium grey to dark grey, as above; calcite veins 3,900 to 3,910 feet
4,010-4,020	Shale, as above; a little silty dolomite, as above
4,020-4,060	Shale, light medium grey to dark grey, as above; metabentonite 4,020 to 4,030 feet
4,060-4,070	Shale, as above; some brownish grey, silty dolomite; calcite veins
4,070-4,110	Shale, light medium grey to dark grey, as above
4,110-4,120	Shale, as above; brownish grey, silty dolomite
4,120-4,260	Shale, as above; pale green metabentonite 4,140 to 4,150 feet
4,260-4,320	Shale, chiefly medium grey and dark grey, fine, fissile; a little dark grey, silty shale, and black shale with a brownish streak; a little siltstone
4,320-4,330	Shale, same as above; brownish grey, argillaceous, silty dolomite
4,330-4,360	Shale, as above
4,360-4,370	Shale, as above; dolomite, brownish grey, argillaceous, silty
4,370-4,450	Shale, as above; metabentonite 4,380 to 4,390 feet
4,450-4,460	Shale, as above; dolomite, greyish brown, dense, silty
4,460-4,480	Shale, as above; pale grey metabentonite 4,470 to 4,480 feet
4,480-4,530	Shale, blackish grey to black, fissile, smooth, with light brownish streak; pyrite streaks and specks
4,530-4,550	Shale, black, as above; dolomite, dark brown, finely crystalline, finely silty; pyrite; calcite veins
4,550-4,570	Shale, as above
4,570-4,580	Shale, as above; dolomite, brown, silty, grades to dolomitic siltstone; pyritic
4,580-4,590	Shale, dark grey, in part with a dark brown streak
4,590-4,620	Shale, black, with a dark brown streak
4,620-4,630	Shale, as above; greenish buff metabentonite with small nodules
4,630-4,680	Shale, black, with a brown streak, as above, slightly calcareous; pyrite; calcite 4,670 to 4,680 feet; trace dark grey siltstone
4,680-4,750	Shale, black, with brown streak, slightly calcareous, becoming more calcareous with depth

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
4,750-4,770	Shale, as above; calcite; pyrite
4,770-4,810	Shale, very dark grey, more fissile than above, harder, micro-silty, calcareous, grey streak
	<i>Trenton</i>
	Terrebonne and Tetreauville Equivalents ?
4,810-4,860	Shale and limestone; dark grey, calcareous, silty shale; limestone, dark grey, argillaceous, silty, very finely crystalline, up to 5 per cent of samples
4,860-4,910	Shale and limestone: dark grey, calcareous shale; a little dark grey, argillaceous, silty, very finely crystalline limestone; metabentonite and vein calcite 4,860 to 4,870 feet; pyrite 4,870 to 4,890 feet
4,910-4,930	Shale, dark grey, calcareous, silty; pyrite; a little limestone, as above
4,930-5,030	Shale and limestone: shale, as above; about 40 per cent limestone, brownish grey, argillaceous, very finely crystalline, silty; vein calcite 4,980 to 5,000 feet; trace pyrite in all samples; metabentonite, brownish, 4,980 to 4,990 feet; slickensides 4,990 to 5,000 feet
5,030-5,040	Dark igneous rock
5,040-5,060	Shale, as above; a little brown-grey, shaly, fine limestone; thick metabentonite 5,040 to 5,050 feet
5,060-5,070	Shale and limestone: shale, same as above; pyrite; limestone, dark blue-grey, argillaceous, silty, very finely crystalline
5,070-5,080	Shale and limestone: shale, as above; much dark brownish grey, finely crystalline limestone; fossil fragments
5,080-5,090	Shale, as above; a little limestone
5,090-5,130	Shale and limestone: shale, as above; 10 to 20 per cent brown-grey, argillaceous limestone
5,130-5,210	Shale, as above; a little limestone, as above; pelecypod and ostracod 5,170 to 5,180 feet
5,210-5,230	Shale and limestone: shale, as above, with fossil fragments; 30 to 40 per cent limestone, grey, dense, finely crystalline
5,230-5,280	Shale, as above; less limestone than above
5,280-5,330	Limestone, grey, finely crystalline to brownish grey, argillaceous, in part silty; 40 per cent silty, dark grey shale
5,330-5,360	Limestone, grey, finely crystalline; some darker grey, very fine, argillaceous limestone as above; dark grey shale; fossil fragments
5,360-5,390	Limestone, grey, cryptocrystalline, dense, slightly silty; dark grey shale
	<i>Montreal Equivalent ?</i>
5,390-5,410	Limestone, grey, very finely crystalline, in part with crinoid fragments; dark grey shale; brachiopod and bryozoa fragments
5,410-5,420	Limestone, grey, cryptocrystalline; some fragments crystalline limestone; dark grey shale
5,420-5,430	Limestone, grey, cryptocrystalline, as above; some lighter grey, coarsely crystalline limestone; dark grey shale, with crinoid disks
5,430-5,450	Limestone, dark grey, cryptocrystalline
5,450-5,460	Limestone, grey, finely crystalline, with more crystalline limestone than above; in part, possibly recrystallized fossil fragments; crinoids, brachiopods
5,460-5,470	Limestone, buff, finely crystalline; some darker, cryptocrystalline limestone; dark grey shale
5,470-5,500	Limestone, buff-grey, finely to medium crystalline, may be recrystallized fossiliferous limestone in part; dark grey, calcareous, silty shale partings
5,500-5,540	Limestone, grey, finely crystalline; buff, medium crystalline, in part recrystallized, fossiliferous limestone

Depth	Lithology
Feet	Montreal Equivalent?— <i>con.</i>
5,540–5,560	Limestone, grey, finely to medium crystalline, as above; some light buff, coarsely crystalline limestone
5,560–5,580	Limestone, light buff, coarsely crystalline, fossiliferous, with brachiopods and bryozoa fragments (probably recrystallized fossil limestone)
5,580–5,600	Limestone, dark brownish grey to light greyish brown, dense to coarsely crystalline, pyritic in part, fossiliferous; brachiopod and bryozoa fragments; dark grey shale partings
5,600–5,630	Limestone, greyish brown to brown, dense to coarsely crystalline, cherty, pyritic, in part slightly dolomitic, fossiliferous; chert, clear, smoky, and dark brownish grey to black; brachiopod fragments
5,630–5,640	Limestone, buff-grey and cream, medium to coarsely crystalline, fossiliferous; poorly preserved crinoid and brachiopod fragments; a little grey, dense limestone; trace pyrite
5,640–5,660	Limestone, creamy grey, coarsely crystalline; a little buff-grey to grey, dense to finely crystalline limestone; stylotites in cream limestone; pyrite; brachiopod fragments
5,660–5,680	Limestone, dark brownish grey, finely crystalline, slightly dolomitic, slightly argillaceous; light grey, coarsely crystalline limestone, with smoky chert; fossil fragments, chiefly brachiopods
5,680–5,690	Limestone, light grey, coarsely crystalline, in part recrystallized fossils; recrystallized bryozoa or coral-like fossils; numerous brachiopod fragments; clear chert
5,690–5,720	Limestone, light grey, coarsely crystalline and darker grey, finely crystalline, slightly argillaceous, fossiliferous; brachiopods common; dark grey shale partings
5,720–5,730	Limestone, dark brownish grey, dolomitic, dense, cryptocrystalline, argillaceous, pyritic in part; in part finely to medium crystalline, as above
5,730–5,740	Limestone, dark brownish grey, finely crystalline to smoothly textured, sublithographic, argillaceous, and in part micro-silty; pyritic
5,740–5,750	Limestone, cryptocrystalline to finely crystalline; in part argillaceous; brownish grey metabentonite
5,750–5,760	Limestone, brownish grey, sublithographic, argillaceous, micro-silty, slightly dolomitic; some brownish grey, crystalline, fossiliferous limestone, with secondary calcite; pyrite; chert, milky to smoky; a little dark grey shale
5,760–5,770	Limestone, dark brownish grey, slightly dolomitic, sandy; brownish grey, sublithographic limestone, as above; light grey, sandy limestone and calcareous sandstone; a little dark grey, calcareous, sandy shale
<i>Black River</i>	
Leray and Lowville Formations	
5,770–5,780	Limestone, dark brownish grey, cryptocrystalline, sublithographic, slightly dolomitic in part, argillaceous, sandy in part
5,780–5,790	Limestone, greyish brown, cryptocrystalline, sublithographic, with white calcite; a little dark grey limestone, dolomitic, micro-silty
5,790–5,810	Limestone, dark brownish grey, cryptocrystalline, sublithographic, with white calcite; a little light grey, dolomitic, micro-silty limestone
5,810–5,820	Limestone, greyish brown, cryptocrystalline, sublithographic, with white calcite as stringers and aggregates; a little grey limestone, dolomitic, silty, and sandy
5,820–5,830	Limestone, medium grey, cryptocrystalline, sublithographic, slightly micro-silty; a little dolomite, limy, medium grey, microcrystalline, silty to sandy

Depth	Lithology
Feet	Pamelia Formation
5,830-5,840	Dolomite, medium grey, finely crystalline, argillaceous, silty; grades to grey, dolomitic, calcareous siltstone; a little medium grey, sublithographic limestone
	<i>Chazy</i>
	'Beldens' Formation ?
5,840-5,850	Limestone and dolomite: dolomitic, brownish grey, cryptocrystalline to finely crystalline limestone; medium grey, crystalline, micro-silty dolomite; a little cream limestone
5,850-5,860	Limestone and dolomite: brownish grey, slightly dolomitic, argillaceous, cryptocrystalline limestone and medium brown, crystalline, micro-silty dolomite; a little dark grey shale
5,860-5,870	Limestone and dolomite: greyish brown, dense, sublithographic limestone; dark brownish grey to light grey, finely crystalline, argillaceous, micro-silty dolomite; a few large, rounded sand grains; some dark grey shale; calcite veins in limestone
5,870-5,880	Limestone and dolomite, as above; a few sand grains; a little greenish grey, calcareous, micro-pyritic shale
5,880-5,890	Dolomite, light grey, crystalline to coarsely crystalline, finely silty to sandy, with large rounded, frosted sand grains; limestone, greyish brown, argillaceous; a little dark grey shale
5,890-5,900	Dolomite, brownish grey, sugary, pyritic in part, sandy, with large quartz grains; some calcite may be from fossil fragments; shaly partings; a little greyish brown, argillaceous limestone
5,900-5,910	Dolomite, light grey, sandy, with large quartz grains; dark grey, shaly partings; pyrite
5,910-5,920	Dolomite, same as above; fossil fragments; a little dolomitic, light grey, fine-grained sandstone; dark grey, sandy shale
5,920-5,930	Limestone, brownish grey, cryptocrystalline, and grey, argillaceous, dolomitic, pyritic; a little dolomite, grey, finely crystalline, sandy; dark grey, dolomitic shale
5,930-5,940	Dolomite, creamy grey, crystalline, sandy, pyritic; greenish grey, argillaceous, pyritic limestone, and dark grey, fossiliferous, argillaceous limestone; dark grey, dolomitic shale
5,940-5,950	Limestone, dark grey, argillaceous, finely crystalline; brownish grey, dense, slightly dolomitic limestone; dark grey, dolomitic, pyritic shale; a few fossil fragments
5,950-5,970	Dolomite, grey, finely sugary, argillaceous, sandy, pyritic; a few large quartz grains; a little dark grey shale
5,970-5,980	Dolomite, sandy, as above; dolomitic sandstone; much interbedded dark grey shale
5,980-5,990	Sandstone, light grey, coarse-grained; chiefly rounded, frosted, and pitted quartz, well cemented with lime
5,990-6,000	Sandstone, as above; much light grey, fine-grained, dolomitic sandstone
6,000-6,010	Limestone, dark brownish grey, finely crystalline to cryptocrystalline, slightly dolomitic and argillaceous; a little secondary calcite; quartz grains (cavings?)
6,010-6,020	Limestone, dark brownish grey, dolomitic, sandy, cryptocrystalline to finely sugary, large quartz grains (cavings?)
6,020-6,030	Dolomite, dark grey, silty, sandy, with large quartz grains, finely sugary; a little limestone, brownish grey, cryptocrystalline, as above
6,030-6,040	Sandstone, light grey, coarse, well cemented, composed chiefly of large, rounded, frosted quartz grains; dolomitic cement
6,040-6,050	Dolomite, dark grey, finely crystalline, argillaceous, sandy, grading to dolomitic, fine-grained sandstone; a little white sandstone, fine-grained, with black fragments
6,050-6,060	Shale, dark grey, fissile, and light grey, with black flecks, limy nodules, and laminæ, sandy, pyritic

Depth	Lithology
Feet	<i>Chazy</i> —con.
	'Beldens' Formation?—con.
6,060-6,070	Dolomite, dark grey, finely sugary, pyritic, silty to sandy, with large quartz grains; some white sandstone, with dark streaks; greenish grey, pyritic shale; a few fossil fragments
	<i>Beekmantown</i>
6,070-6,090	Dolomite, light grey, argillaceous, finely sugary, silty; and dark grey, argillaceous, cryptocrystalline dolomite; dark grey, calcareous shale
6,090-6,110	Dolomite, shaly, medium grey, finely crystalline, silty; much greenish grey, dolomitic, pyritic shale
6,110-6,130	Shale, grey to slightly greenish grey, dolomitic; dolomite, grey, finely crystalline, shaly, silty, pyritic; a few sand grains
6,130-6,140	Missing
6,140-6,150	Dolomite, light grey, shaly to finely crystalline, silty; considerable greenish grey to grey, dolomitic shale
6,150-6,160	Dolomite, dark grey, finely crystalline, silty, argillaceous; dark grey, dolomitic, silty shale

Note. The Pontgravé River shales in this well have been separated from the Lorraine on the basis of their content of finely crystalline limestone. The contact may not correspond exactly with the actual contact as determined by faunal differences, but is probably very close to it.

As in other wells, the Lorraine-Utica contact cannot be determined. The black shales with the dark brown streak, typical of the Utica, appear to grade upwards to grey shales and to be interbedded with the lower part or the Lorraine.

The top of the Trenton has been selected arbitrarily at the highest occurrence of finely crystalline limestone, although there is little limestone in the upper 120 feet of the limestone-shale section in this well beneath the black shales of the Utica. This upper section, consisting of dark, calcareous shales and dark, argillaceous, silty limestones, from 4,810 to 5,390 feet, is believed to be a more shaly facies of the upper part of the Trenton, possibly corresponding with the Terrebonne and Tetreauville of the Montreal area and possibly including beds above or below these formations. It may be equivalent to part of the Utica. The lower crystalline part of the Trenton in this well appears to be thinner than in the St. Hubert or the St-Grégoire wells. The lower beds, from 5,720 to 5,770 feet, are dense to finely crystalline, and the crystalline, fossiliferous beds found just above the Black River in the other wells are missing. The base of the Trenton in this well, unlike the other wells examined, includes a fine-grained calcareous sandstone.

The Chazy in this well consists of finely crystalline dolomitic limestones, dolomites, and sandstones, and is not similar in lithology to the Laval formation of the Montreal area. It may be equivalent to the 'Beldens' formation, which it resembles, or may represent a change in facies of the Laval formation. It is possible that these beds between the Black River and the known Beekmantown do not correspond with either the Laval or the 'Beldens'. Moreover, there is no positive evidence that they are Chazy in age.

CANADIAN SEABOARD ST-GRÉGOIRE No. 1 WELL

Location: lot 300, range bas du village, Parish of St-Grégoire, Nicolet county, Quebec

Elevation: 90± feet

Drilled: 1934

Total depth: 6,030 feet

Rig: cable

Samples examined by H. R. Belyea, 1946; revised in part, 1950

Depth	Lithology
Feet	<i>Richmond</i>
	Bécancour River Formation
40-70	Shale, red, micaceous, spotted with gypsum; a little grey shale
70-170	Shale, red, with a little gypsum
170-180	Shale, red, and greenish grey, micaceous, in about equal proportions
180-210	Shale, red, as above
210-220	Shale, red; a little grey shale
220-260	Shale, red, as above
260-270	Shale, greenish grey; about 40 per cent red shale, as above
270-290	Shale, red; a little grey shale, as above
290-300	Shale, red, as above
300-310	Shale, red; considerable grey shale, as above
310-410	Shale, red, as above
410-420	Shale, red and greenish grey in about equal proportions; trace of grey limestone
420-470	Shale, greenish grey, muddy, in part silty; trace of red shale and of limestone in most samples
	Pontgravé River Formation
470-490	Shale and limestone: greenish grey, soft, fissile shale; dark grey, finely crystalline, very silty, fossiliferous limestone; brachiopods and ostracods
490-520	Shale and limestone: greenish grey shale and dense, bluish grey, silty limestone in about equal amounts; brachiopod imprints, 500 to 520 feet; ostracods in limestone, 500 to 510 feet; trace pyrite, 510 to 520 feet
520-550	Shale, greenish grey, silty; much bluish grey, finely crystalline, silty limestone, some very fossiliferous; brachiopods and ostracods
550-570	Limestone, bluish grey, finely crystalline, fossiliferous, silty; much greenish grey shale; brachiopods 550 to 560 feet
570-580	Shale, greenish grey, sandy; greenish grey, fine-grained, micaceous sandstone; a little limestone; brachiopod imprint
580-590	Shale, greenish grey; some fine-grained, micaceous sandstone; a little fossiliferous limestone; a few ostracods; some shales contain shiny black specks, which may be carbonaceous material
590-640	Shale, greenish grey; a little fossiliferous, silty limestone; fine-grained sandstone and sandy shale
640-650	Shale, greenish grey; a little fossiliferous, silty limestone and fine-grained sandstone; a little red shale has probably caved from above
650-680	Shale, greenish grey; some grey, fossiliferous limestone
680-690	Shale, greenish grey; less grey fossiliferous limestone than above; a little calcareous sandstone
	<i>Lorraine and Utica</i>
690-750	Shale, soft, greenish grey; fragments usually rounded; a little lighter grey, calcareous siltstone and fine-grained sandstone; traces of fossil limestone; brachiopod imprint 740 to 750 feet

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
750-800	Shale, soft, greenish grey, as above; calcareous, sandy shale; green, micaceous siltstone with small black specks, grades to fine-grained sandstone; a little fossiliferous limestone; brachiopod imprints 750 to 790 feet; bryozoa 770 to 790 feet
800-820	Shale, greenish grey; a little light grey, calcareous, fine-grained sandstone; shell fragments replaced by calcite rhombs
820-830	Sandstone, siltstone, and shale: light grey, micaceous, calcareous, sandy shale; siltstone and fine-grained sandstone, as above; little grey, micaceous, fissile, silty shale; imprint of pelecypod 820 to 830 feet
830-850	Shale, as above; a little sandstone and siltstone, as above
850-880	Shale and sandstone, as above; light grey, calcareous, sandy shale and sandstone; ostracods and crinoid disk 850 to 860 feet; brown calcite rhombs replacing shell fragments 860 to 880 feet; bryozoa 870 to 880 feet
880-920	Shale, greenish grey; a little light grey, sandy shale; sandy shell limestone 880 to 900 feet
920-960	Shale, siltstone, and sandstone: greenish grey shale; greenish grey, calcareous siltstone and fine-grained sandstone, more than 50 per cent of sample; vein calcite 950 to 960 feet; brachiopods and bryozoa
960-970	Shale, siltstone, and sandstone, as above; sandy shell limestone; vein calcite
970-990	Shale, as above; siltstone and sandstone, as above, less than 50 per cent of samples
990-1,020	Shale, as above, grading to fissile, slightly silty, grey shale, and calcareous siltstone; a few fragments show slickensides 990 to 1,000 feet; vein calcite 1,000 to 1,010 feet
1,020-1,050	Shale and siltstone: greenish grey shale, in part fissile; calcareous, sandy siltstone; a little shell limestone; metabentonite 1,020 to 1,030 feet; bryozoa fragments 1,020 to 1,030 feet; crinoid stems 1,040 to 1,050 feet
1,050-1,100	Shale and sandstone: about 60 per cent greenish grey shale and sandy shale grading to fine-grained sandstone (about 40 per cent); brachiopod imprints 1,060 to 1,070 feet; crinoid stems 1,090 to 1,100 feet
1,100-1,120	Siltstone, fine-grained sandstone, and shale, as above; some sandy, shell limestone; bryozoa and brachiopods
1,120-1,130	Shale and siltstone, as above; bryozoa
1,130-1,140	Shale, about 70 per cent; siltstone and fine-grained sandstone, as above about 30 per cent
1,140-1,150	Siltstone, sandstone, and shale, as above
1,150-1,180	Shale, greenish grey to grey, in part darker than above and more fissile; a little lighter grey, sandy siltstone and fine sandstone
1,180-1,210	Shale and sandstone: greenish grey, sandy shale, in part fissile; fine sandstone, as above; much soft, greenish grey shale; fossil fragments, mostly replaced by calcite, numerous in sandy layers
1,210-1,240	Shale, siltstone, and sandy shell limestone; bryozoa, brachiopods, and crinoid stems
1,240-1,250	Sandstone, siltstone, and shale, as above
1,250-1,290	Shale, greenish grey, in part fissile; minor grey, sandy siltstone and fine sandstone; a little shell limestone
1,290-1,310	Sandstone, siltstone, and shale: grey, fine-grained, impure sandstone and sandy siltstone; much grey shale; slickensides 1,290 to 1,300 feet; vein calcite 1,300 to 1,310 feet
1,310-1,340	Siltstone, sandstone, and shale; greenish grey shale; grey, calcareous sandy shale, siltstone, and fine-grained sandstone in excess of shale; sandy shell limestone; bryozoa 1,330 to 1,340 feet; trace vein calcite; greenish brown metabentonite 1,330 to 1,340 feet
1,340-1,370	Shale, siltstone, and sandstone: soft, greenish grey and darker grey, fissile shale slightly in excess of siltstone and sandstone; crinoid stems; brachiopod imprint 1,380 to 1,390 feet; vein calcite 1,340 to 1,350 feet

