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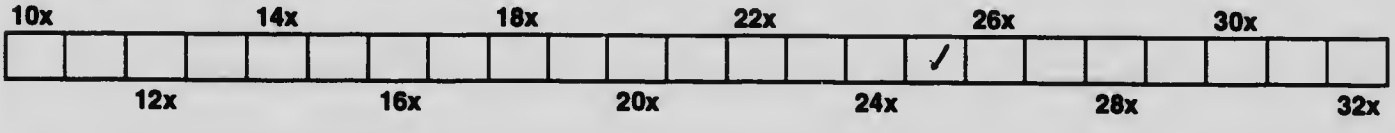

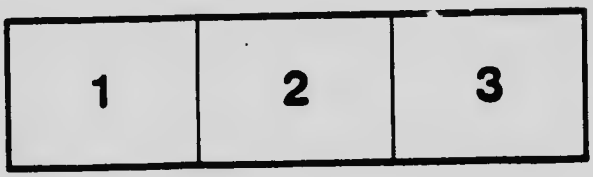

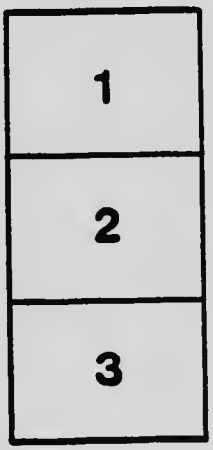

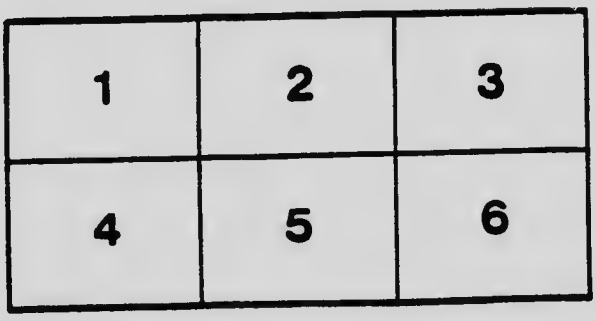

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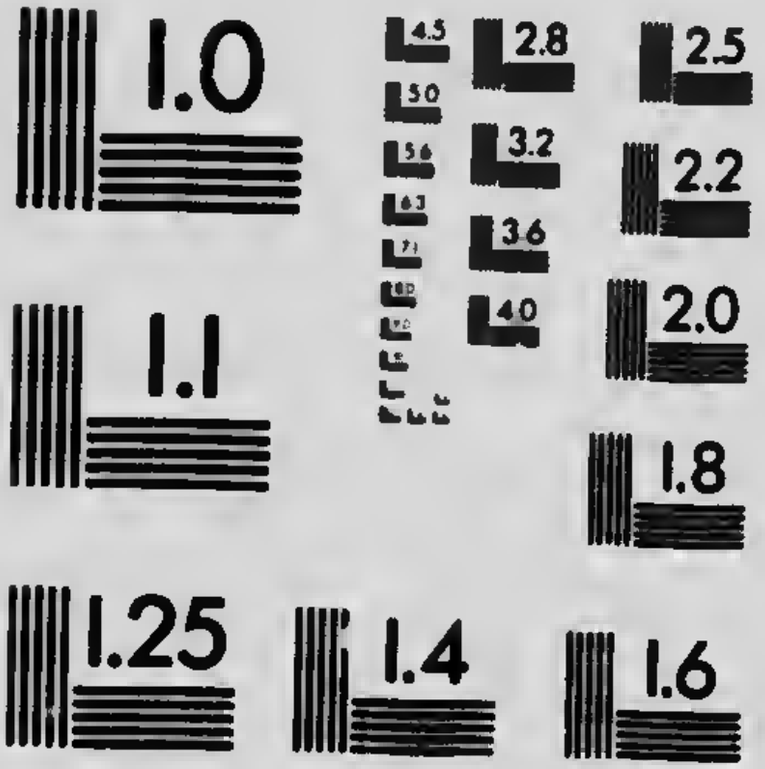

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GEOLOGICAL SURVEY
WILLIAM MCINNES, DIRECTING GEOLOGIST.

MEMOIR 114

No. 95, GEOLOGICAL SERIES

Road Material Surveys in the City and District of Montreal, Quebec

BY
Henri Gauthier

OTTAWA
J. DE LABROQUERIE TACHÉ,
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1919

East wall in O. Martineau and Sons quarry, Mar[illegible] street, Montreal (Map 1747, No. 59). Illustrates the overlying of the coarse-grained grey [illegible]me by uneven, thin-bedded limestone with shaly partings. (Page 28.)

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CONTENTS.

Illustrations.

Road Material Surveys in the City and District of Montreal, Quebec.

CHAPTER I.

INTRODUCTION.

An investigation of road materials was made in and near the city of Montreal during the field season of 1917. As Montreal is the largest city in Canada, with a great and growing seaport and industrial centre, the traffic is heavy and high grade street pavements are necessary in certain parts. In other parts and in the suburbs pavements have to be constructed and maintained on steep grades. Moreover, the geographical situation of the city forces the largest part of the outside vehicular traffic into a few main country highways.

A proper selection of road materials is of great importance in a district like that of Montreal where the roads are put to such severe tests, since the cost of the materials in place is the largest item in the cost of construction of a roadbed, and the quality of the materials largely determines the ensuing annual expenditure for maintenance. The demand for more information on the relative road-making qualities of the numerous deposits of stone lying in and near the city, is consequently greater here than in other localities in Canada, and it was in the hope of meeting this demand that the survey was undertaken.

SCOPE OF THE WORK.

The area covered includes the island of Montreal, isle Jesus, isle Bizard, and isle Perrot, that is, not only the area contributing daily suburban traffic but nearly all of the district from which market wagons drive into the city two or three times a week.

The work consisted in mapping and examining all occurrences of bedrock, field stone, and gravel, and in sampling the more important deposits, for laboratory tests. The value of the different types of material under service conditions was arrived at by the inspection of pavements and country roads on which they had been used.

ACKNOWLEDGMENTS.

Mr. John Stansfield of the geological department of McGill university, made microscopic examinations of a number of the igneous rocks of the district, from samples collected by the writer. The writer is indebted to him for the names of the igneous rocks used in this report. Thanks are due also to the city engineers of Montreal, Westmount, Outremont, Maisonneuve, Lachine, and to the numerous quarry owners and operators for a great deal of information and courtesy.

CONDITIONS AFFECTING ROAD CONSTRUCTION.