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
1,370-1,390	Sandstone, siltstone, shale, and sandy shell limestone
1,390-1,460	Sandstone, siltstone, and shale: same as above, but with sandstone and siltstone in excess; fissile, grey shale increasing in amount; fossil fragments numerous; vein calcite 1,390 to 1,400 feet; bryozoa 1,390 to 1,400 feet; crinoid disks 1,410 to 1,420 feet
1,460-1,480	Shale and sandstone: greenish grey, slightly calcareous, sandy shale, grading into siltstone and fine-grained sandstone; soft, grey, fissile shale in about equal amount; shale and sandy layers inter-laminated; slickensides and vein calcite
1,480-1,600	Shale, soft, light greenish grey, as above, and darker grey, micaceous, fissile shale; lighter grey, slightly calcareous, sandy shale and siltstone, with interlaminae of shale and sand; crinoid fragments 1,470 to 1,480, 1,500 to 1,510, and 1,550 to 1,560 feet; small straight cephalopod 1,510 to 1,520 feet; brachiopods common; vein calcite 1,530 to 1,550 feet
1,600-1,630	Shale, grey, fissile; some greenish grey shale, as above; grey, shaly siltstone and fine sandstone as above
1,630-1,640	Siltstone, sandstone, and shale; siltstone and sandstone in excess
1,640-1,650	Shale and siltstone: grey shale; some sandy siltstone; brachiopod fragments
1,650-1,680	Shale, grey, silty; some light grey and dark grey, fine, micaceous "pencil" shale
1,680-1,770	Shale and siltstone: grey, micaceous, fissile shale and silty shale, with rough partings; darker grey shale increasing downwards; siltstone, as above; interlamination of sandy and shale layers; brachiopod fragment 1,680 to 1,690 feet; shell limestone 1,740 to 1,750 feet
1,770-1,810	Siltstone, sandstone, and shale, as above; sandy beds in excess
1,810-1,870	Shale and siltstone: fissile, brittle, silty, grey shale; sandy, shaly siltstone; interlaminated sandy and shaly layers; brachiopod fragments 1,820 to 1,830 feet; trace vein calcite 1,850 to 1,860 feet; a little fine "pencil" shale 1,860 to 1,870 feet
1,870-1,900	Shale, grey, chiefly with rough fracture; in part darker grey, brittle, silty, sandy shale and siltstone; metabentonite 1,880 to 1,890 feet
1,900-1,960	Shale and sandstone: grey, brittle, silty shale; greenish grey and brown, fine-grained, slightly calcareous sandstone; a little fine, fissile shale; brachiopods and bryozoa 1,900 to 1,930 feet
1,960-2,040	Shale, grey, in part fissile; some darker grey, silty, more brittle shale; a little interlaminated siltstone; metabentonite 1,960 to 1,970 feet; vein calcite 1,990 to 2,000 feet; brachiopod fragments 1,980 to 1,990 and 2,030 to 2,040 feet
2,040-2,070	Shale, medium grey, brittle, interlaminated with siltstone, as above; a little lighter grey shale; trace vein calcite 2,050 to 2,060 feet
2,070-2,110	Shale, grey, as above; silty and sandy shale grading into fine-grained sandstone; some light grey, fissile shale; trace vein calcite 2,080 to 2,100 feet
2,110-2,200	Shale and sandstone: medium to dark grey, brittle shale; lighter grey, fissile and sandy shale; siltstone and fine-grained sandstone, in part interlaminated with shale; brownish metabentonite-like shale 2,180 to 2,200 feet
2,200-2,260	Sandstone and shale, same as above, but with sandy layers predominant
2,260-2,410	Shale and sandstone, same as above, but with sandy layers subordinate to medium grey shale; slickensides 2,320 to 2,350 feet
2,410-2,500	Sandstone and shale: interlaminated grey shale and light grey, sandy siltstone and fine sandstone; some shale darker than the above
2,500-2,530	Shale, dark grey, fissile, with interlaminated light grey, sandy siltstone; considerable lighter grey shale, as above
2,530-2,550	Shale, dark grey, fissile, with a little interlaminated sandy siltstone; some very fine, fissile shale
2,550-2,640	Shale, dark grey, fissile; metabentonite 2,550 to 2,560 feet; slickensides 2,570 to 2,580 feet

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
2,640-2,790	Shale, grey to dark grey, fissile, in part with small pyrite nodules; a little interlaminated sandy siltstone and fine sandstone; slickensides 2,670 to 2,690 and 2,770 to 2,780 feet; vein calcite 2,770 to 2,780 feet; metabentonite 2,740 to 2,750 feet
2,790-2,890	Shale, dark grey, chiefly soft, but some hard and brittle; a little interlaminated fine-grained sandstone; a little dolomitic sandstone 2,800 to 2,840 feet; vein calcite 2,880 to 2,890 feet
2,890-2,950	Shale, dark grey, mostly hard and brittle, with sandy laminations; a little lighter grey, soft shale
2,950-3,040	Shale, chiefly dark grey, with a little interlaminated sandstone; dolomite, light brown, silty, 3,020 to 3,030 feet; metabentonite 3,060 to 3,070 feet
3,040-3,130	Shale, dark grey, with a little interlaminated sandstone; light grey-buff dolomite 3,100 to 3,110 feet
3,130-3,170	Shale, medium to dark grey, as above
3,170-3,550	Shale, dark grey, fissile; trace of dolomitic siltstone in most samples; vein calcite 3,260 to 3,280 feet; pyrite 3,220 to 3,230 and 3,320 to 3,330 feet; metabentonite 3,330 to 3,340 feet
3,550-3,600	Shale, dark grey; a little black shale with dark brownish grey streak, the black shale increasing in proportion downwards
3,600-3,830	Shale, dark grey and black; a little sandstone; pyrite 3,660 to 3,670 feet
3,830-3,840	Shale, black, with brownish grey streak, pyritic; a little brown, silty dolomite
3,840-3,980	Shale, black, with brownish grey streak, calcareous, pyritic in part; pyrite 3,960 to 3,970 feet
3,980-3,990	Shale, black, with brown streak, calcareous, pyritic; metabentonite
3,990-4,060	Shale, black, with brown streak, pyritic
4,060-4,110	Shale, black, with dark brown streak, very calcareous, blocky
	<i>Trenton</i>
	<i>Terrebonne and Tetreauville Equivalents?</i>
4,110-4,130	Shale, black to dark grey: a few fragments of brown, finely crystalline, silty limestone; pyrite; calcite 4,110 to 4,120 feet
4,130-4,140	Shale, dark grey, calcareous, with a slightly brownish streak, grades to dark brownish grey, dense, shaly, silty limestone; pyrite
4,140-4,150	Shale, dark grey, blocky, calcareous; slightly brownish streak
4,150-4,160	Shale, as above; fragment of brown, finely crystalline limestone, with shaly partings
4,160-4,220	Shale, dark grey, as above; in part very calcareous with blocky fracture; gradational towards shaly limestone; pyrite
4,220-4,240	Shale, black, fissile, less calcareous than above, brownish grey streak; some dark grey, calcareous, blocky shale grading to shaly limestone; pyrite
4,240-4,270	Shale, dark grey, calcareous; a few fragments of grey-brown, finely crystalline, argillaceous, silty limestone; slickensides; vein calcite; pyrite
4,270-4,320	Shale and limestone: shale, dark grey, calcareous, slightly brownish streak; dark brownish grey, finely crystalline, shaly limestone
4,320-4,330	Shale and shaly limestone: limestone more abundant than above; brown, highly micaceous metabentonite
4,330-4,380	Shaly limestone and shale: dark brownish grey, dense, slightly silty, shaly limestone; dark grey, calcareous shale
4,380-4,400	Shale and limestone: dark grey, calcareous shale, as above; about 20 per cent brown, finely crystalline, argillaceous, finely silty limestone
4,400-4,410	Shale and limestone, as above; about 40 to 50 per cent limestone
4,410-4,490	Shale and limestone, as above; about 10 per cent limestone
4,490-4,510	Shale, dark grey, calcareous
4,510-4,520	Shale and limestone: dark grey, calcareous shale; 20 per cent dark grey, finely crystalline, finely silty, shaly limestone

Depth	Lithology
Feet	<i>Trenton—con.</i>
	Terrebonne and Tetreauville Equivalents?— <i>con.</i>
4,520–4,540	Shale and limestone, as above; about 30 to 50 per cent limestone
4,540–4,600	Shale, dark grey, calcareous; a little shaly limestone, as above
4,600–4,670	Limestone and shale: limestone, brownish grey, finely crystalline to dense, argillaceous, slightly silty; interbedded shale, dark grey, with light brown streak, calcareous, silty, pyritic in part; minute calcite veins 4,600 to 4,620 feet
4,670–4,690	Limestone, in part brownish grey, dense, and argillaceous, and in part dark grey, crystalline, and argillaceous; much shale, dark grey, calcareous, finely silty, fissile; pyritic in part
4,690–4,710	Limestone, chiefly dark grey, finely crystalline; some brownish grey, argillaceous limestone; a little shale, as above; brachiopod and crinoid fragments 4,710 to 4,720 feet
	Montreal and Mile End Equivalents?
4,710–4,730	Limestone, dark grey, finely to medium crystalline, argillaceous; some brachiopod and crinoid fragments
4,730–4,780	Limestone, dark brownish grey, finely to medium crystalline; some fossil fragments; a little dark grey shale, with a grey streak; ostracods 4,760 to 4,770 feet; a little light grey, finely sugary, dense, argillaceous limestone 4,750 to 4,780 feet
4,780–4,790	Limestone, same as above; shale partings and laminations
4,790–4,810	Limestone, dark grey, finely crystalline, finely silty; lighter grey, medium crystalline limestone, in part recrystallized fossil fragments; crinoids and ostracods
4,810–4,820	Limestone, light grey, medium to coarsely crystalline; some darker, finely crystalline limestone; dark grey shale, with crinoid disks; brachiopods
4,820–4,850	Limestone, grey, medium to coarsely crystalline; probably recrystallized fossiliferous limestone; milky to smoky chert 4,830 to 4,840 feet
4,850–4,860	Limestone and shale: brownish grey, finely to medium crystalline, silty limestone; some clear, crystalline calcite; dark grey shale
4,860–4,880	Limestone, dark grey, finely crystalline, argillaceous; grey chert
4,880–4,900	Limestone, dark grey, finely crystalline, slightly dolomitic, slightly argillaceous; a little smoky chert; brachiopods
4,900–4,910	Limestone, grey, finely to medium crystalline, finely silty; a few brachiopod fragments; trace of pyrite
4,910–4,930	Limestone, grey, finely crystalline, and light grey, coarsely crystalline; brachiopods; light grey chert, with pyrite; the coarser limestone drills to small fragments
4,930–4,970	Limestone, buff-grey, medium to coarsely crystalline, cherty, with grey to buff chert; brachiopod fragments
4,970–4,980	Limestone, dark grey, finely to medium crystalline; some dark grey chert; brachiopods
4,980–4,990	Missing
4,990–5,000	Limestone, dark grey, finely crystalline, silty; some lighter grey, crystalline limestone; dark grey shale partings; crinoid disks
5,000–5,030	Limestone, buff-grey, finely to coarsely crystalline; silty, in part; dark shale partings; a few poorly preserved brachiopod and crinoid fragments
5,030–5,050	Limestone, dark grey, finely crystalline, silty, fossiliferous; brachiopod fragments; shale, with a few large sand grains, 5,030 to 5,040 feet
5,050–5,060	Limestone, dark grey, finely crystalline, silty, argillaceous, fossiliferous; numerous brachiopods; dark grey shale; pyritic, light green meta-bentonite
5,060–5,070	Limestone, dark grey, finely crystalline, silty, argillaceous, as above; brachiopods; dark grey shale

Depth	Lithology
Feet	Montreal and Mile End Equivalents?— <i>con.</i>
5,070–5,090	Limestone, in part dark grey, finely crystalline, finely silty and slightly argillaceous, and in part light grey and coarsely crystalline; brachiopods; crinoids
5,090–5,100	Limestone, dark grey, finely crystalline, as above; light grey, coarsely crystalline limestone, in part recrystallized fossil fragments; brachiopods, crinoids, and recrystallized bryozoa or coral-like fossils
5,100–5,110	Limestone, dark grey, finely crystalline, finely silty, argillaceous; some crystallized fossil fragments; bryozoa and brachiopods; dark grey shale
5,110–5,120	Limestone, buff-grey, medium to coarsely crystalline, dolomitic (20 per cent), in part composed of bryozoa, brachiopods, and crinoids; darker grey, finely crystalline limestone; a little dark grey shale
5,120–5,130	Limestone, light grey, crystalline, and darker grey, finely crystalline, slightly dolomitic; fossil fragments; light grey, clear chert
5,130–5,140	Limestone, light grey, medium to coarsely crystalline, most of it drilled into small fragments; brachiopod fragments common
5,140–5,150	Limestone, grey, finely to medium crystalline, slightly dolomitic, finely silty, fossiliferous; corals(?), bryozoa, and brachiopods
5,150–5,170	Limestone, grey, dolomitic (10 to 20 per cent), crystalline, and light buff-grey, crystalline, slightly dolomitic limestone; pyritic in part; thin, dark shale partings; brachiopod fragments
5,170–5,180	Limestone, grey, finely to medium crystalline; argillaceous in part; dark brownish grey chert
5,180–5,210	Limestone and shale: grey, finely crystalline limestone, in part composed of recrystallized fossil fragments; bryozoa and brachiopods; dark brownish grey chert; black shale, in part waxy; pyrite
<i>Black River</i>	
Leray and Lowville Formations	
5,210–5,240	Limestone, dark greyish brown, cryptocrystalline, sublithographic, slightly dolomitic, silty; some light buff, coarsely crystalline, slightly dolomitic limestone
5,240–5,245	Limestone, dark greyish brown, dense, cryptocrystalline, sublithographic, slightly dolomitic; sandstone, grey, calcareous, pyritic, very fine-grained; a little dark grey shale
Pamelia Formation	
5,245–5,260	Limestone, greyish brown, very sandy, with very fine sand grains; grades to dark grey, calcareous, fine-grained sandstone
<i>Chazy</i>	
5,260–5,270	Limestone, dark greyish brown, cryptocrystalline, slightly dolomitic, and slightly sandy; dark grey shale partings
5,270–5,300	Sandstone, limy, light to medium grey, fine-grained, with a few large quartz grains; a little dark grey shale, and a little brown, dolomitic, sandy limestone
5,300–5,310	Sandstone and dolomite: medium grey, sandy dolomite with quartz veins; coarse-grained sandstone, with rounded, frosted, pitted quartz grains; a little shale, with large quartz grains
5,310–5,330	Dolomite, medium grey, sugary, silty; conglomerate of large quartz grains in a shaly, dolomitic matrix
5,330–5,340	Limestone, medium grey, slightly dolomitic, argillaceous and sandy in part; light grey, fine-grained, calcareous sandstone, with scattered large quartz grains
5,340–5,350	Sandstone, calcareous, fine-grained, with a few large quartz grains; a little limestone, medium grey, sandy; a little dark grey shale

Depth	Lithology
Feet	'Beldens' Formation(?)
5,350-5,360	Limestone, brown, dense, lithographic; some layers very sandy, with rounded, frosted quartz grains
5,360-5,370	Limestone, dark grey, dense, very finely crystalline, slightly dolomitic, in part argillaceous
5,370-5,380	Limestone, dolomitic, dark brownish grey, dense, argillaceous, sandy; a little dark grey, sandy shale
5,380-5,400	Limestone, light brown, cryptocrystalline, and in part dark greyish brown, sandy, slightly dolomitic, and argillaceous; a little dark grey, silty shale; dolomite, grey, calcitic, sandy, granular
5,400-5,410	Limestone, light brown, cryptocrystalline, slightly dolomitic, sandy; dolomite, grey, sandy, argillaceous
5,410-5,420	Dolomite, limy, brownish grey, dense and sugary, argillaceous, sandy; thin sandstone layers
5,420-5,430	Dolomite, grey, sugary, argillaceous, sandy, with a few large quartz grains; grades to dark grey, dolomitic sandstone
5,430-5,440	Dolomite, medium grey to very light grey, sugary, sandy; thin shale partings; sandstone, light grey, fine-grained; dark grey, dolomitic siltstone
5,440-5,450	Dolomite, medium grey, sugary, sandy, with large, rounded quartz grains; grades to dark grey, dolomitic siltstone
5,450-5,460	Sandstone, light to medium grey, fine-grained, dolomitic; a few large sand grains
5,460-5,490	Dolomite, medium grey, limy, sugary, sandy; some layers with large quartz grains; grades to dolomitic, fine-grained sandstone; dark grey shale partings
5,490-5,500	Dolomite and sandstone, same as above, but with a little greenish grey, soft, pyritic shale
5,500-5,510	Dolomite, sandstone, and shale, same as above; a little brown, crystalline limestone
5,510-5,530	Dolomite and siltstone: dark brownish grey, sugary, argillaceous dolomite, in part with large quartz grains; grades to argillaceous, dolomitic siltstone, and dark brownish grey, silty shale
5,530-5,540	Limestone, mottled with dolomite, dark brown, cryptocrystalline, sub-lithographic, sandy in part
5,540-5,550	Dolomite, medium grey, sugary, sandy; grading to dolomitic siltstone and silty shale
5,550-5,580	Dolomite, same as above; interbedded sandstone, light grey, coarse-grained, well cemented; pyritic in part
5,580-5,590	Sandstone, light grey, coarse, well cemented; large quartz grains in finer matrix; sandy dolomite and siltstone, as above
5,590-5,650	Sandstone, coarse, composed chiefly of large, rounded, frosted, pitted quartz grains well cemented in fine quartz and shale matrix
5,650-5,660	Sandstone, same as above; a little interbedded sandy dolomite, shale, and siltstone
5,660-5,670	Shale, dark grey to greenish grey, silty, micaceous, soapy, pyritic; sandstone, coarse quartz grains in a shaly matrix, as above
5,670-5,680	Siltstone, shale, and sandstone: dark grey, dolomitic, argillaceous siltstone and dark grey shale; lighter grey, fine-grained sandstone; olive-grey, soapy shale; a few large, rounded, frosted quartz grains
<i>Beekmantown</i>	
5,680-5,690	Siltstone and shale: dark grey, pyritic, dolomitic siltstone; dark grey shale; some light grey, fine, calcareous sandstone with brown and black shiny fragments, large quartz grains, and pyrite
5,690-5,710	Siltstone and dolomite: dark grey, dolomitic siltstone and fine, silty, argillaceous dolomite; green shale
5,710-5,730	Dolomite and siltstone: light grey, finely crystalline, silty dolomite and dolomitic siltstone; greenish grey shale

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
5,730–5,740	Dolomite and siltstone: light grey, sugary, silty, calcitic, argillaceous dolomite; grey, dolomitic siltstone
5,740–5,770	Siltstone, greenish grey, dolomitic, argillaceous; grades to silty, sugary dolomite; dark grey shale
5,770–5,780	Dolomite and siltstone: light grey, finely crystalline, silty dolomite grading to dolomitic siltstone; dark grey shale partings
5,780–5,790	Siltstone and dolomite: grey, granular, silty dolomite grading to dolomitic siltstone
5,790–5,820	Siltstone, dolomite, and shale: brownish grey, sugary, dolomitic siltstone and silty dolomite; dark grey shale
5,820–5,830	Siltstone and shale: dark grey, dolomitic, argillaceous siltstone and dark grey shale
5,830–5,840	Dolomite, calcitic, grey, finely crystalline, silty, sandy; with large quartz grains
5,840–5,850	Dolomite and siltstone: grey, finely crystalline, silty dolomite and dolomitic siltstone
5,850–5,860	Siltstone and shale: dark grey, dolomitic siltstone, varying to silty dolomite; dark grey and green shale
5,860–5,870	Dolomite, dark grey, finely crystalline, sugary, silty; dark grey, silty shale; scattered large quartz grains
5,870–5,880	Sandstone and dolomite: light grey, fine-grained, dolomitic, pyritic sandstone, with some larger, rounded, frosted sand grains; light grey, fine, sandy dolomite; dark grey shale
5,880–5,890	Dolomite and siltstone: grey, silty, sugary dolomite grading to dolomitic siltstone
5,890–5,910	Dolomite, siltstone, and shale: grey, silty, sugary dolomite and dolomitic siltstone; dark grey, silty shale
5,910–5,920	Dolomite, grey, crystalline, sandy
5,920–5,930	Dolomite and siltstone: grey, sugary, silty dolomite and dolomitic siltstone; a few large quartz grains
5,930–5,940	Dolomite, calcitic, grey, crystalline; scattered sand grains
5,940–5,980	Siltstone, dolomite, and shale: dark grey, finely crystalline to granular dolomite; some dolomitic siltstone; dark grey shale
5,980–5,990	Dolomite and siltstone: dark grey, sugary, silty dolomite and grey, crystalline dolomite; dark grey dolomitic siltstone; scattered large quartz grains
5,990–6,000	Dolomite, grey, crystalline, in part with granular texture
6,000–6,020	Dolomite, light grey, finely crystalline
6,020–6,030	Dolomite, calcitic, grey, sugary, silty

Notes. The Pontgravé River formation is distinguished from the Lorraine by the presence of finely crystalline limestone in the former. This change may not correspond exactly with the boundary between the Lorraine and Pontgravé River as determined by faunal associations, but is probably close to it, is consistent in most of the wells examined, and, thus, makes a fairly reliable criterion.