The country is of a gently rolling character with the exception of mount Royal which rises to 700 feet beside St. Lawrence river. The highest land is generally near the middle of the islands and in very few places does the elevation exceed 100 feet above the shore. The natural grades of the country roads, therefore, are not very steep, but the numerous streets on the slopes of mount Royal have in many cases very high grades.

The islands over which this survey extends lie between the distributaries of Ottawa river and St. Lawrence river, where those two streams join. The main Ottawa and St. Lawrence rivers lie to the southwest, south, and east of the district, and rivière des Prairies and des Milles isles cut across it and bound it on the north. The two latter streams are not navigable, but are crossed by bridges and ferries from 3 to 10 miles apart. The broad St. Lawrence river south of the island of Montreal, with only a few wagon ferries and one bridge, is an obstacle to wagon traffic from the south. Due to this fact truck farming for the Montreal market is not extensively carried on south of the river and the market traffic is confined to the district to the north and west, that is, the area surveyed.

This district, especially the part on isle Jesus, is thickly settled. Summer resorts are numerous along the river banks north of Montreal and on the shores of lake St. Louis and Two Mountains. Roads leading from Montreal to these resorts during the summer months carry a heavy stream of automobiles besides the market wagons. The road from Montreal East to Bout-de-l'Isle along St. Lawrence river leads to the Charlemagne bridge, the only one east of Montreal. This road can also be considered as part of the Provincial Montreal-Quebec highway.

Roads in this part of the country are covered with snow during the winter so that the road surface is not subjected to wear for from four to five months, but heavy frosts and successive thaws are often responsible for damage to the roadbed.

GEOLOGY.

The plain surrounding mount Royal is underlain by rocks of Palæozoic age which consist of sandstones of the Potsdam formation, magnesian limestones and dolomites of the Beekmantown formation, and limestones and shales of the Chazy, Black River, and Trenton formations. Over these lies a mantle of unconsolidated boulder clay and marine clay and sand, laid down in the Glacial period.

There are many outcrops of Palæozoic sediments, but they are generally of small extent. In the western part of the district surveyed, Potsdam sandstone appears on the north side of isle Perrot, and small outcrops of dolomites and magnesian limestones of the Beekmantown occur at Ste. Anne-de-Bellevue and on the west side of isle Bizard. Several outcrops of Chazy limestone are found in the middle part of isle Bizard, south of Ste. Geneviève, and at Pointe Claire on St. Lawrence river. On isle Jesus this formation forms important ridges, especially near St. Martin Junction where it has been quarried on a large scale. It also occurs at Cartierville and at Bordeaux northwest of Montreal.

Scattered outcrops of Black River limestone are found on the island of Montreal and isle Jesus. About 50 feet of the limestone is exposed in an escarpment between the railway and the village at Pointe Claire.

The Trenton formation, consisting of interbedded limestones and shales, is distributed over a wide area on the island of Montreal and on the northeast end of isle Jesus. It is especially well developed about the city of Montreal and at St. Francois de Salles on isle Jesus, and has been extensively quarried for building material and crushed stone under the trade names of "banc noir" and "banc gris."

Mount Royal consists of a core of massive crystalline igneous rocks flanked by beds of sediments mainly of the Trenton formation. The central core consists largely of two kinds of fairly coarse-grained rocks known as essexite and nepheline syenite. The former is coarse in grain, of a dark colour, and varies in texture from place to place; the latter, which is found in smaller amount, is much lighter, of medium grain, and more uniform in texture.

Many dykes and sheets are found cutting through these rocks and the surrounding limestones. They are composed of various fine-grained crystalline rocks, geologically and mineralogically related to the main mass of mount Royal. Among these are sheets of tinguaite outcropping in the northeast part of the city and quarried for road metal. This stone, locally known as "banc rouge," is a massive, fine to medium-grained, greenish grey rock of a somewhat porphyritic texture. On the slopes of mount Royal in Outremont, on isle Bizard, and near Ste. Dorothée on isle Jesus there are outcrops of breccias composed of fragments of Palæozoic sediments and Pre-Cambrian rocks enclosed in an igneous paste of a greenish grey colour.

The greater part of the surface of the area surveyed is composed of boulder clay, but there are a few extensive deposits of stoneless stratified marine clay, capped in places by layers of sand and gravel. In the boulder clay a large percentage of the boulders are of Trenton limestones, except in the western part of the district where boulders of Beekmantown dolomites are predominant. In addition, many boulders of Pre-Cambrian age have been brought by glaciers from the north and northeast. These are gneisses, granites, anorthosites, etc. The marine or Leda clay forms the cliff which runs from Maisonneuve, through the city to mount Royal. It is in places covered by Saxicava sand and fine gravel. A strip of Leda clay varying to about one mile at its greatest width stretches, north of lake St. Louis, from Beaconsfield to Montreal West, and from St. Charles road along the Ste. Marie road to the west end of the island of Senneville. There, as well as near Beaconsfield, the clay is overlain in places by patches of Saxicava sand consisting of yellow, iron-stained sand or of coarser yellow or brown sand with larger, rounded pebbles. These sands and gravels occur also on the flank of mount Royal and at Côte-des-Neiges. On isle Jesus, patches of sand are met with at intervals but only over a short distance. Boulder clay is the more frequently encountered drift.

CHAPTER II.

ROAD MATERIALS.

Stone from bedrock is used extensively for road purposes and is the main class of road stone available in the Montreal district. Field boulders occur, but, except for foundation work, they are not used to a large extent. Sand and gravel are to be found in places but only in very small amount.

BEDROCK.

Road stone from the same geological formation in this area has proved to be of nearly uniform quality even where quarried at widely separated localities. For this reason the supplies of road stone of the district have been classified according to the geological formations from which they are derived.

Potsdam Sandstone.

Outcrops of the Potsdam formation occur only on the north side of isle Perrot. They consist of interbedded fine and coarse-grained, yellowish brown to white sandstones. The fine variety, which is made up almost entirely of quartz, is tough, but the coarse type, which approaches a conglomerate, is soft and a poor road material. The amount of available sandstone is large but the present condition of water-bound macadam roads recently built of this material, on isle Perrot, proves that these sandstones do not cement in the roadbed and do not give satisfactory service even under conditions of light traffic.

Beekmantown Dolomite.

Scattered outcrops of dense and fine-grained, bluish-grey dolomites and magnesian limestones of the Beekmantown formation are found from Ste. Anne-de-Bellevue to 4 miles east of that place, and on the west part of isle Bizard and isle Jesus. This stone has given satisfactory results when used in water-bound macadam under ordinary country traffic. It is much tougher and wears less than the limestones. The deposits are small, however, and are only of local importance.

Chazy Limestone.