As in most of the wells, the change from Utica to Lorraine cannot be determined in this well. The black, Utica-type shales, with the dark brown streak, grade upward and appear to be interbedded with dark shales with a grey streak.

The top of the Trenton is placed at the top of the highest band of finely crystalline limestone below the Utica shales. The limestones in this upper part of the Trenton are very shaly, and are interbedded with dark grey shales. The amount of shale is much greater than in the wells

near Montreal and on the north shore of the St. Lawrence. These beds probably form a more shaly facies of the Terrebonne and Tetreauville, and may also represent a longer period of deposition.

The beds between the Black River and the dark grey silty argillaceous dolomites, typical of the Beekmantown, have all been placed in the Chazy. The lower part of the Chazy, from 5,350 to 5,680 feet, is believed to correspond with the 'Beldens' formation, which is exposed in the St. Dominique thrust slice and to which it is lithologically similar. It is also similar to the Chazy of the St-Gérard well. The beds overlying this group, from 5,260 to 5,350 feet, composed of sandstones, dolomites, and limestones, may correspond with the beds above the 'Beldens' in the St. Dominique thrust slice. They are not similar in lithology to the Laval formation of the Montreal area, although they may represent a different facies of that formation.

CARTIER NATURAL GAS No. 5 WELL

Location: 1½ miles southwest of Lanoraie village, Berthier county, Quebec

Elevation: 101 feet

Drilled: 1934-35

Total depth: 2,500 feet

Rig: cable

Samples examined by H. R. Belyea, 1946

Depth	Lithology
Feet	
0-200	Drift
	<i>Lorraine and Utica</i>
200-220	Shale, medium grey, fissile, micaceous, slightly silty, and darker grey, silty, less fissile shale
220-230	Shale, medium grey, similar to above; some grey, fine-grained, laminated, calcareous sandstone and siltstone; crystallized bryozoa and brachiopods form sandy limestone; metabentonite
230-240	Shale and sandstone, as above; brachiopods and bryozoa
240-280	Missing
280-290	Shale, medium grey, fissile, interlaminated with sandy shale, siltstone, and fine-grained calcareous sandstone; fossiliferous sandy limestone
290-300	Shale, as above; a little sandy shale
300-320	Shale, as above; more sandy shale grading to fossiliferous sandy limestone; brachiopod imprints numerous
320-390	Shale, medium grey, as above; sandy shale and fine-grained, calcareous sandstone; fossil fragments; crinoids 370 to 390 feet
390-430	Shale, medium grey; a little sandy shale and fine-grained, calcareous sandstone
430-450	Shale, sandy shale, and fine-grained sandstone, as above; brachiopods and crinoids 430 to 440 feet
450-460	Shale, sandy shale, and much fine-grained sandstone; bryozoa
460-490	Shale, sandstone, and sandy shale; crinoid stems 480 to 490 feet
490-520	Shale, medium to dark grey; a little sandy shale; vein calcite
520-550	Missing
550-610	Shale, medium to dark grey, fissile, in part micaceous; a little sandy shale and calcareous siltstone
610-620	Shale, medium grey to dark grey, fissile; some calcareous siltstone; light green to light brown metabentonite; slickensides; vein calcite; pyrite
620-630	Shale and siltstone, as above; slickensides; vein calcite; pyrite
630-660	Shale, some siltstone, as above; vein calcite

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
660-740	Shale, dark grey, in part fissile, smooth and in part silty, brittle, rough; some siltstone; a little brown, sandy dolomite; vein calcite
740-790	Shale, dark grey, in part fissile, smooth, micaceous; in part silty, with rough cleavage; some with a brown streak; a little sandy shale and siltstone
790-810	Shale, as above; a little sandy shale, siltstone, and brownish sandy dolomite
810-840	Shale, as above; a little sandy shale and siltstone
840-850	Shale, as above; a little sandy shale, siltstone, and sandy dolomite, as above
850-860	Shale, sandy shale, and siltstone as above
860-870	Shale, as above; dark olive-green metabentonite
870-1,070	Shale, dark grey; a little sandy shale and siltstone
1,070-1,170	Shale, dark grey; some with a brown streak; in part sandy; a little brown, sandy dolomite and fine, dolomitic sandstone
1,170-1,180	Shale, dark grey, as above; grey-green, soapy, speckled metabentonite
1,180-1,320	Shale, dark grey to black, with a light brown streak, the black shale increasing in amount downwards; metabentonite and pyrite 1,260 to 1,270 feet
1,320-1,340	Shale, dark grey, as above; brown, sandy dolomite
1,340-1,460	Shale, black, with a brown streak; some dark grey shale, with a grey streak; pyrite 1,350 to 1,360 feet
1,460-1,470	Shale, as above; a little brown, sandy dolomite
1,470-1,560	Shale, as above; pyrite 1,530 to 1,560 feet
1,560-1,750	Shale, black, with a dark brown streak, fissile; pyrite 1,630 to 1,650 feet
1,750-1,820	Shale, black, with a light brown streak, calcareous; granular texture; metabentonite 1,770 to 1,780 feet; vein calcite 1,700 to 1,780 feet
	<i>Trenton</i>
	Terrebonne and Tetreauville Formations (or Equivalents)
1,820-1,880	Limestone and shale: dark, greyish brown limestone, very argillaceous, finely crystalline; dark grey, calcareous shale, with brown streak
1,880-1,890	Shale, dark grey, as above; limestone, as above
1,890-1,940	Limestone and shale: dark brown, argillaceous, and finely crystalline limestone and dark grey shale, as above
1,940-1,950	Limestone and shale, as above; light green metabentonite
1,950-1,960	Limestone and shale, as above; dark brown, bentonitic shale
1,960-2,020	Limestone and shale: dark brown, argillaceous limestone and dark grey shale, as above
2,020-2,030	Limestone and shale, as above; green metabentonite, with nodules
2,030-2,040	Limestone and shale, as above; light brown, shaly metabentonite
2,040-2,060	Limestone and shale, as above
2,060-2,100	Shale and limestone: dark grey, calcareous, soapy shale; dark grey, finely crystalline, argillaceous limestone
2,100-2,140	Limestone and shale: dark greyish brown, argillaceous, finely crystalline limestone; dark grey shale
2,140-2,150	Shale, dark grey; a little limestone; pale green metabentonite, with black nodules
2,150-2,220	Limestone, dark greyish brown, as above; dark grey shale
2,220-2,240	Shale and limestone: chiefly dark grey shale; some limestone, as above
2,240-2,250	Limestone and shale: greyish brown limestone and dark grey shale, as above; light bluish green metabentonite, with small nodules
2,250-2,300	Limestone and shale: dark greyish brown, finely crystalline limestone; dark grey shale; brachiopods 2,280 to 2,290 feet

Depth	Lithology
Feet	Montreal Formation (or Equivalent)
2,300-2,310	Limestone, dark grey, finely crystalline; light grey, crystalline, fossiliferous limestone; crinoids and brachiopods
2,310-2,320	Limestone, brownish grey, cryptocrystalline
2,320-2,330	Limestone, grey, finely crystalline; brachiopods
2,330-2,340	Limestone, light grey, coarsely crystalline, fossiliferous; brachiopods; dark grey shale
2,340-2,350	Missing
2,350-2,360	Limestone, brownish grey, finely crystalline; brachiopods
2,360-2,390	Limestone, grey to light grey, finely to coarsely crystalline; fossiliferous
2,390-2,410	Limestone, brownish grey to grey, finely to coarsely crystalline, as above; black, soapy shale
2,410-2,430	Limestone, light grey, coarsely crystalline, dolomitic (40 per cent); fossiliferous—bryozoa
2,430-2,440	Missing
2,440-2,455	Limestone, dark grey, very finely crystalline; black chert; dark grey shale
2,455-2,480	Limestone, cream, dolomitic (40 per cent), crystalline, fossiliferous, cherty; milky, banded, and smoky chert
2,480-2,490	Limestone, cherty, as above; pale green metabentonite, with brown mica
2,490-2,500	Limestone, as above, with chert

CARTIER NATURAL GAS ST. HUBERT No. 1 WELL

Location: lot 26, St. Hubert parish, Chambly county, Quebec

Elevation: 91 feet

Drilled: 1934-35

Total depth: 3,490 feet

Rig: cable

Samples examined by H. R. Belyea, 1946; revised, 1950

Depth	Lithology
Feet	
0-20	Drift and grey shale fragments
	<i>Lorraine and Utica</i>
20-50	Shale and siltstone: medium grey, fissile shale, in part, silty; lighter grey, calcareous and dolomitic siltstone
50-60	Shale and siltstone, as above; a little green igneous rock
60-120	Shale and siltstone, same as above
120-130	Shale and siltstone; green igneous rock
130-140	Shale and siltstone, as above
140-170	Shale, medium grey, fine, smooth, fissile, micaceous, and dark grey, fissile to silty and irregularly fractured shale, some with a brownish streak; a little interlaminated calcareous siltstone
170-180	Igneous rock; shale, as above
180-240	Shale, medium to dark grey, as above, with a little interlaminated siltstone; calcite veins
240-270	Shale, medium to dark grey, with a little siltstone, as above
270-280	Igneous rock; shale, as above
280-310	Shale, medium and dark grey, in part with a light brown streak, as above; a little siltstone
310-330	Shale, as above; calcite veins

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
330-350	Shale, as above; a little siltstone
350-370	Shale, as above; calcite veins
370-470	Shale, medium and dark grey, as above; in part with a light brown streak
470-490	Igneous rock
490-500	Shale, dark grey, fissile, in part silty; some with a light brown streak; metabentonite
500-510	Shale, dark grey, fissile, as above; a little light brown, dolomitic siltstone grading to silty dolomite
510-530	Shale, dark grey, as above; calcite veins
530-550	Shale, as above
550-560	Shale, dark grey, fissile, as above, in part with a brown streak; a little light brown, dolomitic siltstone and silty dolomite
560-580	Shale, dark grey, as above; calcite veins
580-590	Shale, as above; calcite veins; metabentonite
590-640	Shale, dark grey, in part with a brown streak, as above; some igneous rock 590 to 620 feet
640-650	Shale, as above; a little brown, silty dolomite and dolomitic siltstone; calcite veins
650-690	Shale, dark grey, in part with a brown streak, as above
690-700	Shale, as above; some igneous rock
700-720	Shale, as above, in part with a brown streak
720-730	Shale, dark grey, fissile, as above; most of it has a brown streak
730-740	Shale, dark grey, as above; brown, silty dolomite and dolomitic siltstone
740-750	Shale, as above, pyritic
750-800	Shale, dark grey, as above; in part black, with a brown streak that becomes more prominent downwards
800-820	Shale, as above; brown, dolomitic siltstone and silty dolomite, as above
820-830	Shale, as above; igneous rock
830-840	Shale, as above
840-870	Shale, dark grey, as above; brown, dolomitic siltstone and silty dolomite
870-880	Shale, as above
880-900	Shale, as above; igneous rock; metabentonite 890 to 900 feet
900-930	Shale, black, with a brown streak, as above
930-940	Shale, as above; pyrite
940-950	Shale, as above
950-970	Shale, as above; igneous rock
970-1,000	Shale, as above; pyrite
1,000-1,020	Shale, as above, pyrite; igneous rock
1,020-1,050	Shale, dark grey to black, with a brown streak; minute calcite veins; pyrite
1,050-1,170	Shale, black, with a brown streak, as above; minute calcite veins
1,170-1,180	Shale, black, with a brown streak; pyrite
1,180-1,195	Shale, as above
1,195-1,210	Shale, black, calcareous, light brown streak; granular texture
1,210-1,220	Shale, same as above; brown metabentonite
1,220-1,240	Shale, dark grey, calcareous, as above
	<i>Trenton</i>
	Terrebonne and Tetreauville Formations
1,240-1,250	Limestone and shale: dark brownish grey, very argillaceous, finely silty, finely crystalline limestone, with a few fossil fragments; about 10 per cent dark grey, calcareous shale, with a light brown streak

Depth	Lithology
Feet	<i>Trenton—con.</i>
	Terrebonne and Tetreauville Formations— <i>con.</i>
1,250–1,270	Limestone, dark grey, finely crystalline, argillaceous; a few brachiopod fragments; grades to dark grey, massive, calcareous shale; slickensides and calcite
1,270–1,300	Limestone, dark grey, as above, grading to massive, limy shale
1,300–1,310	Limestone, as above; brachiopod fragments; ostracods
1,310–1,320	Limestone, as above; crinoid fragments
1,320–1,360	Limestone and shale: dark grey, finely crystalline, argillaceous limestone; dark grey, massive, calcareous shale
1,360–1,380	Limestone, dark grey, finely crystalline, finely silty, argillaceous; a little dark grey shale; a few fragments of medium crystalline limestone
1,380–1,390	Limestone, dark grey, finely crystalline, finely silty, argillaceous; fragments of vein calcite with slickensides
1,390–1,430	Limestone, as above; some dark grey, calcareous shale
1,430–1,440	Limestone, as above; shale, dark grey, calcareous; pyrite
1,440–1,450	Limestone and shale, as above; ostracods
1,450–1,470	Limestone, dark grey, finely crystalline, argillaceous, as above
1,470–1,480	Limestone, as above; brachiopods; some dark grey shale
1,480–1,500	Limestone, dark grey, finely crystalline; in part, finely silty; some dark grey, shaly limestone and shale
1,500–1,510	Limestone, as above; much dark grey shale; fragment of trilobite; calcite veins
1,510–1,520	Limestone, grey to dark grey, finely crystalline, finely silty; dark grey shale, with ostracods
1,520–1,530	Limestone, grey, finely crystalline; shale, dark grey, with crinoid disks
1,530–1,550	Limestone, grey, finely crystalline; dark grey shale, with crinoid stems; ostracods; fragment of a trilobite; a little green igneous rock; calcite veins
1,550–1,590	Limestone and shale: dark grey, finely crystalline, finely silty, argillaceous limestone and dark grey shale; brachiopod fragment 1,570 to 1,580 feet
1,590–1,610	Limestone, dark grey, finely crystalline; in part fossiliferous; in part finely silty and argillaceous; dark grey, calcareous shale; trilobite and brachiopod fragments
1,610–1,630	Limestone, dark grey, finely crystalline, finely silty and argillaceous; dark grey shale
1,630–1,650	Limestone, dark grey, finely crystalline, finely silty, argillaceous; in part fossiliferous; dark grey shale, with ostracods, trilobite fragments, and brachiopod imprint
	Montreal and Mile End Formations
1,650–1,710	Limestone, grey, fossiliferous, with crinoid disks and some brachiopods in a finely silty, argillaceous, finely to medium crystalline limestone matrix; some dark grey shale
1,710–1,720	Limestone, grey, finely crystalline, finely silty, slightly argillaceous; in part, lighter grey, coarsely crystalline, and slightly dolomitic; fossil fragments—crinoids and brachiopods; trilobite fragment; one crystal-coated fragment suggests vuggy porosity
1,720–1,760	Limestone, light grey, finely to coarsely crystalline (possibly coquinoid), and in part darker grey, finely crystalline, finely silty, and slightly argillaceous; dark grey shale; brachiopods; small crinoid disks common
1,760–1,780	Limestone, darker grey, finely crystalline, finely silty, as above, with some crystalline, fossiliferous (possibly coquinoid) limestone, as above
1,780–1,810	Limestone, light grey-buff, finely crystalline to medium crystalline, in part, composed of crinoid and brachiopod fragments; some darker finely crystalline limestone; dark shale partings

Depth	Lithology
Feet	Montreal and Mile End Formations— <i>con.</i>
1,810–1,840	Limestone, light grey-buff, finely crystalline to crystalline; fossiliferous, as above, with brachiopods; more dark grey, finely crystalline, silty limestone and shale than above
1,840–1,860	Limestone, buff-grey, finely to coarsely crystalline; fossiliferous (coquinoid?)—abundant brachiopods; some dark grey, calcareous, massive shale; traces of pyrite
1,860–1,900	Limestone, buff-grey, finely to coarsely crystalline; fossiliferous—brachiopods fewer than above; some dark grey shale
1,900–1,940	Limestone, buff-grey, finely to coarsely crystalline, as above, the latter more abundant than above; brachiopod fragments; some dark grey shale, with ostracod, 1,910 to 1,920 feet
1,940–1,960	Limestone, buff-grey, as above; mostly finely crystalline; some coarsely crystalline; brachiopod fragments; ostracods 1,950 to 1,960 feet
1,960–1,980	Limestone, light grey, coarsely crystalline, slightly dolomitic; some darker, finely crystalline, finely silty limestone, as above; dark grey shale; brachiopods and crinoids
1,980–1,990	Limestone, dark grey, finely crystalline, finely silty, pyritic; some light grey, coarsely crystalline limestone; brachiopod fragments
1,990–2,000	Limestone and shale: dark grey, finely crystalline, slightly silty, argillaceous, pyritic limestone; dark grey shale; brachiopod fragments; some coarsely crystalline limestone fragments
2,000–2,020	Limestone, light grey, coarsely crystalline, fossiliferous; numerous fragments of fossils resembling corals or bryozoa; dark grey, silty, finely crystalline limestone and dark grey shale
2,020–2,060	Limestone and shale: dark grey, finely crystalline limestone grading to dark grey, calcareous, massive shale; a little crystalline, fossiliferous limestone; brachiopods; trilobite fragment 2,050 to 2,060 feet
2,060–2,070	Limestone, grey, crystalline; pyritic in part; dark grey, calcareous, fossiliferous shale, with crinoids and ostracods
2,070–2,080	Limestone, light grey, crystalline to coarsely crystalline, slightly dolomitic, slightly argillaceous; some dark grey, finely crystalline limestone and thin, dark, pyritic shale partings
2,080–2,090	Limestone, light grey, coarsely crystalline; very dark grey, fine, shaly limestone; bryozoa abundant
2,090–2,100	Limestone, light grey, crystalline, probably coquinoid; fragments of fossils resembling corals or bryozoa; very dark grey, crypto-crystalline to finely crystalline limestone with crinoid disks
<i>Black River</i>	
Leray and Lowville Formations	
2,100–2,110	Limestone, buff-grey, cryptocrystalline, sublithographic, slightly silty; spots of calcite; some light grey oolitic limestone; some finely brecciated limestone
2,110–2,120	Limestone, dark grey, very finely crystalline, and brown cryptocrystalline, sublithographic; black shale partings
2,120–2,130	Limestone, dark grey and brown, cryptocrystalline, slightly silty
2,130–2,140	Limestone, light grey, cryptocrystalline, sublithographic; dolomite, dark grey, granular, with black material separating grains
Pamelia Formation	
2,140–2,150	Dolomite, grey, finely crystalline, silty; grades to dolomitic siltstone; black shale partings with pyrite; a few quartz grains
2,150–2,160	Dolomite and limestone: silty dolomite, same as above; pyrite; limestone, grey, finely crystalline, dolomitic