In the western part of the area surveyed, outcrops of Chazy limestones occur within a narrow belt across the island of Montreal and on isle Bizard. On isle Jesus outcrops are seen over much greater areas. This formation is in most places made up of massive beds of granular grey limestones and some of the layers consist almost entirely of fossil shells. At cap St. Martin and near the village of St. Martin the beds are exposed over a thickness of 25 feet and vary in character from a coarse-grained,

grey, fossiliferous limestone to a darker, fine-grained rock containing irregular, wavy streaks along which the stone has a tendency to split. Among the more important outcrops of this type of limestone are those of Cap St. Martin, St. Martin village, Cartierville, Bordeaux, St. Vincent de Paul, and Côte St. Michel. Quarrying operations for building stone have been carried on for many years in all these places and more recently some of them have produced large quantities of crushed stone. Within the city limits the only place where Chazy limestone can be obtained, is from the Villeray quarries. This stone has been used to a large extent in the construction of water-bound and bituminous macadam roads on isle Jesus and outside of Montreal district. It has made good roads under light traffic conditions, but under heavy automobile traffic the roads wear fast even where a bituminous binder is used.

Black River Limestone.

The Black River formation consists of rather thin-bedded, dark, fine-grained to compact, splintery limestones with interbedded shaly partings. These limestones can be obtained at Pointe Claire and on St. Charles road, $1\frac{1}{4}$ miles north of Beaconsfield station, where they form ridges standing from 20 to 35 feet above the general level of the country A large quantity of this material has been used for railway construction and more recently some of it was used in tarvia roads in the village of Pointe Claire. Apparently this stone is much harder than the coarse-grained type of Chazy limestone.

Trenton Limestone.

The limestones of the Trenton formation have been the chief source of road material in Montreal and in its neighbourhood to the north and northeast as they are available more than any other rock. In the city and near it the limestone is of two types, with a third intermediate variety. These are commonly called "bane noir", "banc gris", and "pierre batarde". "Bane noir" is a black, dense to fine-grained, thin-bedded limestone with bituminous and shaly partings; "banc gris" is a medium to coarse-grained, fossiliferous, grey limestone occurring in more massive beds. In the "pierre batarde" the limestone varies irregularly from a coarse, light grey to a dark, fine-grained stone, the two occurring together within the same beds. The beds are thin and contain many bituminous and shaly partings. The more important quarries producing crushed stone from this formation, in the northeast part of the city, are: the Morrison quarries operated by O. Martineau and Fils (see Plate I, Frontispiece), the Maisonneuve, De Lorimier, Rogers, and Gravel quarries.

On isle Jesus the most important occurrence of Trenton limestone is that of St. François de Salles. There the limestone is dark grey and rather fine-grained. It occurs in very thick massive beds in which dark, wavy streaks, from $\frac{1}{4}$ inch to 1 inch apart, are strongly developed and well shown in the weathered rock. The outcrops extend over an area of about 300 acres and form ridges which facilitate the quarrying. This deposit was especially worked for dimension stone (Plate IVB), and large quantities

have been obtained. At the present time three companies are producing crushed stone for road purposes and concrete. They are: the Kennedy Construction Company, the Montreal Concrete Works Company, and J. O. Labelle and Company.

The best road-making stone in the Trenton formation is probably that in which a minimum of the black shales and of the clayey partings exists. The so-called "pierre batarde" gives a rather uneven product and is better used as rubble, and the dark grey, fine-grained limestone of St. François de Salles has less resistance to wear than the "banc noir" and "banc gris" occurring in Montreal.

Igneous Rocks.

Outside of the city of Montreal, practically none of the igneous rocks has ever been quarried for road work. There are, however, on the island of Montreal and on isle Jesus a certain number of dykes and sheets of dark, basic, igneous rock which should make excellent road material. The amount available in certain cases is quite large. The best two deposits located during this survey lie immediately east of the village of Ste. Dorothée (Plate III B) and 1½ miles northeast of St. Vincent de Paul on the west side of Terrebonne road. In both cases the rock is massive, dark coloured, fine-grained, and extremely tough.

Practically all the igneous rock quarried and crushed for concrete or paving purposes in the city of Montreal is obtained from outcrops of tinguaite lying between Côte de la Visitation and Maisonneuve. These outcrops occur in lens-shaped sheets and reach in places a thickness of 35 feet (Plates II and III A). The tinguaite generally overlies Trenton limestone, but is quarried separately. The stone is known under the trade name of "banc rouge". It is a massive, medium-grained holocrystalline and porphyritic greenish grey rock of rather uniform texture, with a few feet of dark greenish, glassy, and somewhat porphyritic rock near the contact with the limestone. In certain places, however, the rock is altered to a whitish colour and is of inferior toughness.

A great deal of this stone has been crushed and sold to the city for street paving during the last ten years, and the amount available is now limited. The outcrops south of Masson street, with the exception of Iberville street, are the main occurrences and the only deposits that can be quarried in the future. The Morrison Quarry Company, Jas. Rogers, and Antoine David are the only firms quarrying banc rouge at present.

Formerly large quantities of nepheline syenite were obtained from the Corporation quarry at Outremont on the northwest flank of mount Royal, but this quarry has not been worked for several years. This and other first-class deposits of stone are no longer available because of the growth of the city around them.

Many thousand cubic yards of igneous rock have also been quarried for road work from a massive dyke of fine-grained, greenish-grey rock, probably nepheline syenite, cutting through a ridge of marmorized limestone and breccias on the west side of Rockland avenue, Outremont. This rock is extremely tough, but the amount available is comparatively small, and

the irregular nature of the dyke makes quarrying very difficult. Many outcrops of nepheline-syenite and essexite occur on mount Royal, but they are either in Mount Royal park or in the Côte-des-Neiges cemeteries where quarrying will probably never be allowed for commercial purposes.

BOULDER DEPOSITS OR FIELD STONE.

Field stone piled in fences or heaps is not uniformly distributed over the area surveyed, but is found in large quantities in the western part of the island of Montreal, on isle Bizard, and in many scattered areas on isle Jesus. On the island of Montreal the field stone is concentrated in a belt stretching along the north side of the island from a few miles northeast of Ste. Anne-de-Bellevue to Cartierville. It is especially plentiful near Ste. Geneviève and Saraguayville along rivière des Prairies. Near the city of Montreal and in the eastern part of the island, field stone is very scarce, except in one area north of Côte St. Michel road, 2 miles from the city. On isle Bizard there are large quantities over its entire area. The main boulder deposits on isle Jesus are found near Abord-à-Plouffe, Ste. Dorothée, and St. Vincent de Paul.