Depth	Lithology
Feet	<i>Chazy</i>
	Laval Formation
2,160-2,170	Limestone, light grey to grey, cryptocrystalline, slightly argillaceous; grey, soapy shale partings; some light grey, fragmental limestone; brachiopod fragments
2,170-2,190	Limestone, dark grey, cryptocrystalline to finely crystalline, silty, argillaceous in part; some dark grey to greenish grey, soapy shale
2,190-2,200	Limestone, grey, crystalline to coarsely crystalline, fossiliferous; dark grey shale
2,200-2,210	Limestone, dark grey, cryptocrystalline, finely silty; some recrystallized fossil fragments; grades to dark grey shale
2,210-2,220	Limestone, grey, finely to coarsely crystalline; in part finely silty and argillaceous; recrystallized shell fragments; dark grey shale; pyrite
2,220-2,240	Limestone, light grey, slightly dolomitic, coarsely crystalline, fossiliferous—some fragments resembling corals or bryozoa and brachiopods; dark grey shale partings
2,240-2,250	Limestone, grey, finely to coarsely crystalline, fossiliferous; some light grey, cryptocrystalline limestone; brachiopods; dark grey shale
2,250-2,270	Limestone, light grey, coarsely crystalline, dolomitic (20 per cent); fossiliferous—possibly coquinoid; brachiopods; dark grey, shaly laminations and partings; trace pyrite
2,270-2,280	Limestone, grey, finely crystalline, with some recrystallized fossil fragments; dark grey shale partings; pyrite
2,280-2,300	Limestone, dark grey, cryptocrystalline to finely crystalline, argillaceous; some dark grey, finely granular dolomite; some light grey, finely crystalline to crystalline, fossiliferous limestone; dark grey shale partings
2,300-2,310	Limestone and shale: grey, finely crystalline to crystalline, fossiliferous limestone; dark grey, soapy, pyritic shale; brachiopods
2,310-2,330	Limestone, light grey, crystalline to coarsely crystalline, slightly dolomitic (10 per cent); dark, pyritic, shale partings
2,330-2,350	Limestone and shale: grey, cryptocrystalline to finely crystalline, light grey, fossiliferous limestone; dark grey, soapy, pyritic shale
2,350-2,360	Limestone, light grey, coarsely crystalline, in part oolitic and nodular; brachiopod fragments—bryozoa; dark grey, pyritic shale
2,360-2,410	Limestone and sandstone: light grey, crystalline to coarsely crystalline, fossiliferous limestone; sandy in part; grey and white, fine-grained, calcareous sandstone, with small black specks
2,410-2,420	Sandstone, grey, quartzose, calcareous, pyritic, fine-grained; small black specks may be trilobite remains; some light grey, crystalline limestone, as above; dark grey shale
2,420-2,450	Sandstone, as above, with some dark shale partings
2,450-2,470	Shale, grey, soapy, pyritic; a little grey, finely crystalline limestone
2,470-2,510	Sandstone, light grey, fine-grained, well cemented, calcareous; small black specks may be trilobite remains
2,510-2,520	Limestone, grey, crystalline, slightly silty, fossiliferous—ostracod
2,520-2,530	Sandstone, grey, fine-grained, slightly pyritic; scattered small black specks; some dark grey shale
2,530-2,538	Sandstone, light grey, fine-grained, with scattered large, frosted, rounded quartz grains; shale, grey, soapy, pyritic
	<i>Beekmantown</i>
2,538-2,540	Siltstone and shale: dark grey, calcareous siltstone and silty limestone; dark grey shale
2,540-2,550	Siltstone and limestone: dark grey, calcareous siltstone grading to silty limestone; dark, brownish grey, cryptocrystalline, slightly dolomitic, silty limestone
2,550-2,560	Dolomite and siltstone: dark grey, silty, very finely crystalline dolomite and dark grey, dolomitic siltstone; some dark grey shale; some dark grey, crystalline limestone

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
2,560-2,570	Shale, dark grey, dolomitic
2,570-2,580	Dolomite, grey, cryptocrystalline, finely silty
2,580-2,590	Siltstone, dark grey, dolomitic, argillaceous; grades to silty dolomite; some dark grey shale
2,590-2,600	Shale, siltstone, and limestone: dark grey, silty, calcareous shale; dark grey, calcareous siltstone and dark grey, finely crystalline, pyritic limestone
2,600-2,610	Dolomite and siltstone: dark grey, silty, finely crystalline dolomite and dolomitic siltstone
2,610-2,620	Siltstone and shale: dark grey, dolomitic siltstone and some silty dolomite; dark grey shale; some fragments crystalline limestone (cavings?)
2,620-2,630	Dolomite, light grey, finely crystalline, silty
2,630-2,650	Dolomite and siltstone: grey to dark grey, fine, silty dolomite and dolomitic siltstone
2,650-2,660	Limestone, light grey, finely crystalline to crystalline, mottled, possibly recrystallized shell limestone; grey to dark grey siltstone
2,660-2,670	Siltstone, dark grey, calcareous; some light grey limestone as above
2,670-2,680	Dolomite and siltstone: grey, finely crystalline, silty dolomite grading to dolomitic siltstone; dark grey shale; fractures with dolomite veins
2,680-2,690	Sandstone, light greenish grey, dolomitic; light greenish grey, silty to sandy shale; pyrite
2,690-2,700	Dolomite, light grey, cryptocrystalline
2,700-2,710	Siltstone, grey, dolomitic; grey, silty dolomite and dark grey shale
2,710-2,740	Siltstone, light grey, dolomitic, grading to light grey, silty dolomite; dolomite veins; some greenish grey shale; pyrite
2,740-2,750	Dolomite, light grey to buff, finely crystalline; calcite veins
2,750-2,790	Dolomite, light grey, silty, very finely crystalline, pyritic; may be a dolomitic siltstone
2,790-2,800	Dolomite and siltstone: light grey, silty dolomite and darker grey, dolomitic siltstone
2,800-2,810	Dolomite, brownish grey, calcitic in part, silty, finely crystalline
2,810-2,820	Siltstone, dark grey, argillaceous, calcareous
2,820-2,830	Dolomite, grey, finely crystalline, silty, pyritic; in part shaly
2,830-2,840	Dolomite and siltstone: grey, fine, calcitic, silty dolomite; darker grey, dolomitic siltstone and dark grey shale; a few large, frosted sand grains
2,840-2,850	Dolomite, dark grey, granular, pyritic, silty
2,850-2,870	Dolomite, siltstone, and shale: grey, silty, finely granular dolomite; grey, dolomitic siltstone, with scattered large, frosted sand grains; dark grey shale
2,870-2,880	Limestone, dark grey, dolomitic (40 to 50 per cent), argillaceous
2,880-2,890	Dolomite, light grey, silty; grades to dark grey, dolomitic siltstone
2,890-2,900	Shale and siltstone: dark grey shale; light grey, dolomitic siltstone and silty dolomite
2,900-2,910	Siltstone, grey, dolomitic, argillaceous; grading to silty dolomite
2,910-2,930	Siltstone, limestone, and shale: grey, dolomitic siltstone; dark grey, cryptocrystalline limestone; dark grey, pyritic shale
2,930-2,940	Siltstone, dark grey, dolomitic, argillaceous; dark grey shale
2,940-2,950	Dolomite, light grey, very finely crystalline, calcitic, slightly argillaceous, silty
2,950-2,960	Siltstone, sandstone, shale, and dolomite: dolomite as above; light grey, dolomitic siltstone and lighter grey, fine-grained, dolomitic sandstone; greenish grey, soapy, pyritic shale
2,960-2,970	Siltstone, greenish grey, dolomitic, shaly; dark grey, shaly, silty dolomite; green, pyritic shale
2,970-2,990	Siltstone, grey to dark grey, dolomitic, argillaceous, pyritic in part; grades to fine-grained sandstone and finely granular, silty dolomite

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
2,990-3,000	Limestone, grey, crystalline; in part pseudo-oolitic, fragmental, fossiliferous; in part darker, argillaceous, dolomitic; crinoid stem; dark grey, calcareous siltstone and shale
3,000-3,020	Limestone, grey, crystalline; darker grey dolomite and shale; ostracods
3,020-3,040	Dolomite, dark grey, very finely crystalline, argillaceous; dark grey shale
3,040-3,060	Dolomite, grey, finely crystalline, calcitic, argillaceous; fine to medium crystalline limestone, with fossil fragments
3,060-3,070	Limestone and siltstone; dark grey, finely crystalline, silty limestone and dark grey, calcareous siltstone
3,070-3,090	Limestone, as above; some fine, granular, silty dolomite and dark grey, calcareous siltstone
3,090-3,100	Dolomite, siltstone, and limestone: fine, granular, silty, dolomite; dark grey, calcareous siltstone; some grey, crystalline limestone, with fossil fragments
3,100-3,110	Dolomite and limestone: grey, finely granular dolomite, and grey, crystalline limestone
3,110-3,120	Limestone, light grey, finely crystalline to crystalline; dark grey, calcareous siltstone and dark grey shale
3,120-3,130	Limestone, grey, cryptocrystalline to crystalline, argillaceous; traces of fossils; limestone appears fragmental; dark grey shale; some granular dolomite
3,130-3,140	Limestone, dark grey, dolomitic (40 per cent); limestone as above; dark grey shale; some dark grey, calcareous siltstone
3,140-3,160	Dolomite, light grey, finely crystalline
3,160-3,170	Limestone, light grey, argillaceous, shaly, and dark grey, dolomitic, silty
3,170-3,180	Dolomite, light grey, finely crystalline; some darker grey, silty dolomite
3,180-3,190	Dolomite, light grey, cryptocrystalline, argillaceous; some darker grey, finely crystalline
3,190-3,200	Dolomite, light grey, finely granular, silty, calcitic
3,200-3,210	Dolomite, light grey, granular
3,210-3,220	Siltstone and shale: dark grey, dolomitic siltstone and silty dolomite; dark grey shale; pyrite
3,220-3,230	Dolomite, light grey, cryptocrystalline, silty; in part granular; dark grey shale; pyrite
3,230-3,240	Dolomite, dark grey, granular, silty, argillaceous
3,240-3,260	Dolomite and siltstone: dark grey, fine, silty dolomite grading to dolomitic siltstone; dark grey shale
3,260-3,290	Dolomite, dark grey, granular, silty to sandy; some porosity 3,280 to 3,290 feet
3,290-3,300	Dolomite, light grey, silty; in part granular
3,300-3,310	Dolomite, grey, granular, silty; with some porosity
3,310-3,330	Dolomite, grey, coarsely granular; some crystalline limestone
3,330-3,340	Limestone, grey, very finely crystalline; lighter grey, granular dolomite, as above
3,340-3,350	Siltstone and limestone: dark grey, calcareous siltstone, grading to dark grey, silty limestone; some grey, crystalline limestone
3,350-3,360	Limestone, light grey to dark grey, crystalline, slightly silty dolomite, grey, calcitic, silty; some limestone, brownish grey, cryptocrystalline; dark grey shale partings
3,360-3,370	Siltstone and limestone: grey to dark grey, calcareous siltstone and finely crystalline, grey, silty limestone; dark grey shale partings
3,370-3,380	Limestone, grey to dark grey, finely crystalline; silty, in part; some dark grey, calcareous siltstone; some coarse calcite may fill vugs
3,380-3,390	Limestone, grey, cryptocrystalline to finely crystalline, silty; dark grey siltstone and shale
3,390-3,400	Siltstone, grey, calcareous; some lighter grey, silty, finely crystalline limestone
3,400-3,410	Dolomite, light grey, coarsely crystalline and grey, granular

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
3,410-3,430	Dolomite, grey, granular
3,430-3,440	Siltstone and sandstone: light grey, calcareous, very fine, quartz sandstone and siltstone; some darker grey siltstone grading to fine, silty limestone; dark grey, pyritic shale
3,440-3,450	Dolomite, grey, crystalline, granular
3,450-3,460	Dolomite, grey, granular, silty to sandy, with some large sand grains; grades to sandy, dolomitic siltstone
3,460-3,490	Sandstone and dolomite: light grey, calcareous, very fine quartzose sandstone; pyritic in part; grey, fine, silty dolomite

Note. This well begins in the lower part of the Lorraine shales, which appear to be gradational into the Utica. The Utica shales have a dark brown streak, but shales with a brown streak occur from near the top of this well. Below 700 feet, the streak is darker, and a greater proportion of shale has a brown streak, but no exact contact can be drawn on this basis alone.

LINCOLN No. 1 WELL

Location: corner of Lincoln and Du Fort Streets, Montreal, Quebec

Total depth: 685 feet

Drilled: 1945

Rig: standard cable

Samples examined by H. R. Belyea, 1951

Depth	Lithology
Feet 0-30	Surface deposits
	<i>Trenton</i>
30-40	Poor sample: shale, dark grey; limestone, dark grey, finely crystalline
40-70	Missing
70-80	Poor samples: shale, dark grey, calcareous
80-150	Missing
150-160	Igneous rock; shale, black, hard, pyritic
160-175	Poor sample: shale, dark grey, calcareous
175-182	Poor sample: shale, dark grey, calcareous; few fragments of grey, finely crystalline, silty limestone; trace of pyrite
182-208	Samples missing
208-212	Shale, dark grey, calcareous; limestone, dark grey, finely crystalline, in part shaly and silty; trace of pyrite; fine-grained igneous rock
212-230	Shale, dark grey, calcareous; limestone, dark grey, very finely crystalline
230-258	Shale, dark grey, calcareous; limestone, dark grey, very finely crystalline; trace pyrite
258-290	Samples poor and small
290-295	Shale, dark grey, calcareous; grey, silty limestone; igneous rock?; pyrite; metabentonite
295-300	Shale, dark grey, calcareous; limestone, grey, very finely crystalline; in part shaly; pyrite
300-305	Poor sample
305-315	Shale, dark grey, calcareous; few fragments dark grey, very fine, argillaceous limestone; brachiopods and ostracods; pyrite

Depth	Lithology
Feet	<i>Trenton—con.</i>
315-320	Shale, dark grey, calcareous; limestone, dark grey, very finely crystalline; much pyrite
320-325	Shale, dark grey, calcareous; a few fragments of dark grey, shaly limestone
325-330	Shale, dark grey, calcareous; ostracods; some grey, finely crystalline, silty limestone; pyrite
330-335	Shale, dark grey, calcareous; limestone, grey, finely crystalline, silty; pyrite
335-340	Shale, dark grey, calcareous; some dark grey, shaly limestone; pyrite; metabentonite
340-365	Shale, dark grey, calcareous, pyritic; limestone, dark grey, finely crystalline, silty; vein calcite; ostracods 340 to 345 feet
365-370	Shale, dark grey, calcareous; some light grey, finely silty limestone; pyrite
	Montreal Formation
370-375	Limestone, grey, very finely crystalline, silty; pyrite
375-380	Igneous rock; limestone, light grey, finely crystalline; a few fragments of dark grey, calcareous shale; much pyrite
380-385	Shale, dark grey, calcareous; igneous rock
385-420	Missing
420-423	Igneous rock; some dark, dense material, may be chert
423-427	Shale, dark grey, calcareous; pyrite
427-440	Shale, dark grey, calcareous; few fragments of light grey, silty limestone; trace pyrite
440-450	Shale, dark grey, with crinoid and other fossil fragments; grades to dark grey, shaly, fine limestone and grey, coarsely crystalline limestone; pyrite
450-455	Limestone, grey, finely to coarsely crystalline; some dark grey shale
455-470	Limestone, grey, finely crystalline, silty
470-475	Limestone, grey, very finely crystalline, hard, siliceous; igneous rock
475-500	Shale, limestone; dark grey, calcareous shale and dark grey, dense, shaly, silty limestone
500-505	Limestone and shale: dark grey shale, with crinoid fragments; limestone, grey, finely to coarsely crystalline
505-520	Missing
520-530	Limestone, grey, finely to coarsely crystalline; dark grey shale; fossil fragments—crinoids and brachiopods
530-535	Limestone, dark grey, finely crystalline, hard, silty, pyritic; brachiopods
535-540	Limestone, grey, finely crystalline to coarsely crystalline; brachiopods
540-550	Limestone, dark grey, finely crystalline, silty, argillaceous; dark grey shale; crinoid fragments
550-555	Limestone, grey, crystalline to coarsely crystalline; in part argillaceous; brachiopods
555-560	Limestone, as above; brachiopods; igneous rock
560-565	Limestone, grey, crystalline to coarsely crystalline; some fine, silty, pyritic limestone
565-570	Limestone, dark grey, shaly, and dark grey, calcareous shale; fossil fragments—crinoids and brachiopods
570-578	Limestone, dark grey, finely crystalline, silty
578-586	Limestone, dark grey, fine, shaly; grey, coarsely crystalline limestone; dark grey shale
586-627	Limestone, grey, finely to coarsely crystalline; some dark grey shale; brachiopods
627-632	Limestone, light grey, finely crystalline, silty
632-637	Limestone, as above, pyritic; dark grey, finely crystalline, silty limestone
637-640	Igneous rock
640-642	Igneous rock; grey, fine limestone

Depth	Lithology
Feet	Montreal Formation— <i>con.</i>
642-650	Limestone, grey, finely crystalline; some igneous rock
650-655	Limestone, grey to dark grey, very finely crystalline, silty; pyrite; brachiopods
655-660	Igneous rock
660-665	Limestone, dark grey, very finely crystalline; in part shaly; dark grey shale; brachiopods
665-670	Limestone, grey, crystalline, and darker grey, finely crystalline; brachiopods
670-675	Limestone, dark grey, finely crystalline to crystalline; crushed by drill
675-680	Limestone, dark grey, as above; light grey, very finely crystalline, finely silty limestone
680-685	Limestone, grey, crystalline; darker grey, finely crystalline, silty limestone; brachiopods

LONGUEUIL BARRACKS WELL

Location: Longueuil, Quebec

Elevation: 50± feet

Drilled: 1911

Total depth: 1,425 feet

Rig: cable

Samples examined by H. R. Belyea, 1946; revised, 1951

Depth	Lithology
Feet	<i>Lorraine(?) and Utica</i>
0-75	Shale, dark grey, fissile, micaceous; micro-silty in part; some with a light brown streak
75-90	Shale; a little dark green, porphyritic igneous rock
90-135	Shale, same as above
135-180	Igneous rock same as from 75 to 90 feet
180-210	Shale, black, with a light brown streak; pyrite; metabentonite 180 to 195 feet
210-240	Shale, dark grey to black, mostly with a brown streak; thin, dolomitic and limy bands, dark brown, very argillaceous, silty, finely crystalline; pyrite
240-270	Shale, black, fissile, fine, dark brown streak, pyritic; less than 10 per cent silty limestone, very argillaceous, brownish grey, finely crystalline
270-390	Shale, black, fissile, as above; metabentonite 360 to 370 feet; some igneous rock 360 to 390 feet
390-410	Shale as above; fine-grained, igneous rock
410-415	Missing
415-435	Shale, dark grey, calcareous; with a granular texture and a brown streak
	<i>Trenton</i>
	Terrebonne and Tetreauville Formations
435-450	Shale and limestone: dark grey, calcareous shale; dark brownish grey, very argillaceous, finely crystalline limestone; a few crinoid fragments
450-480	Limestone, dark brownish grey, very finely crystalline, silty, argillaceous; scattered large calcite rhombs; dark grey shale; brachiopods

Depth	Lithology
Feet	<i>Trenton—con.</i>
	Terrebonne and Tetreauville Formations— <i>con.</i>
480-540	Limestone, as above; vein calcite; brachiopod fragments; crinoids
540-585	Limestone, dark brownish grey, finely crystalline, argillaceous, silty; brachiopod fragments; a little vein calcite
585-600	Limestone, as above; dark grey shale; calcite veins
600-630	Limestone, dark brownish grey, argillaceous, silty, finely crystalline; brachiopods; dark grey shale
630-720	Limestone and shale, as above; igneous rock
720-735	Limestone, dark brownish grey, dense, silty, argillaceous; dark grey shale
735-760	Missing
760-865	Limestone, dark brownish grey, argillaceous, silty
865-965	Limestone, dark brownish grey, as above; a few fragments of crinoids and ostracods; dark grey shale
	Montreal Formation
965-980	Limestone, dark grey, finely crystalline, and lighter grey, medium to coarsely crystalline; crinoids and brachiopods
980-1,020	Limestone, dark grey, crypto-crystalline, argillaceous; little crystalline, fossiliferous limestone; bryozoa 980 to 1,000 feet; brachiopods; coral-like fossil; dark grey shale; metabentonite 980 to 990 feet
1,020-1,085	Limestone, dark grey-brown, crystalline, fossiliferous; buff, coarsely crystalline, slightly dolomitic limestone; thin shale partings; brachiopods and other fossil fragments
1,085-1,130	Limestone, dark grey-brown, finely to coarsely crystalline, very fossiliferous, slightly dolomitic; brachiopods and ostracods
1,130-1,205	Limestone, brownish grey to buff, coarsely crystalline, slightly dolomitic, fossiliferous; dark grey shale partings; brachiopods
1,205-1,262	Limestone, brownish grey, finely crystalline; buff, coarsely crystalline, slightly dolomitic limestone; shale, dark grey, soapy; greenish metabentonite 1,205 to 1,220 feet; ostracods 1,205 to 1,220 feet; brachiopods and bryozoa
1,262-1,291	Limestone, dark grey, finely crystalline, argillaceous; bryozoa and brachiopods; black shale
1,291-1,306	Limestone, grey-brown, coarsely crystalline; fossiliferous; thin shale partings; ostracods, brachiopods, and crinoids
1,306-1,321	Limestone, greyish brown, medium to coarsely crystalline, fossiliferous; with milky chert
1,321-1,336	Shale, dark grey, limy, brown streak; much dark grey, finely crystalline, argillaceous limestone
1,336-1,341	Limestone, grey, finely crystalline; buff, crystalline, dolomitic limestone; shale partings; a little dark grey chert 1,371 to 1,376 feet; metabentonite 1,376 to 1,380 feet
1,341-1,351	Limestone, dark grey, finely crystalline, argillaceous; dark grey shale
1,351-1,380	Limestone, as above; light grey, crystalline, fossiliferous limestone; dark grey shale; a little dark grey chert 1,371 to 1,376 feet; metabentonite 1,376 to 1,380 feet
1,380-1,396	Limestone, dark brownish grey, finely crystalline, argillaceous; much dark grey shale; brachiopods; trilobite fragment
1,396-1,425	Limestone, brownish grey, crystalline to coarsely crystalline, fossiliferous, slightly dolomitic; much shale

Note. This well begins either very low in the Lorraine or near the top of the Utica. It is difficult to determine from the samples where the Lorraine passes into the Utica, and the upper 135 feet of this well may be Lorraine.