The amount of piled field stone was measured fence by fence and the fences grouped into mapped areas. The total amount measured was 575,752 cubic yards, distributed as follows: island of Montreal 282,673 cubic yards; isle Jesus 153,135 cubic yards; and isle Bizard 139,944 cubic yards. Of this, 459,578 cubic yards were estimated to be under 1 foot in diameter, that is to say about 80 per cent of the field stone examined is of such size as to permit handling in a small crusher without preliminary breaking.

Composition of the Aggregates.

The composition of the field stone varies greatly from one deposit to another. It is expressed here in percentages of limestone, dolomite, sandstone, and igneous rock. These four classes of stone are the chief groups under which the field stone can be more easily classified. The average composition of the stone in each area was calculated by means of estimates made in the field on each pile. In every case estimates of the composition were made both on the stone under one foot and that over one foot. As a rule the percentage of igneous rock is greater in the boulders over one foot. It is generally true, also, that the composition is related to the underlying bedrock. Thus, the percentage of limestone, dolomite, or sandstone is high in fences lying close to outcrops of one of these rocks or where the bedrock is to be found close to the surface. For instance the field stone on isle Perrot consists mainly of the underlying Potsdam sandstone, but it is scarce elsewhere. Dolomites and magnesian limestones are found in proportions ranging from 40 to 90 per cent in the composition of deposits lying in the western part of the island of Montreal near Ste. Anne-de-Bellevue, Baie d'Urfé, and Beaurepaire, and on isle Jesus west of Ste. Rose, where outcrops of bedrock of the Beekmantown formation are to be found. Neither of these two classes of stone is to be found east of the localities above mentioned.

Limestones and igneous rocks are more uniformly distributed; they are found in nearly every deposit in proportions varying from 10 to 90 per cent. The percentage of limestone is very high especially in deposits lying close to outcrops of that rock, such as those near Ste. Geneviève, Beaconsfield, Pointe Claire, and Cartierville on the island of Montreal, and near Abord-à-Plouffe, St. Martin, and St. Vincent de Paul on isle Jesus. On the island of Montreal the deposits at Saraguayville and Côte St. Michel carry over 50 per cent of igneous rocks. The more important deposits of similar composition of isle Jesus are those lying near Ste. Dorothée, Laval des Rapides, Pont Viau, and between St. Martin and Ste. Rose.

Character of the Boulders.

The character of the field stone boulders resembles that of the bedrock from which they are derived. The Potsdam sandstone boulders are white to reddish brown and from fine to very coarse-grained. The finer-grained variety is fresh, whereas the coarse sandstone, which is almost a conglomerate, is much weathered. The dolomites and magnesian limestones of the Beekmantown formation are more uniform and although weathered on the surface to yellowish brown they are generally fresh inside. They are fine-grained and of a steel to bluish-grey colour.

Very coarse-grained Chazy limestone, weathering to reddish-grey, forms over 75 per cent of the aggregates near Ste. Geneviève, Cartierville, Abord-à-Plouffe, and St. Martin, where outcrops of Chazy limestone occur. Dense, dark blue Black River limestone is found in large proportions to the north of Beaconsfield and Pointe Claire. Elsewhere, the Trenton limestone varies from fine to coarse-grained and is generally weathered on the surface to a dark colour.

Igneous boulders consist chiefly of greyish and reddish granite-gneisses, of hornblende and garnet-gneisses, more or less foliated and from fine to coarse-grained in texture. They also occasionally included light coloured anorthosites. All of these rocks are of Pre-Cambrian age. They are generally well rounded boulders and fairly fresh. A certain amount of fine-grained, often porphyritic, dark basic dyke rocks are also found in many deposits. These rocks, as a rule, resemble the various dykes which cut through the limestone formation of the particular locality where they are encountered. They are angular and of a rusty appearance.

SAND AND GRAVEL.

Small patches of sand and gravel are found in places in the district of Montreal, but they are too small for any but local use. There are no gravel roads and nearly all of the sand and gravel used in the city pavements is imported. A large proportion of the sand used in concrete or sheet asphalt in Montreal and its suburbs comes from Ste. Emelie Junction, Joliette. A large number of firms in Montreal import their sand and gravel from the counties of L'Assomption, Terrebonne, and Two Mountains.

RESULTS OF LABORATORY TESTS.

EXPLANATION OF TESTS.

Laboratory tests have been devised to furnish a rapid means of judging of the value of a rock as a road metal. In these tests an attempt is made to approximate the condition which will obtain in a roadbed under traffic. The more important tests are for the resistance to abrasion (percentage of wear) and for the resistance to impact (toughness). Tests are also made for hardness, specific gravity, and absorption.

The methods for the determination of the physical properties of road materials are described in Bulletin No. 347 of the U.S. Department of Agriculture, by F. H. Jackson, jun., and in Memoir 85, Geological Survey of Canada, by L. Reinecke.

Abrasion.

In the abrasion test fifty particles of the rock, of uniform size, between 2 and 2½ inches in diameter and weighing in the aggregate within 10 grammes of 5 kilograms, are revolved in a cast iron cylinder set at an angle of 30 degrees to the axis of the machine. After 10,000 revolutions in the abrasion machine, the 5 kilogram charge is washed on a 16-mesh sieve, and after drying the loss in weight is determined. This loss calculated to per cent is used to express the wearing quality of the rock and is called the per cent of wear.

An arbitrary factor, the "French coefficient of wear" is also used. This is equivalent to 40 divided by the per cent of wear. This coefficient was devised to give an increasing scale of numbers to represent an increasing ability to resist wear.

Toughness.

The toughness test is made on a rock cylinder 25 millimetres in diameter and 25 millimetres high, carefully cut and ground true from a diamond drill core drilled from a solid block of the rock. This cylinder is placed on the platform of the impact machine where it is subjected to blows from a 2 kilogram hammer transmitted to it through a plunger with a spherical end resting on its upper surface. The height of the drop of the hammer is increased by increments of 1 centimetre until the point of failure of the test piece is reached. The height in centimetres of the fall of the hammer causing the failure of the test cylinder is recorded as the toughness.

Hardness.

The hardness test is performed on a diamond drill core, 25 millimetres in diameter. This core is held freely in a vertical position and under a weight of 1,250 grammes against a disk revolving in a horizontal plane and carrying an artificial quartz sand (30- to 40-mesh). The hardness is expressed by an arbitrary number derived from the equation: hardness = $20-\frac{1}{3}$ W, where W is equal to the weight in grammes lost through 1,000 revolutions of the disk.

Specific Gravity.

Specific gravity is the weight of the material compared with that of an equal volume of water, and is obtained by dividing the weight in air of a rock fragment by the difference between its weight in air and in water. The weight of a cubic foot of rock is found by multiplying the specific gravity by 62·37 pounds, the weight of a cubic foot of water.

Absorption.

The absorption test determines the amount of water which the rock will absorb. Values for absorption are expressed as pounds of water absorbed per cubic foot of rock. This value is easily computed from the known specific gravity of the rock and from the weight of water observed to be absorbed by a sample during 48 hours immersion.

Recommended Values for Per Cent of Wear and Toughness.

The abrasion test is supposed to simulate the abrasion of the rock fragments in the roadbed under traffic. The impact of the hammer in the toughness test represents the blows of horses' hoofs and of wagons passing over irregularities on the road, and the hardness test is an attempt to duplicate the grinding action of the steel tires of vehicles.

As a result of comparisons made by engineers between laboratory tests and the wear of the stone in practice, certain limits have been set upon the values for the toughness and percentage of wear of stone that is to be used in macadam construction. The American Society of Civil Engi ers recommended, in 1917, that stone used in water-bound macadam roads shall have a percentage of wear of not more than 5, and a toughness value of not less than 6. The specifications, adopted by the American Society of Municipal Improvement in 1914, require that stone used in the wearing course of bituminous macadam or bituminous concrete roads shall have a per cent of wear of not more than 3·7, and a toughness of not less than 13. The United States Office of Public Roads sets the minimum limits of toughness for stone used on roads subjected to traffic of less than 100 vehicles a day at from 5 to 9, except in the case of bituminous concrete where the lower limit is 7. On roads subjected to from 100 to 250 vehicles a day the minimum toughness is 10 for water-bound macadam and bituminous macadam, and 13 for bituminous concrete. For roads carrying over 250 vehicles the minimum toughness is 19 for water-bound macadam, 10 for macadam with bituminous mat and bituminous macadam, and 13 for bitumious concrete.

The specifications used by the city of Montreal require that crushed stone shall be classed into three grades, according to qualities which shall be determined by tests conducted in a properly equipped laboratory. The properties deter shall be French coefficient of wear, toughness, and absorption. M: meeting the requirements of any of the grades with respect to coefficient of wear and toughness, but failing to meet the requirement with respect to absorption, may, on consideration of the engineer, be classed with the higher grade. Grade "A" a rock which

General Limiting Values for Broken Stone.

(U. S. Office of Public Roads, Washington, D.C.)

Type of construction.	Traffic.[1]	Limiting values.			
		Per cent wear.[2]	Fr. coefficient.	Toughness.	Hardness
Water-bound macadam, plain or with dust palliative treatment.	Light.	8·0 to 5·0	5 to 8	5 to	10 to 17
	Moderate.	5·0 to 2·5	9 to 15	10 to	14 or over.
	Heavy.	2·5 or less.	16 or over.	19 or over.	17 or over
Macadam with bituminous carpet.	Light to moderate.	8·0 or less.	5 or over.	5 or over	[4]
Bituminous macadam with seal coat.	Moderate to heavy.	6·5 or less.	7 or over.	10 or over.	
Bituminous concrete.	Light to moderate.	5·5 or less.	7 or over	7 or over	[4]
	Moderate to heavy.	4·0 or less.	10 or over	13 or over.	
Binder course for sheet asphalt or Topeka type.	Any.	5·5 or less	7 or over.	8 or over	[4]
Portland cement concrete.	Moderate to heavy.		[4]	8 or over.	16 or over
Stone paving block.[3]	Any.		[4]	9 or over.	16 or over
Broken stone foundations Cement concrete foundations.	Any	13 or less	3 or less	3 or over	8 or over

[1] Light traffic is assumed as less than 100 vehicles per day, moderate traffic between 100 and 250 vehicles, and heavy traffic over 250 vehicles per day.

[2] Limiting values for the per cent of wear are not given in the table as published by the U. S. Office of Public Roads. The limits given in the above table are based on the limiting values for the French coefficient of wear, and are included for the convenience of those who prefer to think in terms of per cent of wear rather than in terms of French coefficient.

[3] Crushing strength of 20,000 pounds, or greater per square inch, is frequently required.

[4] Limits for French coefficient of wear (or per cent of wear) are not at present considered necessary for this type of construction.

Numerous tests have shown that limits for hardness are unnecessary if the material possesses the required French coefficient of wear (or per cent of wear) and toughness.

has a toughness of not less than eighteen (18), a French coefficient of wear of not less than fourteen (14), and an absorption of not more than six-tenths (0·6) pound per cubic foot. Grade "B" is a rock which has a toughness of not less than ten (10), a French coefficient of wear of not less than seven (7), and an absorption of not more than one (1) pound per cubic foot. Grade "C" is a rock which has a toughness of not less than seven (7), a French coefficient of wear of not less than five (5), and an absoprtion of not more than one and five-tenths (1·5) pound per cubic foot.

BEDROCK.

The results of laboratory tests made upon bedrock are given in Table I, page 17. The figures are, in each case, the average values for tests made on duplicate samples of the rock. For quarries, where some noticeable variation in the character of the stone was observed in the same formation, samples were collected from each phase of the rock. The figures, therefore, are in many cases, and especially for the more important quarries, the average values for results of tests made on several samples taken in different parts of the quarry. Such results can be considered as representatives of the value of a crushed product produced from the deposit.

An examination of the results of the tests given in Table I shows that the values obtained for the per cent of wear and the toughness of samples collected from the same rock formation, though quite widely separated throughout the Montreal district, are uniform. A fairly narrow range of variation can be set for the per cent of wear and the toughness for each rock formation which will include by far the majority of the results of tests obtained for the samples of rock collected from each formation. This range of variation is conveniently expressed by the average per cent of wear or toughness for the rock formation and the average deviation from such average value shown by the results of tests.

The relatives percentages of wear and toughness of the various classes of rock are indicated graphically in Figure I, page 13, and are compared with limiting values for water-bound macadam and bituminous macadam. It will be seen from the diagram that the most durable stone in the district of Montreal is of igneous origin. The average values for certain dykes or sheets of igneous rock for instance are 2·4 for wear and 22 for toughness, as shown in the diagram. The percentage of wear of all except one of eight samples that were tested, ranges between 2 and 2·4, and the toughness varies from 18 to 30. Unfortunately only a small quantity of this class of rock is available. It occurs in narrow dykes or thin sheets through the limestone formations and cannot be readily quarried separately. However, the amount available in deposits near Ste. Dorothée (Map 1747, No. 97, Plate IIIB) and St. Vincent de Paul (Map 1747, No. 128) is quite large. Their respective values for wear are 2 and 2·2 and for toughness 20 and 29.