The Trenton in this well is exceptionally thick as compared with the Trenton in the St. Hubert wells and in the Montreal area. The Black River was not reached, but the bottom samples appear to be the coarsely crystalline, fossiliferous limestones that immediately overlie the crypto-crystalline Black River limestones.

MALLET TEST HOLE No. 1

Location: lot 513, parish of Ste. Thérèse, Mille Isles seigniory, Terrebonne county, Quebec

Elevation: 125± feet

Drilled: 1937

Total depth: 3,035 feet

Rigs: diamond drill

Core chips examined by H. R. Belyea, 1946; revised in part, 1950

Depth	Lithology
Feet	<i>Chazy</i>
	Laval Formation
0-20	Limestone, grey, shaly, fossiliferous, crystalline
20-30	Limestone and shale: grey limestone, as above, in part dolomitic; grey shale, with a green tinge
30-40	Limestone, grey, shaly, in part dolomitic; interbedded greenish grey shale
40-50	Shale, grey-green, fissile, fossiliferous, calcareous
50-90	Limestone, grey, with a brown tinge, coarsely crystalline, slightly dolomitic, fossiliferous
90-100	Limestone and shale: grey, crystalline limestone; a little dark grey, calcareous, fossiliferous, micro-silty shale
100-107	Shale, grey-green; with recrystallized bryozoa and other fossil fragments; brachiopods
107-110	Limestone, grey, mottled with shale, as above
110-130	Limestone, grey-brown, coarsely crystalline, fossiliferous, dolomitic
130-140	Shale, grey-green, laminated; a little dolomitic limestone; trace of pyrite
140-150	Sandstone, grey, shaly, calcareous, very fine-grained; green shale partings and laminae
150-160	Limestone, grey, coarsely crystalline, slightly dolomitic, fossiliferous
160-180	Shale and sandstone: grey-green, fissile shale; much light grey, dolomitic, micaceous sandstone; fossil fragments
180-190	Shale, grey-green, calcareous; thin sandstone layers
190-200	Sandstone, light grey, fine-grained, micaceous, slightly calcareous; has small black specks—possibly trilobite fragments; green shale partings
200-210	Shale, green, calcareous, some very sandy, with large, rounded, frosted quartz grains; fossiliferous—brachiopods
210-220	Shale and sandstone: grey, calcareous shale with fossil imprints; sandstone, light grey, calcareous
220-230	Shale, green, sandy; with large, rounded quartz grains; pyritic; fossiliferous
230-240	Shale and sandstone: shale, grey-green; sandstone, light grey, fine-grained, calcareous; pyrite
240-260	Sandstone, light grey, fine- to coarse-grained, well cemented, with quartz and dark grains; pyrite; grains and streaks of soft green shale
260-270	Sandstone, light grey, coarse, with pebbles of rounded quartz; dark igneous rock; much shale; pyrite
270-280	Sandstone, light grey, coarse-grained, grains chiefly of rounded quartz; angular fragments of dark rock; shale partings

Depth	Lithology
Feet	<i>Beekmantown</i>
280-290	Dolomite, light grey, dense, very finely crystalline, silty, argillaceous
290-310	Dolomite, medium grey, silty, shaly; much dark grey shale interbedded
310-320	Dolomite, dark grey, argillaceous, silty, micaceous, pyritic; grades to dolomitic siltstone
320-340	Dolomite, medium grey, argillaceous, finely granular, silty
340-350	Shale, dark grey, silty; with dolomitic streaks
350-360	Dolomite, medium grey, argillaceous, silty; shale partings
360-370	Limestone, grey, crystalline, dolomitic, fossiliferous
370-390	Dolomitic limestone, dense, finely crystalline, argillaceous, silty, grading into calcitic dolomite; some dolomitic siltstone
390-410	Shale, green, dolomitic, finely silty
410-420	Dolomite, medium grey, very sandy; grey, dolomitic siltstone
420-440	Dolomite, medium grey, sandy, finely crystalline; greenish grey shale interbedded; much calcite 430 to 440 feet
440-450	Shale, dark grey-green, dolomitic, grading to grey-green, shaly dolomite
450-458	Dolomite, dark grey, argillaceous, silty
458-460	Dolomite, light grey, crystalline, argillaceous
460-470	Shale, grey-green, dolomitic, grading to shaly dolomite
470-480	Dolomite, light grey, dense, argillaceous, silty, fossiliferous; stylolites
480-500	Dolomite, medium grey, very finely crystalline, silty, argillaceous; shaly partings 490 to 500 feet
500-510	Dolomite, dark grey, argillaceous; shale partings
510-520	Dolomite, light grey, finely crystalline, argillaceous, silty
520-525	Shale, dark grey, silty, dolomitic; trace of slickensides; a little siltstone, very dark grey, dolomitic
525-530	Dolomite, light grey, finely crystalline
530-540	Dolomite, dark grey, argillaceous, finely silty; black shale
540-550	Shale, black, silty
550-560	Limestone, medium grey, dolomitic, finely crystalline, argillaceous
560-570	Limestone, dolomitic, grey, finely to coarsely crystalline; a few large sand grains
570-580	Limestone, medium grey, dolomitic, sandy, in part oolitic, fragmental; small fossil fragments; ostracods; some calcareous sandstone
580-590	Dolomite, shaly, dark grey, dense, silty, with semi-conchoidal fracture; a few pieces show slickensides; black shale partings
590-600	Dolomite, light grey, crystalline, granular, silty; vugs filled with calcite
600-610	Shale, dark grey, calcareous; with fine dolomitic laminæ
610-630	Dolomite, light grey, dense, finely granular, argillaceous, silty; shale partings
630-636	Shale, soft, medium grey, with a bluish tinge
636-670	Dolomite, medium grey, argillaceous, finely crystalline to granular, silty; calcite 660 to 670 feet
670-680	Dolomite, calcitic, light grey, finely crystalline, finely granular, pyritic
680-690	Shale, dark grey, dolomitic, silty
690-720	Dolomite, medium grey, finely crystalline, silty; black shaly streaks near top
720-730	Shale, dark grey, calcareous; laminæ of dark grey, shaly, silty dolomite
730-740	Dolomite, light grey, crystalline, silty
740-750	Dolomite, light grey, argillaceous, earthy, finely crystalline
750-760	Dolomite, brownish grey, granular, sandy; vugs filled with dolomite; pyrobitumen
760-770	Dolomite, dark grey, granular, silty to sandy, shaly; shale partings; very finely pyritic
770-780	Dolomite, light grey, finely crystalline
780-790	Dolomite, medium brownish grey, finely crystalline, silty, shaly; shale partings
790-800	Dolomite, light grey, finely crystalline, and granular, silty, argillaceous; vugs filled with calcite
800-810	Dolomite, as above; dark grey shale partings

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
810-830	Dolomite, brownish grey, finely granular; dark grey shale mottlings and partings; pin-point porosity 820 to 830 feet
830-850	Dolomite, medium grey, argillaceous, silty; shale partings
850-860	Dolomite, light grey, granular, porous; with crystal-lined cavities
860-880	Dolomite, light grey, finely crystalline, and granular, finely silty, argillaceous
880-900	Dolomite, medium grey, finely crystalline, and granular, argillaceous, silty
900-910	Dolomite, dark grey, crystalline; with shaly, silty partings
910-928	Dolomite, medium grey, crystalline, and granular, sandy; shale partings containing large quartz grains 910 to 922 feet
928-930	Igneous rock
930-940	Dolomite, medium grey, calcitic, granular
940-950	Dolomite, grey, finely granular; dark grey shale
950-980	Dolomite, grey, granular
980-990	Dolomite, grey, coarsely granular; dark grey shale; pyrite
990-1,000	Dolomite, grey, coarsely crystalline, coarsely granular; calcite, filling vugs?
1,000-1,010	Dolomite, grey, finely granular, argillaceous
1,010-1,030	Dolomite, grey, granular, argillaceous
1,030-1,040	Dolomite, grey, granular, argillaceous; vugs with calcite and dolomite
1,040-1,050	Dolomite, light grey, finely granular; with irregular shale mottlings and partings; in part sandy, with large quartz grains; pin-point porosity
1,050-1,060	Sandstone, medium grey, dolomitic, fine-grained; thin layers with dark grey shale partings
1,060-1,070	Dolomite, light grey, coarsely crystalline, and granular, finely silty; large vugs with calcite rhombs
1,070-1,080	Dolomite, dark grey, granular; thin shale layers
1,080-1,090	Dolomite, medium grey, granular, pyritic, micro-silty; argillaceous laminae
1,090-1,100	Sandstone, light grey, fine-grained; well cemented with dolomite; shale partings
1,100-1,102	Dolomite, light grey, finely crystalline, sandy; large quartz grains
1,102-1,120	Dolomite, medium grey, dense, finely crystalline, argillaceous, silty
1,120-1,130	Sandstone, medium grey, coarse, composed of large, rounded, frosted quartz grains, with dolomitic cement; some coarsely crystalline, sandy dolomite
1,130-1,140	Dolomite, medium grey, crystalline, and granular, sandy; shaly and sandy layers
1,140-1,150	Dolomite, brown-grey, finely granular; pin-point porosity; dark grey shale partings
1,150-1,160	Dolomite, light grey, crystalline, sandy; shale layers
1,160-1,170	Dolomite, medium grey, crystalline, sandy, varying to light grey sandstone
1,170-1,180	Sandstone, light grey, medium-grained, composed chiefly of rounded, frosted quartz grains in dolomitic cement
1,180-1,190	Dolomite, medium grey, sandy, crystalline to granular
1,190-1,200	Dolomite, medium grey, granular; thin dark grey shale partings; light grey, fine sandstone
1,200-1,209	Dolomite, grey, granular, sandy, glauconitic, pyritic
1,209-1,210	Dolomite, dark grey, finely granular; interlaminated with shale
1,210-1,220	Sandstone, grey, coarse-grained, with rounded, frosted quartz grains; crystalline, sandy dolomite
1,220-1,230	Dolomite, light grey, crystalline, silty; vugs filled with calcite
1,230-1,240	Dolomite, medium grey, crystalline, sandy
1,240-1,250	Sandstone, light grey, fine-grained; mottled with dark grey shaly streaks; calcareous cement; pyrite

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
1,250-1,270	Dolomite, medium grey, crystalline, and granular, sandy; dark grey shale streaks; grades to dolomitic, medium to coarse sandstone 1,260 to 1,270 feet
1,270-1,280	Sandstone, medium grey, dolomitic, coarse-grained, with rounded, frosted, pitted quartz grains
1,280-1,290	Sandstone, dolomitic, dark grey, medium-grained
1,290-1,300	Igneous rock
1,300-1,310	Shale, dark grey, sandy
1,310-1,320	Dolomite, light grey, crystalline, sandy
1,320-1,334	Sandstone, light grey, dolomitic, fine-grained, glauconitic; some fine sandy dolomite
	<i>Upper Cambrian</i>
	Potsdam and Possibly Older
1,334-1,530	Sandstone, white, medium- to coarse-grained; quartz grains well rounded; siliceous cement
1,530-1,538	Sandstone, mottled white, with dark grey spots
1,538-1,600	Sandstone, white, quartzose, medium- to coarse-grained; a few greenish streaks 1,580 to 1,590 feet
1,600-1,630	Sandstone, white, medium-grained; with numerous large, rounded quartz grains
1,630-1,720	Sandstone, white, medium-grained; a few large grains; pyrite 1,670 to 1,680 feet
1,720-1,730	Igneous rock
1,730-1,735	Sandstone, medium grey, fine-grained, argillaceous
1,735-1,740	Sandstone, white, fine- to coarse-grained
1,740-1,750	Sandstone, grey; shale partings
1,750-1,760	Sandstone, white, fine- to coarse-grained
1,760-1,770	Quartzite, light grey
1,770-1,790	Igneous rock
1,790-1,795	Shale, grey, laminated
1,795-1,800	Sandstone, light grey, coarse; soft green streaks; pyrite
1,800-1,880	Sandstone, white, medium- to coarse-grained; soft buff shale 1,860 to 1,870 feet; feldspar grains 1,860 to 1,870 feet
1,880-1,890	Sandstone, greenish grey, medium- to coarse-grained
1,890-1,900	Sandstone, white
1,900-1,940	Sandstone, pinkish, chiefly quartz, with minor pink feldspar grains
1,940-1,960	Conglomerate; pebbles of varying sizes, mostly small, composed chiefly of quartz, with a little feldspar
1,960-1,970	Sandstone, quartzose; a little feldspar
1,970-1,990	Sandstone, pink; a few dark grey streaks
1,990-2,010	Sandstone, buff
2,010-2,020	Sandstone, pink; with darker grey streaks
2,020-2,057	Shale, greenish grey, micaceous; sandstone interbeds
2,057-2,150	Sandstone, buff, medium-grained; some coarse-grained layers
2,150-2,160	Sandstone, with buff, dark grey, and green streaks
2,160-2,220	Sandstone, light buff; a little pink sandstone 2,170 to 2,180 feet
2,220-2,240	Sandstone, buff, coarse to conglomeratic
2,240-2,250	Sandstone, red
2,250-2,300	Sandstone, light grey, coarse-grained
2,300-2,330	Sandstone, grey, micaceous, medium-grained
2,330-2,360	Sandstone, buff, medium- to coarse-grained; deep pink, micaceous band 2,340 to 2,350 feet
2,360-2,370	Sandstone, light grey, micaceous, fine- to medium-grained
2,370-2,410	Sandstone, pinkish, fine- to medium-grained
2,410-2,510	Sandstone, light grey; pink bands at 2,450 to 2,460 and 2,500 to 2,510 feet

Depth	Lithology
Feet	<i>Upper Cambrian—con.</i>
	Potsdam and Possibly Older—con.
2,510-2,540	Poor sample, largely calcareous brown dust; numerous feldspar crystals
2,540-2,550	Sandstone, buff—composed of quartz with some feldspar grains
2,550-2,560	Conglomerate, pinkish—composed chiefly of quartz, with a little feldspar
2,560-2,590	Sandstone, buff; a few large quartz pebbles
2,590-2,610	Sandstone, pink—composed of quartz and pink and green fragments; micaceous; quartz pebbles
2,610-2,810	Sandstone, pink to buff, coarse-grained; pink feldspar; pebbles 2,700 to 2,720 feet
2,810-2,850	Conglomerate and sandstone; coarse quartz sand with large quartz pebbles; a few large feldspar fragments
2,850-2,930	Sandstone, cream, medium- to coarse-grained
2,930-2,950	Sandstone, pink, fine- to coarse-grained
2,950-2,970	Sandstone, cream, as above
2,970-2,980	Sandstone, pink
2,980-3,010	Sandstone, cream
3,010-3,020	Sandstone, pink
3,020-3,030	Sandstone, cream
3,030-3,035	Sandstone, red

Note. The Potsdam formation in this hole is 1,700 feet thick, much thicker than in any of the measured surface exposures. It may represent the filling of a local channel or depression on the surface of the Precambrian basement.

MOHR No. 1 WELL

Location: lot 729, Lanoraie parish, Berthier county, Quebec

Elevation: 100± feet Drilled: 1934

Total depth: 1,380 feet Rig: cable

Samples examined by H. R. Belyea, 1948

Depth	Lithology
Feet	<i>Lorraine and Utica</i>
70-270	Shale, dark grey, smooth, fissile; irregularly bedded, silty shale, some with a brownish streak; a little medium grey, fissile shale; inter-laminated siltstone, in part calcareous or dolomitic
270-310	Shale, dark grey to black, with brown streak more common than above
310-320	Shale, dark grey as above; brown, bentonitic shale
320-415	Shale, dark grey, most of it giving a brown streak, as above
415-420	Shale, dark grey to black, with a brown streak; green, soapy meta-bentonite
420-520	Shale, dark grey to black, as above; brown, silty dolomite 440 to 450 and 500 to 520 feet; vein calcite 420 to 450 feet
520-565	Shale, chiefly black, with a brown streak; some medium grey shale; brown, silty dolomite; metabentonite 540 to 545 feet
565-720	Shale, black, with a dark brown streak; pyrite; vein calcite
720-840	Shale, dark grey, light brown streak, calcareous; has a granular appearance

Depth	Lithology
Feet	<i>Trenton</i>
	Terrebonne and Tetreauville Formations
840-850	Shale and limestone: dark grey shale; a little dark greyish brown, argillaceous limestone
850-945	Limestone and shale: dark greyish brown, argillaceous, finely crystalline limestone; dark grey, calcareous shale
945-950	Limestone and shale, as above; green, laminated metabentonite
950-995	Limestone and shale, as above
995-1,035	Limestone, dark grey-brown, argillaceous, finely crystalline; dark grey shale; metabentonite 995 to 1,000 feet; greenish brown, pyritic metabentonite 1,010 to 1,015 feet
1,035-1,060	Shale and limestone: dark grey, calcareous shale and dark brown, dense, argillaceous limestone
1,060-1,080	Limestone and shale, as above
1,080-1,100	Chiefly shale, as above; some dark brown limestone, as above
1,100-1,150	Shale and limestone, as above, in about equal amounts
	Montreal Formation
1,150-1,200	Limestone, dark grey-brown, finely crystalline to crystalline, slightly dolomitic, fossiliferous; some buff, coarsely crystalline, dolomitic limestone; dark grey, fissile, soapy shale; metabentonite 1,170 to 1,175 feet
1,200-1,220	Limestone, dark grey, finely crystalline; light grey, dolomitic, crystalline, fossiliferous limestone, argillaceous in part; dark grey shale partings; brachiopods and crinoids
1,220-1,240	Limestone, light greyish brown, dolomitic (about 10 per cent), coarsely crystalline; fossiliferous; dark grey chert
1,240-1,260	Limestone, greyish brown, finely to medium crystalline, dolomitic, as above; metabentonite 1,255 to 1,260 feet; dark grey shale; crinoids
1,260-1,280	Limestone, greyish brown, finely crystalline; buff, slightly dolomitic, coarsely crystalline, fossiliferous, cherty limestone, with black chert; brachiopods
1,280-1,290	Limestone, greyish brown, finely crystalline; buff, coarsely crystalline, fossiliferous limestone, as above
1,290-1,310	Limestone, light buff to brown, crystalline to coarsely crystalline, dolomitic, cherty (milky chert); dark grey shale partings
1,310-1,350	Limestone, light buff to brown, crystalline to coarsely crystalline; fossiliferous
1,350-1,380	Limestone, dark brown to grey, finely crystalline, slightly dolomitic

Note. The Lorraine and Utica are grouped together. Shales with a dark brown streak, which are typical of the Utica, appear to be interbedded with shales with a grey streak higher in the section. With no fossil evidence available, it is not practicable to identify the top of the Utica from the cuttings.

The upper part of the Trenton consists of dark shaly limestones and shales. These may be equivalent to the Terrebonne and Tetreauville formations of the Montreal area. They can be distinguished from the crystalline limestones lower in the Trenton, which are believed to correspond to the Montreal formation, and in which the well bottoms.

NATIONAL GAS COMPANY No. 1 WELL

Location: lot 1319, range St. André, parish of St. Thomas d'Aquin,
3½ 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	<i>Richmond</i>
	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
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
	<i>Lorraine</i>
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

Depth	Lithology
Feet	<i>Lorraine—con.</i>
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
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; brachiopod 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.

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	Lithology
Feet	<i>Richmond</i>
	Bécancour River Formation
120-230	Shale, reddish brown, sandy; a little greenish grey, sandy shale; large quartz grains

Depth	Lithology
Feet	<i>Richmond—con.</i>
	Bécancour River Formation— <i>con.</i>
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
	<i>Lorraine</i>
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
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

Depth	Lithology
Feet	<i>Lorraine—con.</i>
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 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.