Next in the order of durability is the tinguaite or "banc rouge". Six samples of this type of rock gave very uniform results, the percentage of wear is 2 and the toughness varies from 19 to 29 with an average value of 22. This is the best road-making stone that is available near Montreal and it has given good service in various types of pavements in the city of Montreal, Outremont, Westmount, and Maisonneuve.

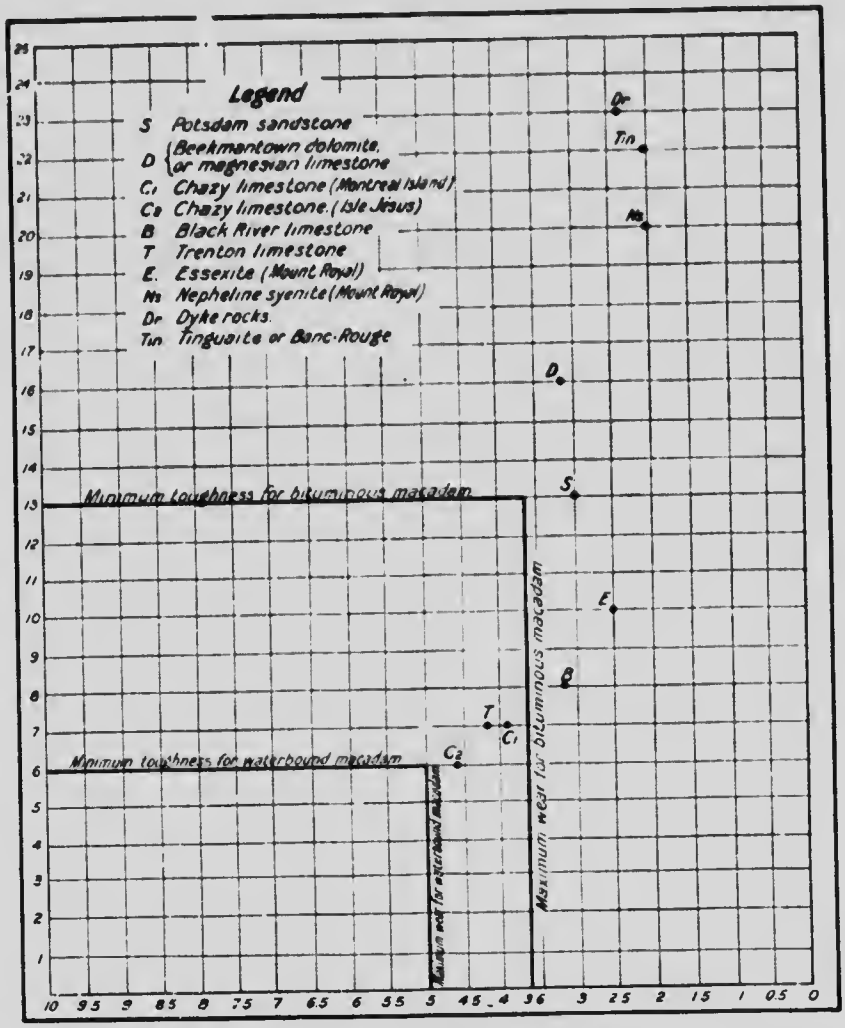


Figure 1. Relative toughness and percentage of wear of various kinds of bedrock, in and near Montreal.

Nepheline-syenite proved also to be a first class road material. It does not wear any more than the tinguaite and its average toughness, although lower than that of the latter, is still high. One sample of this class of rock taken from Stinson Reeb quarry in Outremont has given the best results of all the rocks tested. The per cent of wear is as low as 1·8 and the toughness is 30. Where the nepheline-syenite is coarse-grained or where it holds inclusions of essexite, as is the case in the Corporation quarry, the per cent of wear is slightly higher and the toughness lower.

Coarse-grained essexite from mount Royal, although showing little wear, is a much weaker rock. Its toughness value is 10, that is, below the minimum set for bituminous macadam. This may be due to weathering.

The results of tests upon the dolomites and magnesian limestones of the Beekmantown formation indicate that they can be safely used in bituminous macadam and in water-bound macadam roads under traffic conditions up to 250 vehicles a day. The average per cent of wear for five samples which were collected is 3·1 with an average deviation of ±0·5 from this value, and the average toughness is 16 with an average deviation of ±7. This class of rock, however, does not cement well in water-bound macadam roads subjected to light traffic.

Potsdam sandstone with a per cent of wear of 3 and a toughness of 13 could be economically used with a bituminous binder, but its poor cementing value will prevent its use in water-bound macadam.

The values for the various classes of limestones are not very far apart. Figure 1 shows that of the Chazy, Black River, and Trenton limestones, the best material is the Black River limestone. This fine-grained, dark rock is equal in durability (per cent of wear 3·1) to the dolomite, but it is more brittle and its average toughness is 8 with an average deviation of ±1·5 from this value.

Chazy and Trenton limestones gave fairly uniform results under the tests. The figures shown in Figure 1 are the average of more than twenty samples each, that is a much larger number of samples were tested than for any other type of rock. It will be seen that the Chazy limestone from isle Jesus is softer than that occurring on the island of Montreal, and the per cent of wear and toughness of this class of rock from certain deposits are in some cases below the minimum values recommended for water-bound macadam. The average per cent of wear for Chazy limestone from the island of Montreal is 3·9 with an average deviation of ±0·1 from this value, and the average toughness is 7±1. The values of Chazy limestone from isle Jesus are: per cent of wear 4·6, deviation ±0·5, toughness 6, deviation ±1·5.

Tests have shown some varieties of the Trenton limestones to be better than the Chazy limestone, but as a class they are of about the same quality. The average per cent of wear for Trenton limestone from both the island of Montreal and isle Jesus is 4·1 with an average deviation of ±0·6 and the toughness is 7 with an average deviation of ±1·5 of this value. The average values for each one of the different types of

Trenton limestone, such as described under the heading of bedrock in this report, are given below.:

	Average per cent wear.	Average toughness.
Bane noir (dense, black)	3·5	8
Bane gris (medium to coarse, grey)	3·9	7
Pierre batarde (uneven with shaly partings)	4·7	7

FIELD STONE.

Field stone forms a cheap and often valuable source of road stone. In the production of crushed stone from boulders the crusher can be located next the proposed highway, the boulders hauled there in winter and put in the crusher with little or no preliminary breaking. There are no quarrying expenses and the owners are generally willing to dispose of what has to them been a source of labour without profit. Field stones in large quantities occur in parts of Montreal district.

The disadvantages of using this form of material for road surfacing arise from its heterogeneous character, which may cause one section of a road to wear more rapidly than another or may give rise to uneven wear in the same section of road.