RICHELIEU GAS COMPANY ST. DENIS No. 1 WELL

Location: lot 549, range 3, parish St. Denis, St. Hyacinthe county, Quebec

Elevation: 50± feet

Drilled: 1931-32

Total depth: 4,140 feet

Rig: standard cable

Samples examined by H. R. Belyea, 1946

Depth	Lithology
Feet	<i>Richmond</i> Bécancour River Formation
145-149	Sandstone, grey, coarse; a little red shale
149-190	Shale, red; a little greenish grey, sandy shale; 170 to 180 feet, chiefly grey shale
190-200	Sandstone, greenish grey, coarse; a little red shale
200-245	Shale, red; sandstone, grey, with a greenish tinge, medium-grained
245-252	Sandstone, greenish grey, fine-grained; a little red shale
252-419	Shale, red, sandy; sandstone, greenish grey, fine-grained, argillaceous; some large, rounded sand grains
419-423	Sandstone, greenish grey, fine-grained
423-439	Shale, red, silty to sandy
439-445	Shale, red and greenish grey
445-449	Shale, red
449-557	Sandstone, red and green, fine- to coarse-grained, impure; with argillaceous material between sand grains
557-790	Shale, red, silty, spotted with gypsum; a little green-grey shale
790-803	Shale, greenish grey
803-930	Shale, red, silty to sandy; some large, frosted sand grains; 10 per cent green shale
930-939	Shale, green, mudstone, sandy; grades to reddish shale
939-940	Igneous rock

Depth	Lithology
Feet	<i>Richmond—con.</i>
	Pontgravé River Formation
940-953	Shale, green, silty to sandy, mudstone, as above; greenish grey to grey, fissile shale and light green, argillaceous, slightly calcareous siltstone, in part appears baked
953-960	Igneous rock
960-985	Shale, grey, finely micaceous, calcareous; a little calcareous, grey siltstone
985-995	Shale, as above; grey, very calcareous siltstone grading to silty, finely crystalline, grey limestone
995-1,005	Shale, grey, calcareous; siltstone, grey, calcareous
1,005-1,010	Shale, as above; siltstone, as above; grey, finely crystalline, silty limestone; fossil fragments
1,010-1,015	Shale, as above; a little grey, very calcareous siltstone grading towards silty limestone
1,015-1,025	Shale, as above; grey, vary calcareous siltstone; a little finely crystalline, grey limestone; fossil fragments
1,025-1,042	Shale and limestone: shale, as above; grey, finely crystalline limestone, in part silty; bryozoa; some light grey siltstone, as above
1,042-1,075	Shale, siltstone, and limestone; grey, calcareous shale; lighter grey, highly calcareous siltstone grading to grey, finely crystalline, silty limestone; brachiopods and other fossil fragments; pyrite 1,058 to 1,067 feet
1,075-1,123	Shale and siltstone; grey, calcareous shale, as above; grey, micaceous, calcareous siltstone, grading towards limestone; bryozoa 1,085 to 1,095 feet
1,123-1,145	Shale, siltstone, and limestone; grey shale, as above; grey, micaceous, calcareous siltstone; grey, finely crystalline, silty limestone; brachiopod fragments
1,145-1,155	Shale, grey, calcareous; siltstone, grey to greenish grey, micaceous, calcareous; some grey, finely crystalline, highly silty limestone; brachiopod and other fossil fragments
	<i>Lorraine and Utica</i>
1,155-1,186	Shale, greenish grey to grey, in part fissile, micaceous; grades through sandy, silty shale to greenish grey, argillaceous, micaceous, calcareous siltstone
1,186-1,200	Shale and greenish grey to grey siltstone, as above; piece of crystalline grey limestone, with ostracod and other fossil fragments
1,215-1,258	Shale, grey, finely silty, micaceous, slightly calcareous; fragments both rounded and irregular; siltstone, greenish grey, argillaceous, micaceous, calcareous; little shell limestone, in part mixed with shale; bryozoa and brachiopods
1,258-1,268	Shale, as above; 10 per cent dark greenish grey siltstone, as above; bryozoa and brachiopods
1,268-1,290	Shale, grey, rounded fragments, some fissile, micaceous, and finely silty; about equal amounts of dark green, argillaceous, micaceous, laminated, slightly calcareous siltstone; accumulations of shells form limestone; bryozoa and brachiopods
1,290-1,300	Shale, siltstone, and fine sandstone; crinoid disks
1,300-1,340	Shale, siltstone, and fine sandstone, as above; fossil fragments
1,340-1,370	Shale, siltstone, fine sandstone, and some shell limestone; calcite veins 1,340 to 1,350 feet
1,370-1,400	Shale, less siltstone and fine sandstone than above; crinoid disks
1,400-1,410	Shale, fine sandstone, and shell limestone
1,410-1,448	Shale and minor siltstone, as above
1,448-1,458	Shale, minor siltstone and sandy limestone; bryozoa
1,458-1,478	Shale; minor fine sandstone and sandy shell limestone; brachiopod fragments

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
1,478-1,495	Shale; minor siltstone and fine sandstone; bryozoa; calcite veins and pyrite
1,495-1,515	Shale; minor fine sandstone and sandy shell limestone
1,515-1,540	Shale; minor siltstone and fine sandstone; brachiopods and crinoid disks
1,540-1,605	Shale; minor siltstone and fine sandstone, as above; calcite veins; crinoids 1,583 to 1,605 feet
1,605-1,625	Shale and fine sandstone; crinoid disks
1,625-1,660	Shale; minor fine sandstone; brachiopod fragments 1,625 to 1,640 feet
1,660-1,672	Shale, siltstone, and fine sandstone; bryozoa
1,672-1,680	Shale, siltstone, and fine sandstone; brown bentonitic shale; brachiopod fragments
1,680-1,695	Shale, siltstone, and fine sandstone; brachiopod fragments
1,695-1,725	Shale, siltstone, fine sandstone, and sandy shell limestone; crinoid disks
1,725-1,755	Shale, as above; some grey, fissile shale; some fine-grained sandstone; brachiopods and bryozoa; pyrite
1,755-1,765	Shale and fine sandstone, as above; a little shell limestone; crinoid disks
1,765-1,858	Shale, grey; in part fissile, micaceous, pencil shale; in part silty to sandy shale, with rough partings; some greenish grey, soft shale in rounded fragments, as above; some light grey, laminated, calcareous siltstone and fine-grained impure sandstone; bryozoa; brachiopod fragments 1,765 to 1,820 feet; crinoids 1,800 to 1,830 feet
1,858-1,872	Shale, siltstone, and sandy shell limestone
1,872-1,880	Shale; about 40 per cent siltstone; brown and green metabentonite
1,880-1,890	Shale, siltstone, and shell limestone, as above
1,900-1,908	Shale, and about 40 per cent siltstone; trilolite fragment
1,908-1,919	Shale, siltstone, and fine sandstone, as above; sandy shell limestone
1,919-1,928	Shale, grey; chiefly pencil shale; a little siltstone; pale green, finely speckled metabentonite
1,928-1,948	Siltstone, fine sandstone, and shale; brachiopod fragments
1,948-1,977	Shale, grey, fissile, silty to sandy; some sandy shale, and little fine-grained, impure, calcareous sandstone; a little shell limestone; fossil fragments less abundant than above
1,977-2,008	Shale, grey, silty, micaceous; a little siltstone
2,008-2,019	Shale, grey, as above; siltstone, fine sandstone, and sandy shell limestone
2,019-2,040	Shale, as above; fine, brown, dolomitic sandstone; crinoid disks
2,040-2,095	Shale, grey, pencil, micaceous; fine sandstone, as above
2,095-2,105	Shale, siltstone, fine sandstone; quartz veins with pyrite
2,105-2,153	Igneous rock
2,153-2,159	Shale, grey and brown; grey in part with white flecks; calcite veins; pyrite
2,159-2,162	Shale, dark grey, fissile, micaceous, mostly silty to sandy; fine-grained, impure, calcareous sandstone and sandy shale, in part inter-laminated with shale
2,162-2,220	Shale, as above; minor fine sandstone and sandy shale; brachiopod fragment 2,162 to 2,167 feet
2,220-2,230	Shale; a little fine sandstone and sandy shale; metabentonite
2,230-2,335	Shale, dark grey, micaceous, silty; a little siltstone
2,335-2,403	Shale; minor interlaminated fine sandstone, sandy shale, and siltstone, as above
2,403-2,470	Shale and fine sandstone in about equal amounts
2,470-2,610	Shale, very dark grey; a little siltstone
2,610-2,650	Shale, medium to dark grey, fissile, in part silty to sandy, and roughly bedded; a little siltstone and fine, impure, brown, dolomitic sandstone

Depth	Lithology
Feet	<i>Lorraine and Utica—con.</i>
2,650-2,660	Shale, siltstone, and fine sandstone, as above; metabentonite
2,660-2,700	Shale, as above; much pencil shale; brown, dolomitic siltstone
2,700-2,710	Sandstone, grey, fine-grained; shale, as above
2,710-2,750	Shale, as above, but with a little siltstone or fine sandstone
2,750-2,765	Shale and siltstone about equal; metabentonite
2,765-2,785	Shale and fine-grained, dolomitic sandstone
2,785-2,820	Shale, as above; minor fine sandstone
2,820-2,830	Shale; a little siltstone; metabentonite
2,830-3,025	Shale, dark grey; a little siltstone, as above; pyrite 3,015 to 3,025 feet
3,025-3,035	Shale, dark grey; a little siltstone; <i>Leptobolus insignis</i> identified by T. H. Clark
3,035-3,075	Shale; a little siltstone, as above; pyrite 3,060 to 3,075 feet
3,075-3,270	Shale, medium to dark grey, fissile; some dark, silty to sandy shale; a little fine-grained, dolomitic sandstone and shaly, sandy dolomite
3,270-3,280	Shale, as above; metabentonite
3,280-3,350	Shale, as above; a little dolomitic sandstone and shaly sandy dolomite
3,350-3,420	Shale, dark grey to black, some with slightly brownish streak; a little fine, dolomitic sandstone and sandy dolomite
3,420-3,430	Shale, as above; pyrite
3,430-3,560	Shale, as above, in part with a brownish streak
3,560-3,625	Shale, dark grey to black, as above; more with a brown streak
3,625-3,645	Shale, as above, some with a brown streak; a little brownish grey, silty, impure dolomite
3,645-3,675	Shale, as above
3,675-3,690	Shale, as above; a little brownish grey, silty, impure dolomite
3,690-3,710	Shale, dark grey to black, much of it giving a brown streak
3,710-3,740	Shale, as above; a little silty dolomite and dolomitic siltstone
3,740-3,920	Shale, brownish black; much of it giving a brown streak; pyrite 3,750 to 3,760, 3,800 to 3,830, 3,865 to 3,875, and 3,895 to 3,920 feet
3,920-3,930	Shale, brownish black as above; pyrite; brown soapy metabentonite
3,930-3,940	Shale, as above
3,940-3,965	Shale, as above; igneous rock
3,965-4,000	Shale, as above; pyrite
4,000-4,020	Shale, black, very calcareous, with a granular texture; some with a greyish brown streak
4,020-4,025	Shale, as above; <i>Leptobolus insignis</i> identified by T. H. Clark
4,025-4,040	Shale, as above
	<i>Trenton</i>
	Terrebonne and Tetreauville Formations and/or Equivalents
4,040-4,070	Shale, dark grey, calcareous (with a grey streak); some dark brownish grey, argillaceous limestone
4,070-4,085	Shale; a little limestone, as above; igneous rock
4,085-4,095	Shale and limestone, as above; metabentonite
4,095-4,140	Limestone, brownish grey, very argillaceous, dense, as above; dark grey, calcareous shale, as above; pyrite

ST. JOHN'S PETROLEUM COMPANY ST. HUBERT NO. 1 WELL

Location: about 75 feet from Cartier St. Hubert No. 1 well, parish of St. Hubert, Chambly county, Quebec

Elevation: 90± feet Drilled: 1947, 1948

Total depth: 4,085 feet ? Rig: cable

Samples examined by H. R. Belyea, 1949, 1950

Depth	Lithology
Feet	<i>Lorraine and Utica</i>
20-30	Shale, grey, very finely silty; with pyrite nodules; thin, grey, calcareous siltstone
30-40	Siltstone and shale: grey, slightly calcareous, micaceous siltstone; grey shale, as above
40-50	Shale, grey, finely silty; a little grey siltstone
50-60	Shale and siltstone, as above, with fossil remains; some dark green metabentonite; a little igneous rock
60-70	Shale, as above; dark igneous rock
70-130	Shale, grey, finely silty, with thin, grey, slightly calcareous, micaceous siltstone layers; fragment of brachiopod shell 110 to 120 feet
130-140	Shale, as above; green and brown igneous rock
140-190	Shale, dark grey, finely silty, micaceous; a little grey, calcareous siltstone
190-220	Shale and siltstone; dark grey shale, as above, and interbedded, grey, slightly calcareous siltstone and fine sandstone
220-230	Shale, dark grey, as above; a little siltstone
230-240	Dark igneous rock
240-250	Missing
250-260	Shale, dark grey; igneous rock
260-470	Shale, dark grey, as above; thin, grey siltstone
470-480	Siltstone and shale: grey, slightly calcareous siltstone interbedded with dark grey shale
480-500	Igneous rock
500-590	Shale, dark grey, silty; a little dark brownish grey, slightly calcareous siltstone
590-600	Shale, as above; green igneous rock
600-610	Shale, dark grey, finely silty; pyritic in part
610-620	Shale, dark grey, as above; a little brown, dolomitic siltstone
620-650	Shale, dark grey, in part finely silty, micaceous
650-660	Shale, dark grey, as above; calcite veins
660-690	Shale, dark grey, in part smooth, in part silty and rough
690-700	Shale, as above; green igneous rock
700-720	Shale, dark grey, smooth, very finely micaceous
720-730	Shale and siltstone: dark grey shale, as above, and some black, rough, silty shale; brown, dolomitic siltstone, with a very slight oil stain
730-740	Shale, dark grey, smooth; black, rough, silty shale; one fragment shows carbonaceous streak, probably a graptolite
740-750	Shale, dark grey, silty, micaceous
750-760	Shale and siltstone: dark grey shale, as above, and brown dolomitic siltstone
760-850	Shale, dark grey, silty, as above; some with a slightly brownish tinge
850-860	Igneous rock
860-940	Shale, black, silty, with a brown streak
940-970	Shale, as above; igneous rock; pyrite 970 to 980 feet
970-1,000	Shale, dark grey to black, silty, with a dark brown streak; pyrite
1,000-1,020	Shale, black, as above; igneous rock
1,020-1,220	Shale, black, finely silty, smooth, with a dark brown streak, slightly calcareous; pyrite
1,220-1,240	Shale, black, silty, calcareous; granular texture; pyrite

Depth	Lithology
Feet	<i>Trenton</i>
	Terrebonne and Tetreauville Formations
1,240-1,306	Limestone, dark brown, finely crystalline, argillaceous, finely silty; dark grey, calcareous shale; ostracods 1,260 to 1,265 feet
1,306-1,336	Limestone, dark brown, finely crystalline, silty, argillaceous, as above; scattered brachiopod and other fossil fragments; dark grey, calcareous shale
1,336-1,535	Limestone and shale: dark greyish brown, very silty, argillaceous, finely crystalline limestone and dark grey, calcareous, silty shale
1,535-1,570	Limestone and shale: dark brown, dense, argillaceous, finely silty limestone and dark grey, calcareous, silty shale; brachiopod fragments 1,540 to 1,546 feet
1,570-1,650	Shale and limestone: dark grey, silty, calcareous shale and dark brownish grey, silty, argillaceous limestone; ostracods 1,582 to 1,588 and 1,606 to 1,612 feet
1,650-1,656	Missing
1,656-1,662	Shale and silty limestone, as above
	Montreal and Mile End Formations
1,662-1,680	Limestone and shale: dark grey, finely crystalline to coarsely crystalline limestone, with crinoid stems and brachiopod fragments; dark grey calcareous shale, with crinoid stems
1,680-1,716	Limestone and shale: brown, coarsely to finely crystalline limestone, in part fossiliferous; dark grey shale, with crinoid stems; brachiopod fragments 1,704 to 1,716 feet
1,716-1,744	Limestone and shale: buff, coarsely crystalline, fossiliferous limestone, with brachiopod fragments; dark grey, silty shale
1,744-1,760	Limestone, buff, coarsely crystalline, slightly dolomitic, slightly argillaceous; dark grey shale partings
1,760-1,826	Limestone, buff, crystalline, finely silty; dark grey shale
1,826-1,838	Limestone, as above; some grey, dolomitic, crystalline limestone and grey dolomite; white dolomite veins
1,838-1,844	Limestone, buff, finely crystalline, with scattered fossil fragments; dark grey shale
1,844-1,884	Limestone, grey to buff, finely to coarsely crystalline; dark grey shale
1,884-1,890	Limestone, grey, as above; dark grey shale; brown metabentonite
1,890-1,974	Limestone, grey, crystalline, as above; dark grey, finely crystalline, argillaceous, silty limestone; dark grey shale
1,974-2,004	Limestone, grey, crystalline; a little, dark grey, finely crystalline limestone; dark grey shale
2,004-2,016	Limestone, dark grey, finely crystalline, argillaceous, silty; some fragmental limestone; grey shale
2,016-2,068	Limestone and shale: dark grey, finely crystalline, argillaceous, finely silty limestone and dark grey calcareous shale; a few fossil fragments; ostracods 2,038 to 2,044 feet; brachiopods
2,068-2,080	Limestone and shale: dark grey, very finely crystalline, finely silty, argillaceous limestone and dark grey shale, as above; some lighter grey, finely to coarsely crystalline limestone—largely fragments of brachiopods, crinoids, etc.; dark grey shale
2,080-2,086	Limestone, light grey, finely to coarsely crystalline—largely shell limestone; some bryozoa or coral-like fossils; brachiopods and crinoids; dark grey shale partings
2,086-2,092	Limestone, light grey, coarsely crystalline; fragments of brachiopods and crinoid disks
2,092-2,104	Limestone and shale: grey, finely to coarsely crystalline limestone with recrystallized fossils—brachiopods, ostracods, bryozoa, and coral-like fossils; dark grey shale, with fossil fragments
2,104-2,116	Limestone, light grey, coarsely crystalline, fossiliferous; dark grey shale; bryozoa and brachiopods common; pyrite; few fragments dark grey, cryptocrystalline limestone 2,110 to 2,116 feet

Depth	Lithology
Feet	<i>Black River</i>
	Leray and Lowville Formations
2,116-2,128	Limestone, dark grey, dense, sublithographic, slightly argillaceous, finely silty, pyritic in part
2,128-2,134	Limestone, as above; some dark brownish grey, cryptocrystalline limestone, with small calcite spots
2,134-2,140	Limestone, brownish grey, cryptocrystalline, with white crystalline calcite spots; some light grey oolitic limestone; two fragments crystalline limestone, with large, rounded, frosted quartz grains
2,140-2,148	Limestone, brown, cryptocrystalline, as above; some sandy crystalline limestone, with large quartz grains; dolomite, dark grey, crystalline, silty, granular, in part pyritic
	Pamelia Formation
2,148-2,156	Dolomite and siltstone: dark grey, finely granular, silty dolomite and dolomitic siltstone; pyrite; dark grey shale
2,156-2,164	Dolomite, siltstone, and shale, as above; some light grey, crystalline, fossiliferous limestone
	Chazy
	Laval Formation
2,164-2,176	Shale and limestone: dark grey, finely to medium crystalline limestone and dark olive-grey shale; pyrite; fossil fragments
2,176-2,188	Limestone and shale: dark grey, finely crystalline, argillaceous limestone and smooth, brownish grey, pyritic shale; brachiopods
2,188-2,194	Limestone, dark grey, finely crystalline; grey, medium crystalline limestone, with traces of fossil fragments
2,194-2,200	Shale and limestone: dull greenish grey shale; dark grey, finely crystalline, argillaceous limestone; brachiopods
2,200-2,222	Limestone, grey, crystalline to coarsely crystalline, finely silty, in part with fossil fragments; ostracod 2,200 to 2,208 feet; brachiopods; some dark grey shale
2,222-2,234	Limestone, grey, coarsely crystalline, slightly silty, fossiliferous
2,234-2,240	Limestone, as above; dark grey shale partings
2,240-2,252	Limestone and shale: grey, coarsely crystalline limestone and dark grey, silty, fine-grained limestone; dark grey shale
2,252-2,258	Limestone and dolomite: light grey, coarsely crystalline limestone and dark grey, silty, crystalline dolomite and dolomitic siltstone; some dark grey shale
2,258-2,264	Limestone, light grey, coarsely crystalline
2,264-2,276	Limestone, dark grey, finely crystalline to crystalline, argillaceous, silty; dark grey shale partings
2,276-2,302	Limestone, light grey, coarsely crystalline to dark grey, silty, dolomitic; dark grey shale; brachiopod, and ostracods 2,288 to 2,294 feet
2,302-2,310	Limestone and shale: brownish grey, cryptocrystalline limestone, with some crystalline patches; dark grey shale
2,310-2,320	Limestone, grey, coarsely crystalline; some brown, dense limestone; dark grey, pyritic shale
2,320-2,336	Limestone, light grey, coarsely crystalline, with dark argillaceous mottling; small brachiopods
2,336-2,364	Shale and limestone: dark grey, pyritic shale grading to shaly limestone, with crystalline fossil fragments; some grey, cryptocrystalline to crystalline limestone
2,364-2,372	Limestone and shale: grey, coarsely crystalline limestone and dark grey shale and shaly limestone, as above
2,372-2,382	Limestone, light grey, coarsely crystalline; thin dark grey, shale partings; ostracods 2,372 to 2,376 feet