The boulder deposits are aggregates of many varieties of stone, each of which may vary in road-building character, and the quality of the aggregate must vary according to the variation in the quality and proportions of its component boulders.

It was found by sampling separately each of the main classes of stone found in the aggregates that the quality of any one variety was fairly constant over the area surveyed.

The results of abrasion tests upon samples of field stone are given below:

Rock species.	Average per cent wear.	Number of samples tested.
Igneous (chiefly gneisses)	3·2	6
Potsdam sandstone, fine-grained	2·2	2
Beekmantown dolomite	3·3	2
Chazy limestone, fine-grained	3·3	2
" coarse-grained	5·0	8
Trenton limestone, dense to fine-grained	3·7	2

The igneous gneisses, dolomites, and fine-grained limestones are probably the best classes of field stone for road work. The igneous rocks and dolomites, however, do not cement as well as the limestone. Although the sandstone wears less than all other types, it can not make by itself a successful water-bound macadam because of its extremely poor cementing power. However, mixtures of igneous rock, sandstone, and dolomite have given fairly good results in water-bound macadam construction in other parts of the country. Broken stone roads south and southeast of Ste. Dorothée, built of mixtures of igneous rock, dolomite, and limestone, were in good condition after two years of service. The top screenings had been washed out and shallow ruts had formed, but the roads apparently wear less than other roads in the same locality, built entirely of quarried limestone.

Composition estimates of each boulder deposit in the district surveyed are to be found in Appendix B. Knowing the composition of the aggregates, their durability or resistance to abrasion can be arrived at. Experiments conducted by K. A. Clark[1] established the fact that the per cent of wear of any combination of rock species could be calculated from the per cent of wear of each species and their relative proportions in the combination. If the per cents of wear of the various species are expressed by $W_1, W_2, \ldots . W_n$ and the percentage proportions in which they occur in the mixture $C_1, C_2, \ldots . C_n$, the per cent wear of the mixture W_m is given by the formula $W_m = \frac{\Sigma CW.}{100}$ For instance, the per cent of wear of the aggregate under 1 foot, in the boulder deposit east of Sennevillc (Map 1747, No. 1) can be calculated thus:

$$W_m = \frac{3{\cdot}2 \times 10 + 2{\cdot}2 \times 15 + 3{\cdot}3 \times 75}{100} = 3{\cdot}12\ \%$$

[1]Mines Branch, Dept. of Mines, Sum. Rept. 1917, p. 126.

Table I.—Results of Tests made upon Bedrock.[1]

Map[2] No.	Locality and owners.	Rock species.	Age or formation.	Physical properties.					
				Per cent wear.	French coef. of wear.	Toughness.	Hardness.	Spec. grav.	Absorp. in lbs. per cu. ft.
			Isle Perrot.						
1	Quinlan and Robertson quarry.	Sandstone.	Potsdam	3·7	10·8	16	19·4	2·59	0·9
2	Quarry of municipality of Isle Perrot.	"	"	2·4	16·7	10	19·2	2·59	0·7
			Island of Montreal.						
3	A. H. Maher's quarry, Ste. Anne-de-Bellevue.	Magnesian limestone	Beekmantown	3·1	12·9	14	16·8	2·80	1·4
6	H. Morgan's quarry, Senneville.	" "	"	4·2	15·5	8	16·0	2·70	1·4
16	Hon. J. L. Perron's quarry, Beaconsfield.	Dolomite	"	2·6	15·4	26	17·8	2·74	1·1
		"	"	2·4	16·7	28	16·6	2·73	1·4
21	G. T. R. quarry, Pointe Claire.	Limestone	Black River	3·2	12·5		-	2·70	0·5
22	Charlebois and Chetagne's quarry, Pointe Claire.	"	"	2·3	17·4	7	16·3	2·70	0·2
24	G. Meloche's quarry, Pointe Claire.	"	"	3·1	12·9	6	15·4	2·69	0·3
		"	"	2·8	14·3	7	17·2	2·71	0·2
27	Adénai St. Denis' quarry, Ste. Geneviève.	"	Chazy	3·7	10·8	5	14·9	2·69	0·8
28	Lavigne and Laframboise's quarry, Ste. Geneviève.	"	"	3·9	10·3	6	13·7	2·68	0·5
29	O. Laniel's quarry, Ste. Geneviève.	"	"	3·8	10·5	7	16·1	2·79	0·8
39	H. Cousineau's quarry, Cartierville.	"	"	3·8	10·5	7	14·9	2·72	0·5
40	E. Leonvalier's quarry, Cartierville.	"	"	3·9	10·3	7	15·9	2·70	0·2
42	J. Rhéaume's quarry, Bordeaux.	"	"	4·1	9·8	6	13·9	2·70	0·7
43	Carrière and Deguire's quarry, St. Laurent.	"	"	3·9	10·3	7	15·0	2·73	0·8
45	Villeray quarry, Rosaire and Boyer sts., Montreal.	"	"	3·1	12·9	8	15·0	2·74	0·3
46	O. Martineau and Fils quarry, Côte St. Michel.	"	"	3·9	10·3	6	13·9	2·70	0·2

[1]The tests were made in the Road Materials Laboratory of the Mines Branch, Department of Mines, under the direction of K. A. Clark, chief engineer.
[2]The deposits are numbered on the map in the order of their occurrence in the field from west to east.

Table I.—Results of Tests made upon Bedrock—Continued.