Depth	Lithology
Feet	<i>Chazy—con.</i>
	Laval Formation— <i>con.</i>
2,382-2,388	Limestone and sandstone: light grey, finely crystalline, sandy, dolomitic limestone and light grey, calcareous sandstone, with small black detrital fragments—possibly trilobite remains
2,388-2,394	Limestone, light grey, coarsely crystalline; dark grey shale
2,394-2,400	Limestone, light grey, coarsely crystalline
2,400-2,412	Limestone, light grey, as above; green igneous rock
2,412-2,424	Dark igneous rock; limestone, as above
2,424-2,430	Limestone, light grey, coarsely crystalline
2,430-2,436	Limestone and sandstone: light grey, coarsely crystalline limestone, as above; light grey, fine, calcareous sandstone, with small black specks—possibly trilobite remains
2,436-2,445	Sandstone, light grey, fine, calcareous, with small black specks
2,445-2,462	Sandstone, as above; dark greenish grey shale partings
2,462-2,474	Shale, dull greenish grey; some crystalline limestone fragments
2,474-2,486	Limestone and shale: grey, coarsely crystalline limestone; dull greenish grey shale and sandy shale
2,486-2,492	Sandstone and limestone: light grey, fine-grained sandstone, with black specks and some coarse, rounded, pitted, frosted quartz grains; some light grey, crystalline limestone
2,492-2,518	Sandstone, light grey to grey, fine-grained, calcareous; with black specks
2,518-2,524	Limestone, light grey, crystalline; fine-grained, light grey sandstone
2,524-2,536	Shale and sandstone: dull greenish grey shale; light grey, fine sandstone, as above; some crystalline limestone; pyrite
2,536-2,542	Sandstone, grey, fine-grained, pyritic
	<i>Beekmantown</i>
2,542-2,548	Limestone and shale: dark grey, dense, silty, argillaceous limestone and dark grey shale
2,548-2,560	Limestone, grey, silty, argillaceous, dense; some dark grey limestone, as above, and dark grey shale; grey, calcareous siltstone
2,560-2,566	Shale and limestone: dull greenish grey shale and grey, cryptocrystalline to crystalline, silty limestone; fragments of light grey, oolitic limestone
2,566-2,578	Shale, dark grey; thin, grey, fine-grained sandstone and grey, sandy dolomite bands
2,578-2,590	Dolomite, grey, dense, argillaceous, finely silty; grades to grey dolomitic siltstone; dark grey shale; pyrite
2,590-2,602	Shale, grey to dark grey, finely silty, calcareous; finely silty, argillaceous limestone and calcareous siltstone
2,602-2,620	Shale, dark grey, silty, calcareous; grey, dolomitic siltstone; some dark grey, argillaceous, finely silty dolomite; pyrite
2,620-2,626	Siltstone and shale: dark grey, dolomitic siltstone and silty dolomite; dark grey shale; some white quartz
2,626-2,632	Igneous rock with pink feldspars; some dark grey shale; greenish and white, siliceous limestone; quartz crystals
2,632-2,644	Dolomite and siltstone: light grey, finely crystalline, silty dolomite grading to dolomitic siltstone; some dark grey shale
2,644-2,650	Shale, dark grey, calcareous; limestone, grey, crystalline—probably recrystallized shell fragments
2,650-2,674	Siltstone, dark grey, calcareous; some grey, silty, dense limestone and light grey, crystalline limestone
2,674-2,686	Limestone, grey, dense, finely silty, dolomitic, argillaceous; grades to calcareous siltstone and silty dolomite
2,686-2,692	Sandstone, grey, fine-grained, calcareous; grey, dolomitic siltstone
2,692-2,698	Dolomite and siltstone: light green to grey, fine, silty dolomite and dolomitic siltstone; some light grey, fine-grained sandstone

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
2,698-2,730	Shale, siltstone, and dolomite: green to grey, dolomitic shale; light green to grey, dolomitic siltstone and fine, silty dolomite, in part pyritic
2,730-2,754	Dolomite and siltstone: brownish grey to green, dense, shaly, finely silty dolomite, varying to dolomitic siltstone
2,754-2,760	Limestone and shale: light brown, argillaceous, silty limestone and green, limy shale, as above; some brown, finely granular, dolomitic limestone
2,760-2,766	Dolomite, grey-brown, finely crystalline, slightly argillaceous, silty
2,766-2,772	Dolomite, grey, finely crystalline, silty
2,772-2,786	Dolomite and shale: buff, finely crystalline, argillaceous, very finely silty dolomite; greenish grey and dark grey, dolomitic shale
2,786-2,798	Dolomite and shale: greenish grey, shaly dolomite and dolomitic shale, with pyrite; calcite veins 2,792 to 2,798 feet
2,798-2,804	Siltstone, dark grey, dolomitic, argillaceous; some light greenish grey, dense dolomite, as above
2,804-2,810	Shale, dark grey, dolomitic; varies to dark brownish grey, very argillaceous, silty dolomite and dolomitic siltstone
2,810-2,822	Shale, dark grey, calcareous, silty: grades to dark grey, argillaceous, calcareous siltstone
2,822-2,828	Siltstone, dark grey, dolomitic, argillaceous
2,828-2,840	Dolomite, siltstone, and shale: dark grey, silty, finely crystalline dolomite and dolomitic siltstone; dark grey, silty shale
2,840-2,850	Siltstone and dolomite: grey, cryptocrystalline to finely granular, calcitic dolomite and grey, dolomitic siltstone; a few large, frosted quartz grains; dark grey shale
2,850-2,870	Siltstone, dolomite, and shale: dark grey, dolomitic siltstone and dark grey, granular, silty dolomite; dark grey shale
2,870-2,876	Shale, dark grey; some grey, sandy, fine, dolomitic limestone, with large sand grains
2,876-2,882	Limestone and siltstone: dark brownish grey, argillaceous, dense limestone, and dark grey siltstone
2,882-2,888	Limestone, as above; some brecciated, fine, brown, dolomitic limestone, with calcite and large sand grains; dark grey shale and siltstone, as above
2,888-2,894	Dolomite, brown, finely granular
2,894-2,900	Dolomite light grey, dense, calcitic, argillaceous; some dark brownish grey dolomite, as above
2,900-2,912	Dolomite, limestone, and shale: light grey, cryptocrystalline, silty, argillaceous limestone; dark grey, fine, silty dolomite and dolomitic siltstone; calcareous shale
2,912-2,918	Dolomite, dark grey, crystalline, argillaceous
2,918-2,924	Limestone and dolomite: dark grey, dense, argillaceous limestone; dark grey, crystalline, silty dolomite; pyrite
2,930-2,936	Siltstone and dolomite: grey, dense, argillaceous dolomite; dark grey, crystalline dolomite; dark grey, dolomitic siltstone
2,936-2,942	Limestone, siltstone, and shale: dark grey, dense limestone and dark grey, hard, massive, calcareous shale and siltstone
2,942-2,948	Limestone, dolomitic, light grey, finely crystalline; dark grey, silty shale and siltstone
2,948-2,954	Siltstone, dark grey, calcareous—sample badly rusted
2,954-2,960	Limestone, dark grey, dense, slightly argillaceous; dark grey, calcareous siltstone
2,960-2,972	Limestone, grey, finely crystalline, argillaceous; some dark grey limestone; grey calcareous siltstone
2,972-2,978	Limestone and shale: light grey, finely crystalline, silty, siliceous to cherty limestone; olive-green, pyritic, calcareous shale

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
2,978–2,984	Shale and siltstone: greenish grey, pyritic, slightly calcareous shale varying to shaly siltstone
2,984–2,996	Shale and some greenish siltstone, as above, but chiefly dark grey, slightly calcareous shale
2,996–3,002	Limestone, grey, finely crystalline, silty, siliceous, in part dolomitic, argillaceous; some pseudo-oolitic or fragmental limestone; a little dark grey shale
3,002–3,014	Limestone, grey to dark grey, finely crystalline, argillaceous, silty; limestone grades to calcareous siltstone
3,014–3,032	Limestone, siltstone, and shale: dark grey, finely crystalline, argillaceous, silty limestone and calcareous siltstone; dark grey shale
3,032–3,500	Missing
3,500–3,510	Dolomite and sandstone: light grey, sandy dolomite and dolomitic sandstone, fine to coarse, with sand grains of various sizes, some large, frosted, and rounded
3,510–3,515	Missing
3,515–3,530	Sandstone and dolomite: light grey, fine, dolomitic sandstone and grey, silty to sandy, finely crystalline dolomite
3,530–3,535	Missing
3,535–3,540	Sandstone and dolomite, as above, with some large rounded, frosted sand grains
3,540–3,545	Missing
3,545–3,550	Sandstone, light grey, fine, dolomitic
3,550–3,560	Sandstone, as above
3,560–3,565	Missing
3,565–3,570	Sandstone, light grey, fine-grained; calcareous cement
3,570–3,580	Sandstone and dolomite: light grey, fine sandstone, as above; dark grey, finely crystalline dolomite and dark grey shale
3,580–3,590	Missing
3,590–3,600	Dolomite and sandstone: dark grey, crystalline, sandy dolomite; light grey, fine-grained sandstone, with dolomitic cement
3,600–3,610	Sandstone, light grey, fine, with some coarse grains; grades to grey, sandy dolomite
3,610–3,640	Dolomite and sandstone: dark grey, sandy, argillaceous dolomite and light grey sandstone, as above
3,640–3,650	Sandstone and dolomite: light grey, fine sandstone, with abundant large, rounded, frosted grains; dark grey dolomite, as above
3,650–3,680	Dolomite, dark grey, sandy; some light grey, fine-grained sandstone; large, frosted sand grains
3,680–3,690	Sandstone, light grey, fine, with dark shale partings; dark grey, sandy dolomite, as above
3,690–3,720	Dolomite and sandstone: grey, sandy dolomite grading to grey, fine, dolomitic sandstone
3,720–3,740	Sandstone and dolomite: medium to coarse, light grey, indurated, quartz sandstone, with grains of variable size; dark grey, sandy dolomite
3,740–3,750	Dolomite, dark grey, sandy; sandstone, light grey, fine, quartzose; dark grey shale
3,750–3,765	Sandstone and dolomite: light grey, fine- to medium-grained quartz sandstone and grey, sandy dolomite
3,765–3,785	Dolomite, dark grey, sandy, with coarse sand grains; light grey sandstone
3,785–3,820	Dolomite, dark grey, finely crystalline, argillaceous, sandy; varies to light grey, medium-grained, dolomitic sandstone
3,820–3,825	Missing
3,825–3,835	Dolomite, shale, and sandstone: dark grey dolomite, as above, grading to dark grey shale; grey, fine- to medium-grained sandstone, as above

Depth	Lithology
Feet	<i>Beekmantown—con.</i>
3,835-3,840	Sandstone and dolomite: light grey, quartzose, medium- to coarse-grained sandstone, with large, frosted grains; dark grey dolomite, as above
3,840-3,845	Dolomite, dark grey, sandy
3,845-3,855	Sandstone and dolomite: light grey, coarse-grained sandstone, with rounded, frosted grains; dolomite as above
3,855-3,860	Dolomite and sandstone: light grey, finely crystalline, very sandy dolomite, with abundant large, rounded, frosted sand grains embedded; grades to dolomitic sandstone; some finer sandstone contains dark, argillaceous material
3,860-3,865	Sandstone, dark grey, in part dolomitic, argillaceous, with fine stringers of dark, argillaceous material; dark grey, pyritic shale; some light grey sandstone and dolomite, as above; some dark grey, silty dolomite, with argillaceous material around grains
3,865-3,870	Dolomite and siltstone: grey, finely crystalline, silty dolomite grading to dolomitic, argillaceous siltstone; some large sand grains in dark, shaly, pyritic matrix
3,870-3,875	Dolomite, dark grey, finely silty, finely crystalline
3,875-3,880	Dolomite, light grey to grey, finely crystalline, sandy, in part with large sand grains; pyritic
3,880-3,885	Dolomite, light grey to dark grey, very finely crystalline, slightly silty; in part pyritic; dark grey shale partings
3,885-3,895	Sandstone, light grey, fine-grained, dolomitic; in part grades to fine, sandy dolomite
3,895-3,900	Sandstone, grey, fine-grained, dolomitic, finely pyritic
3,900-3,905	Dolomite, grey, coarsely granular, pyritic; light grey, fine-grained, dolomitic sandstone, as above
3,905-3,910	Dolomite, grey, finely crystalline, silty; in part crystalline; pyritic; appears to have vugs or fractures filled with selenite
3,910-3,925	Missing
3,925-3,930	Limestone, grey, crystalline
3,930-3,935	Limestone, same as above; some very pyritic, with green streaks that may be glauconite; some finely crystalline, sandy limestone and fine-grained sandstone
3,935-3,940	Missing
3,940-3,945	Sandstone, grey, very fine-grained, calcareous, pyritic
3,945-3,950	Dolomite, grey, crystalline to granular; some fine-grained sandstone, as above
3,950-3,965	Missing
	<i>Potsdam</i>
3,965-3,970	Sandstone, white, coarse, quartzose; grains, large, rounded, with few smaller grains; slightly calcareous cement
3,970-4,060	Missing
4,060-4,062	Sandstone, grey, fine-grained, quartzose, slightly calcareous
4,062-4,070	Sandstone, white, coarse, quartzose; grains, rounded; some finer grains; calcareous cement
4,070-4,085	One sample: sandstone, grey, very fine-grained, dolomitic; pyritic in part; some large sand grains

STE. MADELEINE No. 1 WELL

Location: lot 93, Ste. Madeleine, St. Hyacinthe county, Quebec

Elevation: 100± feet Drilled: 1917

Total depth: 525 feet Rig: cable

Samples examined by H. R. Belyea, 1946

Depth	Lithology
Feet	<i>Richmond</i> Bécancour River Formation
185-305	Shale, grey-green, sandy; with quartz grains
305-315	Shale, reddish brown, sandy
315-325	Shale, green, sandy
325-335	Shale, reddish brown, sandy
335-355	Shale, greenish grey, sandy
355-515	Shale, greenish grey, sandy; some reddish brown, sandy shale
515-525	Shale, reddish brown, sandy

ST. PHILIPPE No. 1 WELL

Location: lot 531, St. Philippe range, L'Assomption county, Quebec

Elevation: 100± feet Drilled: 1933

Total depth: 445 feet Rig: cable

Samples examined by H. R. Belyea, 1946; revised, 1951

Depth	Lithology
Feet	<i>Trenton</i>
80-120	Limestone, buff, finely to coarsely crystalline, fossiliferous; in part recrystallized fossil fragments; brachiopods and crinoids; dark shale partings
120-150	Limestone, brownish grey, finely crystalline, argillaceous; some coarsely crystalline fragments; fossiliferous—crinoids and brachiopods
150-160	Limestone, brownish grey, dense, very finely crystalline, argillaceous; metabentonite
160-190	Limestone, brownish grey, dense, very finely crystalline; some recrystallized fossil fragments; brachiopods
190-200	Limestone, brownish grey, dense, very finely crystalline, argillaceous; metabentonite
200-240	Limestone, brownish grey, dense, very finely crystalline, some coarsely crystalline fragments; brachiopods, crinoids, and ostracods
240-252	Limestone, brownish grey, dense, very finely to finely crystalline; in part slightly argillaceous
252-262	Limestone, brownish grey, dense, very finely crystalline
262-272	Limestone, brownish grey, finely crystalline, as above; dark grey shale
272-282	Limestone, brownish grey, very finely crystalline
282-292	Limestone, dark brownish grey, very finely crystalline to finely crystalline; in part slightly argillaceous; some crystalline limestone; fossil fragments; some dark grey shale

Depth	Lithology
Feet	<i>Black River</i>
292-312	Limestone, buff, cryptocrystalline, argillaceous; some grey limestone, as above; dark grey shale
312-342	Limestone, buff, cryptocrystalline; some crystalline fragments; dark grey shale
342-352	Limestone and shale: dark grey, very finely crystalline limestone, in part argillaceous; dark grey shale
352-365	Limestone, grey, very finely crystalline, argillaceous; a few ostracods; dark grey shale
	<i>Chazy</i>
365-372	Limestone, grey to buff, finely to coarsely crystalline; crinoid disks abundant
372-382	Limestone, brownish grey, finely to coarsely crystalline; crushed by drill
382-392	Limestone, grey, finely crystalline to crystalline; crinoids, and brachiopods common
392-412	Limestone, brownish grey, finely to coarsely crystalline; brachiopods and crinoids
412-432	Limestone, brownish grey, coarsely crystalline, fossiliferous—brachiopods and crinoids
432-455	Limestone, as above

SENIQON No. 1 DIAMOND DRILL-HOLE

Location: lot 136, range 2, Noyan seigniory, Missisquoi county, Quebec

Total depth: 2,296 feet Drilled: 1942

Rig: diamond drill

Examined by H. R. Belyea, 1947; revised, 1950

Depth	Lithology
Feet	The following descriptions are from core chips:
24-54	Shale, dark grey, micaceous, slightly calcareous, brownish streak
54-74	Shale, as above; calcite vein
74-104	Shale, as above; thin, pyritic, limestone beds; dip, about 5 degrees
104-180	Missing
180-190	Shale, dark grey, slightly calcareous; pyrite nodules; cracks with calcite
190-210	Shale, dark grey, calcareous, light brown streak; thin limestone laminæ; dip, 5 degrees
210-255	Missing
255-265	Shale, dark grey, light brown streak, calcareous; graptolite fragment? small black specks
265-285	Shale, dark grey, calcareous, light brown streak; thin, irregular limestone laminæ; dip, 5 degrees
285-295	Limestone, dark brownish grey, shaly, very finely crystalline
295-305	Shale, dark grey, calcareous, brown streak; fractures with calcite
305-315	Shale, dark grey, calcareous, brown streak; pyrite
315-325	Shale as above; fracture with black bituminous shaly material and calcite
325-335	Shale, as above
335-345	Shale and limestone: dark grey calcareous shale, almost limestone, grading to dark brownish grey, finely crystalline limestone

Depth	Lithology
Feet	The following descriptions are from core chips— <i>con.</i>
345-380	Shale, dark brownish grey, very calcareous
380-390	Shaly limestone; dark brownish grey, earthy, very finely crystalline
390-460	Missing
460-470	Shale, dark grey, calcareous, brownish grey streak
470-480	Shaly limestone, dark grey, very finely crystalline, silty; veined with calcite
480-520	Shaly limestone or limy shale, as above
520-530	Shale, dark grey, calcareous
530-550	One sample: shaly limestone or limy shale, as above
550-570	Shale, dark grey, calcareous
570-590	Shaly limestone, finely crystalline, silty; limy shale
590-600	Shale, dark grey, calcareous, grey streak
600-610	Shale, as above; fractures filled with calcite
610-620	Limestone, dark grey, very finely crystalline, argillaceous, silty
620-630	Shale, dark grey
630-640	Shaly limestone, as above
640-680	Shale, as above, light brown streak
680-690	Shale, as above, fractures filled with calcite
690-740	Shale, as above; thin limestone bands, 700 to 710 feet, show dip of about 5 degrees
740-750	Shaly limestone, dark brownish grey, very finely crystalline
750-767	Shaly limestone, as above, finely pyritic; calcite veins
767-790	Shaly limestone, dark brownish grey, very finely crystalline
790-800	Shaly limestone, dark brownish grey, finely crystalline, as above; fractures with calcite veins
800-805	Shale, as above, with limy bands
805-820	Shaly limestone; fine calcite veins
820-840	Shale, as above
840-850	Shaly limestone, dark brownish grey, finely crystalline; calcite
850-870	Shale, black, brown streak, slightly calcareous
870-880	Shale, as above; limy laminæ dip 5 degrees
880-900	Shale, black, as above
900-930	Shale, as above; calcite veins
930-940	Shale and limestone, dark brownish grey, finely interlaminated; limestone is finely crystalline
940-980	Shale, black, brown streak, slightly calcareous
980-990	Shale, black, brown streak; calcite veins
990-1,030	Shale, black, brown streak
1,030-1,040	Shale, as above, calcite veins
1,040-1,070	Shale, dark grey, fine, grey streak
1,070-1,090	Missing
1,090-1,095	Shale and limestone, dark brownish grey, very fine-grained
1,095-1,100	Shale, dark grey
1,100-1,110	Shaly limestone, dark brownish grey, fine; dark grey shale
1,110-1,280	Missing
1,280-1,300	Shale, dark grey, calcareous; grey streak; small pyrite nodules 1,290 to 1,300 feet
1,300-1,310	Shale, as above; graptolite
1,310-1,320	Shale, dark grey, calcareous
1,320-1,330	Shale, as above; small carbonaceous streaks
1,330-1,360	Shale, as above
1,360-1,370	Shale, dark grey, as above; thin, shaly limestone laminæ
1,370-1,380	Shaly limestone, dark brownish grey, very fine-grained, silty; calcite veins
1,380-1,390	Missing
1,390-1,400	Shaly limestone, dark grey, very fine-grained, as above
1,400-1,410	Shale, black, calcareous; carbonaceous streaks
1,410-1,440	Shaly limestone, as above

Depth	Lithology
Feet	The following descriptions are from core chips— <i>con.</i>
1,440–1,460	Shale, black, as above
1,460–1,480	Shale, dark grey, fine-grained, calcareous
1,480–1,500	Shaly limestone, brownish black, silty
1,500–1,510	Shale, black; calcite veins
1,510–1,520	Shale; interlaminated shaly limestone
1,520–1,530	Shale, black; carbonaceous streaks
1,530–1,550	Shale, black, fine, calcareous
1,550–1,560	Shale, black, as above; calcite veins
1,560–1,600	Shale, black, as above
1,600–1,610	Shaly limestone and shale, black
1,610–1,620	Shale, black, smooth, calcareous
1,620–1,640	Shale, black, calcareous
1,640–1,670	Shaly limestone, brownish black, fine
1,670–1,720	Shale, black, calcareous
1,720–1,730	Missing
1,730–1,740	Shaly limestone, as above
1,740–1,790	Shale, black, brown streak
1,790–1,820	Shaly limestone, dark brownish grey
1,820–1,840	Shale, with thin limestone laminae; small carbonaceous streaks
1,840–1,850	Shale, black, brown streak
1,850–1,860	Shale, as above; fractures and slickensides
1,860–1,870	Shale, as above; thin limy laminae
1,870–1,890	Shale, black, as above; carbonaceous streaks
1,890–1,901	Shale, as above; calcite vein parallel with bedding
1,901–1,910	Shale, black
1,910–1,920	Shale, black, grades to black, very fine, argillaceous limestone; graptolite in shale
1,920–1,930	Shale and limestone, as above; limestone in thin laminae
1,930–1,940	Shale, black, calcareous
1,940–1,952	Shale, as above; limestone, black, fine, silty, argillaceous
1,952–1,960	Shale, black; graptolite
1,960–1,970	Shale, black, grey streak
1,970–2,010	Shale, black, brown streak
2,010–2,020	Limestone, black, very finely crystalline, finely silty
2,020–2,060	Shale, black, calcareous, brownish streak
2,060–2,067	Shale, black; small fragments of brachiopods
2,067–2,090	Limestone, black, fine, silty
2,090–2,130	Shale, black, calcareous
2,130–2,140	Limestone, dark grey, crystalline, argillaceous, silty; calcite veins
2,140–2,150	Limestone, dark grey, shaly; large calcite rhombs
2,150–2,170	Missing
2,170–2,180	Shale, black; interlaminated black limestone; brachiopod and other fossil fragments
2,180–2,190	Limestone, black, very fine; in part coarsely crystalline; brachiopods
2,190–2,200	Shale, black; brachiopods
2,200–2,210	Limestone, grey, coarsely crystalline; crinoids
2,210–2,220	Limestone, dark grey; fractures and vugs with coarse calcite crystals; pyrobitumen
2,220–2,233	Limestone, black, very fine; black shale with brachiopods and crinoids
2,233–2,240	Limestone, dark grey, fine; interlaminated black shale
2,240–2,252	Shale, black
2,252–2,260	Limestone, black, finely crystalline, silty
2,260–2,269	Limestone, black, very finely crystalline, silty; calcite inclusions
2,269–2,280	Shale, black, calcareous
2,280–2,296	Limestone, black, very fine, silty; calcite inclusions, probably recrystallized fossils

SOUTH SHORE No. 1 WELL

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

Drilled: 1931-32

Rig: cable

Total depth: 3,200 feet

Samples examined by H. R. Belyea, 1946

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

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

Depth	Lithology
Feet	<i>Lorraine—con.</i>
1,505-1,515	Shale, as above; some light grey, firm, smooth, fissile shale; siltstone, as above, in part varying to silty, shell limestone; bryozoa
1,515-1,565	Shale, siltstone, and fine sandstone, as above; bryozoa 1,555 to 1,565 feet; vein calcite 1,535 to 1,545 feet
1,565-1,575	Shale and siltstone, as above; in part interlaminated; crinoid disks
1,575-1,585	Shale, siltstone, and fine sandstone; a little sandy shell limestone; bryozoa, crinoid disks; trace pyrite
1,585-1,595	Shale, siltstone, and fine sandstone; vein calcite
1,595-1,625	Shale, siltstone, and fine sandstone, as above; brachiopod 1,615 to 1,625 feet
1,625-1,635	Siltstone and fine-grained sandstone; shale, as above
1,635-1,645	Shale, grey, fissile, micaceous; some light greenish grey shale and light grey, smooth, fissile shale; siltstone and fine-grained sandstone, as above; brachiopod fragments
1,645-1,655	Shale, grey, smooth, fissile; some interlaminated siltstone
1,655-1,695	Shale, grey, micaceous, finely silty, fissile in part; some greenish grey and light grey, smooth, fissile shale; siltstone and fine-grained sandstone, as above, some with recrystallized shell fragments
1,695-1,785	Shale, siltstone, and fine sandstone, as above; crinoid disks 1,695 to 1,715 feet; brachiopods 1,775 to 1,785 feet
1,785-1,805	Shale, siltstone, and fine sandstone; calcite veins
1,805-1,865	Shale, siltstone, and fine sandstone; fragment of <i>Proetus</i> 1,855 to 1,865 feet
1,865-1,945	Shale, grey, fissile, slightly silty; some shale with rough cleavage; siltstone and fine-grained sandstone, micaceous, laminated; black carbonaceous specks; some with recrystallized shell fragments; crinoid disks 1,875 to 1,885 feet
1,945-1,955	Shale and siltstone, as above; in part interlaminated; crinoid stems; calcite veins
1,955-1,975	Shale and siltstone, as above
1,975-1,995	Shale, as above; a little siltstone and silty shell limestone
1,995-2,005	Shale and siltstone, as above; brachiopod fragment
2,005-2,015	Shale, as above; more siltstone than above
2,015-2,065	Shale and siltstone, as above; fragment of <i>Proetus</i> 2,015 to 2,025 feet
2,065-2,075	Shale and siltstone, as above; slickensides and vein calcite
2,075-2,095	Shale, as above; 30 to 40 per cent siltstone; siltstone and shale, in part interlaminated
2,095-2,105	Shale and siltstone; stained brown
2,105-2,125	Shale and siltstone, as above
2,125-2,175	Shale, grey, fissile, micaceous, smooth; 30 to 40 per cent siltstone; some recrystallized shell fragments
2,175-2,215	Shale and siltstone, as above; vein calcite 2,175 to 2,185 feet
2,215-2,235	Siltstone, as above; some shale
2,235-2,245	Siltstone and shale, as above; metabentonite
2,245-2,265	Siltstone and shale, as above
2,265-2,275	Siltstone and shale, in part interlaminated
2,275-2,305	Siltstone and shale, as above
2,305-2,325	Siltstone and shale, as above; a little lighter grey, smooth, fissile shale
2,325-2,335	Siltstone and shale, as above; bryozoa and brachiopod
2,335-2,405	Siltstone and shale, as above; bryozoa 2,355 to 2,365 feet
2,405-2,435	Shale, grey, finely silty, fissile; some darker grey, silty shale with rough cleavage; a little grey, smooth, fissile, pencil shale, with pyrite nodules; much siltstone and fine-grained sandstone, as above
2,435-2,495	Siltstone and fine-grained sandstone, as above; shale, as above; bryozoa and broken shell fragments
2,495-2,565	Siltstone, fine sandstone, and shale, as above
2,565-2,575	Siltstone and shale, as above, with brown stain; a little brown, silty dolomite
2,575-2,585	Siltstone, fine-grained sandstone, light grey, slightly calcareous; black, carbonaceous specks; shale, as above

Depth	Lithology
Feet	<i>Lorraine—con.</i>
2,585-2,595	Siltstone, fine sandstone, and shale, as above; bryozoa fragments
2,595-2,605	Siltstone and shale, as above; metabentonite; calcite veins; bryozoa
2,605-2,615	Siltstone and shale, as above
2,615-2,645	Shale as above; some greenish grey shale; siltstone and fine sandstone about equal to shale in amount; bryozoa
2,645-2,665	Siltstone and sandstone, greenish grey, fine-grained, slightly calcareous; shale, grey, fissile, silty, as above
2,665-2,675	Siltstone, sandstone, and shale, as above
2,675-2,695	Siltstone, sandstone, and shale, as above; brown stain; bryozoa
2,695-2,715	Shale, grey, fissile, finely silty and smooth, fissile, pyritic; much siltstone, as above; brachiopod and crinoids; <i>Cornulites</i> 2,705 to 2,715 feet
2,715-2,745	Shale and siltstone, as above
2,745-2,795	Siltstone and minor shale, as above
2,795-2,805	Siltstone and shale; metabentonite; calcite
2,805-2,865	Siltstone and shale, as above; pyrite; bryozoa 2,825 to 2,835 feet
2,865-2,875	Shale, mostly grey, smooth, fissile, pyritic; some darker grey, fissile shale; siltstone, as above; bryozoa
2,875-2,915	Shale and siltstone, as above
2,915-2,995	Shale, darker grey than above, finely silty, fissile; some dark grey, smooth, fissile shale; siltstone, light grey, calcareous
2,995-3,005	Shale, as above, in part pyritic; siltstone, as above; metabentonite; calcite
3,005-3,065	Shale, as above; in part pyritic; siltstone, as above
3,065-3,105	Shale, medium to dark grey, in part silty, with rough cleavage; some siltstone, as above
3,105-3,135	Shale, medium to dark grey, as above; a little shale with a brownish streak, finely silty, fissile; a little siltstone, as above
3,135-3,145	Shale, as above; a little siltstone; metabentonite; calcite veins
3,145-3,165	Shale, as above; a little siltstone; bryozoa 3,145 to 3,155 feet
3,165-3,175	Shale, medium to dark grey, as above; in part with a brown streak; a little brown, sandy dolomite
3,175-3,185	Shale, as above
3,185-3,200	Shale, dark grey, mostly with a brown streak

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

SOUTH SHORE No. 2 WELL

Location: lot 541, concession Sud Ouest de l'Ile, municipalit  de la
Paroisse de la Visitation, Yamaska county, Quebec
Elevation: 150 \pm feet Drilled: 1932
Total depth: 4,100 feet Rig: cable
Samples examined by H. R. Belyea, 1946

Depth	Lithology
Feet	<i>Richmond</i>
	Pontgrav� River Formation
110-130	Shale, light greenish grey, soft, calcareous, fissile; siltstone, light grey, calcareous; limestone, light grey, dense

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

Depth	Lithology
Feet	<i>Lorraine—con.</i>
1,040-1,070	Shale and siltstone, as above, with calcite
1,070-1,090	Shale, siltstone, and sandy shell limestone; bryozoa and crinoid disks 1,080 to 1,090 feet
1,090-1,100	Shale and siltstone; slickensides and calcite veins
1,100-1,110	Shale, as above; siltstone, as above, with fossil fragments
1,110-1,160	Shale and siltstone; abundant bryozoa
1,160-1,170	Shale, greenish grey, mostly darker than above, fissile, splintery, micaceous, slightly silty; some light greenish grey shale, in rounded fragments, as above; siltstone and fine-grained sandstone, light greenish grey, laminated, impure, micaceous, calcareous, in part interlaminated with shale; scattered fossil fragments
1,170-1,280	Shale, siltstone, and fine sandstone, as above; bryozoa 1,170 to 1,180 feet; gastropod 1,220 to 1,230 feet; crinoid disk 1,270 to 1,280 feet
1,280-1,290	Shale, siltstone, and fine sandstone; fossiliferous; in part grading to a sandy shell limestone
1,290-1,310	Shale, siltstone, and sandstone, as above
1,310-1,320	Shale, as above; more siltstone and fine sandstone than above; brachiopods and recrystallized fossil fragments
1,320-1,370	Shale, siltstone, and fine sandstone, greenish grey, as above; grades to sandy shell limestone
1,370-1,400	Shale, siltstone, fine sandstone, and shell limestone; bryozoa
1,400-1,410	Shale, siltstone, and fine sandstone, as above
1,410-1,420	Shale, siltstone, and sandstone, as above; slickensides and calcite veins
1,420-1,430	Shale, siltstone, and fine-grained sandstone, as above; sandstone commonly with recrystallized shell fragments; brachiopod fragments
1,430-1,480	Shale, siltstone, and fine sandstone, as above; brachiopod fragments 1,450 to 1,460 feet
1,480-1,500	Shale, siltstone, and fine sandstone; grades to sandy shell limestone; brachiopods and crinoid disks
1,500-1,510	Shale, siltstone, and fine sandstone; crinoid disks
1,510-1,520	Shale, siltstone, and sandstone, as above; bryozoa
1,520-1,560	Shale, siltstone, and fine sandstone; pyrite 1,520 to 1,530 feet
1,560-1,590	Shale, siltstone, fine sandstone, and sandy shell limestone; brachiopods and bryozoa
1,590-1,630	Shale, siltstone, fine sandstone, and sandy shell limestone; crinoid disks
1,630-1,640	Shale, siltstone, fine sandstone, and sandy shell limestone; bryozoa
1,640-1,660	Shale, siltstone, and fine sandstone; crinoid disks 1,650 to 1,660 feet
1,660-1,690	Shale, siltstone, fine sandstone, and sandy shell limestone
1,690-1,740	Shale, grey, fissile; less siltstone and fine sandstone than above; fossil fragments less abundant; calcite veins; crinoid disks 1,720 to 1,730 feet
1,740-1,750	Shale, grey, as above; nearly an equal amount of siltstone and fine sandstone; sandy shell limestone; bryozoa and crinoids
1,750-1,770	Shale, siltstone, and sandstone, as above; with calcite veins
1,770-1,830	Shale, grey, mostly smooth and fissile, but some darker grey, silty, and irregularly bedded; some siltstone and fine sandstone, as above
1,830-1,840	Shale, grey to dark grey, as above; siltstone and fine sandstone in excess of shale
1,840-1,860	Siltstone and fine sandstone, as above; grey shale, as above; sandy shell limestone
1,860-1,880	Siltstone, fine sandstone, and shale, as above
1,880-1,890	Siltstone, sandstone, and shale, with brown stain
1,890-1,920	Siltstone, sandstone, and shale, as above; crinoid disks 1,910 to 1,920 feet
1,920-1,960	Siltstone, sandstone, shale; calcite 1,920 to 1,940 feet
1,960-2,060	Siltstone, sandstone, and shale, as above; crinoid disks 1,960 to 1,970 feet; calcite veins, 2,000 to 2,030 feet
2,060-2,070	Siltstone, sandstone, and shale; sandy shell limestone
2,070-2,110	Siltstone, sandstone, and shale, as above; bryozoa and crinoids 2,070 to 2,080 feet

Depth	Lithology
Feet	Lorraine—con.
2,110-2,120	Siltstone, sandstone, and shale, as above; some sandy shell limestone
2,120-2,200	Siltstone, sandstone, and shale, as above; brachiopod fragments 2,130 to 2,140 feet and 2,190 to 2,200 feet
2,200-2,230	Siltstone, sandstone, and shale; bryozoa and crinoids
2,230-2,260	Siltstone, sandstone, and shale; bryozoa and brachiopods 2,230 to 2,250 feet
2,260-2,300	Siltstone, sandstone, and shale; crinoid disks 2,260 to 2,270 feet
2,300-2,320	Siltstone, sandstone, and shale; calcite veins
2,320-2,370	Siltstone, sandstone, and shale; brachiopod fragments 2,320 to 2,350 feet
2,370-2,380	Siltstone, sandstone, and shale, as above; pelecypod (<i>Chidophorus</i>), brachiopod
2,380-2,400	Siltstone, sandstone, and shale, as above; brachiopod fragments
2,400-2,420	Shale, medium grey, most silty; in part smooth, fissile; in part with irregular fracture; much siltstone and fine, grey sandstone, some of which is interlaminated with shale; sandstone is dolomitic in part
2,420-2,430	Shale, siltstone, and fine sandstone, as above; slickensides and calcite veins
2,430-2,470	Shale, siltstone, and fine sandstone, as above; greenish grey, silty, micaceous metabentonite
2,470-2,560	Shale, siltstone, and fine sandstone, as above
2,560-2,570	Shale, siltstone, and fine sandstone; calcite veins
2,570-2,580	Shale, siltstone, and fine sandstone; a little green metabentonite
2,580-2,620	Shale, siltstone, and fine sandstone, as above
2,620-2,630	Shale, siltstone, and fine sandstone, as above; slickensides and vein calcite
2,630-2,670	Shale, siltstone, and fine sandstone, as above
2,670-2,710	Shale, siltstone, and fine sandstone, as above; slickensides and vein calcite
2,710-2,850	Shale, siltstone, and fine sandstone, as above
2,850-2,860	Shale, siltstone, and fine sandstone, as above; dull green-grey metabentonite; fragment of <i>Cryptolithus</i>
2,860-2,880	Shale; some siltstone and fine sandstone
2,880-2,890	Shale; some siltstone and fine sandstone; calcite and quartz veins
2,890-3,040	Shale; some siltstone and fine sandstone, as above
3,040-3,050	Shale; some siltstone and fine sandstone, metabentonite
3,050-3,080	Shale; some siltstone and fine sandstone, as above
3,080-3,090	Shale; some siltstone and fine sandstone; much metabentonite
3,090-3,120	Shale; some siltstone and fine sandstone; fragment of <i>Cryptolithus</i> 3,110 to 3,120 feet
3,120-3,230	Shale; some siltstone and fine sandstone, as above; brachiopod fragments 3,160 to 3,170 feet
3,230-3,250	Shale; some siltstone and fine sandstone; slickensides and calcite veins
3,250-3,360	Shale; some siltstone and fine sandstone, as above
3,360-3,370	Shale; some siltstone and fine sandstone, as above; slickensides and calcite veins
3,370-3,450	Shale; some siltstone and fine sandstone, as above
3,450-3,460	Shale, medium grey, smooth, fissile, and dark grey, silty, with irregular fracture; some lighter grey, dolomitic siltstone; in part interlaminated with shale
3,460-3,470	Shale, as above; some siltstone; slickensides
3,470-3,610	Shale, as above; some siltstone
3,610-3,650	Missing
3,650-3,970	Shale, as above; some grey siltstone
3,970-3,990	Shale and siltstone, as above; a little light brownish grey, very silty, finely crystalline, dolomite
3,990-4,000	Shale; some siltstone, as above; slickensides and calcite veins
4,000-4,020	Shale; some siltstone, as above
4,020-4,023	Siltstone; interlaminated shale; grey, micaceous, argillaceous siltstone; grey, fissile shale

Depth	Lithology
Feet	<i>Lorraine—con.</i>
4,023-4,100	Missing
4,100-4,187	Siltstone, sandstone, and shale: greenish grey, argillaceous, micaceous, very slightly calcareous siltstone, grading to fine sandstone; dark grey, fissile, micaceous shale
4,187-4,210	Sandstone, light greenish grey, micaceous, slightly calcareous, argillaceous; siltstone, grey, micaceous, shaly; grey shale, in part micaceous
4,210-4,290	Siltstone and shale: dark grey, fissile, micaceous shale and greenish grey, micaceous, slightly calcareous siltstone; interlaminated siltstone and shale
4,290-4,340	Siltstone, sandstone, and shale: greenish grey, micaceous, argillaceous, very slightly calcareous siltstone and fine-grained sandstone; grey to dark grey shale
4,340-4,345	Shale, siltstone, and dolomite: grey to dark grey shale; greenish grey siltstone, as above, grading to grey, silty dolomite
4,345-4,360	Siltstone, sandstone, and shale: greenish grey siltstone, as above; grey, fine-grained, micaceous, argillaceous sandstone; grey to dark grey shale
4,360-4,400	Shale and siltstone: grey to dark grey shale; grey dolomitic siltstone, grading to silty dolomite

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

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