Map[1] No.	Locality and owners.	Rock species.	Age or formation.	Physical properties.					
				Per cent wear.	French coef. of wear.	Toughness.	Hardness.	Spec. grav.	Absorp. in lbs. per cu. ft.
		Island of Montreal—concluded.							
47	Quinlan and Robertson quarry, Côte St. Michel.	Limestone	Trenton	3·5	11·4	6	14·7	2·70	0·1
		Fourchite	Palæozoic	2·4	16·7	18	17·3	2·78	0·6
52	East of Decelles st., Côte-des-Neiges.	Essexite	Palæozoic	2·5	16·0	10	18·3	3·24	0·2
53	Corporation quarry, Outremont.	Nepheline syenite	"	2·4	16·7	17	18·2	2·68	0·7
		Pyroxenite	"	2·2	18·2	12	18·2	3·10	0·4
		Metamorphosed limestone	"	3·5	11·4	5	13·8	2·77	0·1
54	Stinson Reeb quarry, Outremont.	Nepheline syenite	"	1·8	22·2	30	18·4	2·94	0·3
55	Rockland Ave. cut, Outremont.	Camptonite	"	2·0	20·0	24	18·1	2·90	0·2
		Metamorphosed limestone und breccias	"	3·0	13·3	17	18·1	2·80	0·1
56	Spring Grove Ave. cut, Outremont.	Limestone	Trenton	2·7	14·8	6	14·9	2·72	0·2
57	Jos. Gravel quarry, de Fleurimont and Chambord sts., Montreal.	"	"	4·0	10·0	9	16·7	2·70	0·3
		Sandy dolomite	Palæozoic	4·0	10·0	14	15·8	2·73	1·0
58	Stinson Reeb quarry, Bellechasse and Chambord sts., Montreal.	Limestone	Trenton	3·6	11·1	8	16·2	2·71	0·0
59	O. Martineau and Fils quarry, Carrière and Marquette sts., Montreal.	"	"	4·2	9 5	5	14·3	2·71	0·1
60	De Lorimier quarry, Iberville and Masson sts., Montreal.	"	"	3·4	11·8	5	15·6	2·71	0·2
		Impure sandstone	Palæozoic	2·0	20·0	30	18·9	2·97	0·1
61	Jas. Rogers' quarry, Iberville and Masson sts., Montreal.	Limestone	Trenton	4·3	9·3	7	15·7	2·71	0·2
62	Jas. Rogers' quarry, south of Masson st., Montreal.	"	"	3·7	10·8	9	17·2	2·70	0·3
		Tinguaite	Palæozoic	2·0	20·0	19	18·6	2·58	0·2
		Fourchite	"	2·8	14·3	–	–	–	–

63	Morrison's quarry, south of Masson st., Montreal.	Limestone	Trenton	4·0	10·0	11	16·0	2·70	0·4
		Tinguaite	Palæozoic	2·0	20·0	20	18·5	2·59	0·2
64	Fireproof Crushed Stone quarry, south of Masson st., Montreal.	"	"	2·0	20·0	21	18·6	2·58	0·2
65	Ant. David's quarry, south of Masson st., Montreal.	Tinguaite	Palæozoic	2·0	20·0	29	18·8	2·58	0·1
67	Maisonneuve Quarry Ltd., Jos. Rhéaume 2855 blvd., Rosemont, Maisonneuve.	Limestone	Trenton	5·8	6·9	6	14·8	2·70	0·3
72	La Compagnie de Construction, Durocher Ltd., Montreal East.	"	"	3·7	10·8	9	14·7	2·69	0·5
		Dyke rock	Palæozoic	2·4	16·7	28	18·0	2·94	1·6
79	J. Desjardins' quarry, Rivière des Prairies.	Limestone	Trenton	5·6	7·1	6	13·6	2·69	0·5
		Isle Bizard.							
89	J. D. Théoret's quarry.	Limestone	Chazy	3·9	10·3	6	14·4	2·69	0·4
		Isle Jesus.							
91	T. Gauthier's quarry, Ste. Dorothée.	Magnesian limestone	Beekmantown	3·3	12·1	11	15·8	2·76	1·3
94	Alp. Couvrette's quarry, Ste. Dorothée.	Limestone	Black River	3·6	11·1	16	17·4	2·73	0·4
97	Camille Laurin's farm, Ste. Dorothée	Fourchite	Palæozoic	2·0	20·0	18	18·0	2·83	0·8
99	Nap. Clermont's quarry, Abord-à-Plouffe.	Limestone	Chazy	4·2	9·5	5	13·9	2·70	0·4
100	G. Clermont's quarry, Laval Rapids	"	"	4·2	9·5	9	15·6	2·68	0·5
101	Elie Bigras' quarry, St. Martin.	"	"	4·5	8·9	6	13·5	2·70	0·4
102	A. Gauthier's quarry, St. Martin.	"	"	3·3	12·1	8	14·4	2·71	0·8
103	Damien Bigras' quarry, St. Martin.	"	"	4·3	9·3	5	13·1	2·69	0·3
104	G. Lecavalier's quarry, Côte St. Elzéar.	"	"	5·2	7·7	7	14·4	2·70	0·5
108	Village Bélanger.	"	"	5·0	8·0	6	14·3	2·69	0·5
110	St. Laurent quarry (main quarry), Cap St. Martin.	"	"	5·6	7·1	6	13·5	2·67	0·7
111	St. Laurent quarry (quarry south of road).	"	"	4·9	8·2	4	11·9	2·68	0·4
112	Isaie Desormeaux' quarries, Cap St. Martin.	"	"	5·8	6·9	4	9·6	2·67	0·7
113		"		5·1	7·8	5	13·3	2·69	0·6

The deposits are numbered on the map in the order of their occurrence in the field fr[illegible] est to east.

Table I.—Results of Tests made upon Bedrock—Concluded.

Map[1] No.	Locality and owners.	Rock species.	Age or formation.	Physical properties.					
				Per cent wear.	French coef. of wear.	Toughness.	Hardness.	Spec. grav.	Absorp. in lbs. per cu. ft.
		Isle Jesus.—concluded.							
114	L. Paquette's quarry, Cap St. Martin	Limestone	Chazy	4·2	9·5	7	14·3	2·69	0·5
116	U. Sauriol's quarry, St. Vincent de Paul	"	Trenton	3·9	10·3	7	15·3	2·70	0·1
118	North shore rivière des Prairies, St. Vincent de Paul	Camptonite	Palæozoic	2·4	16·7	14	17·2	2·89	0·8
119 and 120	Ed. Jolicœur's quarry, St. Vincent de Paul	Limestone	Trenton	4·1	9·8	6	14·2	2·70	0·2
		"	"	5·7	7·0	–	–	2·70	0·2
122	Penitentiary quarry, St. Vincent de Paul	"	Chazy	4·2	9·5	6	14·3	2·71	0·2
123	H. Archambault's quarry, St. Vincent de Paul	"	"	4·3	9·3	6	14·2	2·70	0·2
127	Gédéon Legris' farm, St. Vincent de Paul	"	Trenton	3·6	11·1	5	14·9	2·70	0·2
128		Tinguaite	Palæozoic	2·2	18·2	29	18·5	2·87	0·4
132	Félix Labelle quarry, St. François de Salles	Limestone	Trenton	4·4	9·1	6	14·6	2·70	0·4
133	Montreal Concrete Works quarry, St. François de Salles	"	"	3·6	11·1	7	14·7	2·72	0·5
134	Kennedy Construction Co. quarry, St. François de Salles	"	"	3·9	10·3	8	14·8	2·71	0·4
135	J. O. Labelle and Co. quarry, St. François de Salles	"	"	3·5	11·4	7	14·5	2·72	0·8

[1]The deposits are numbered on the map in the order of their occurrence in the field from west to east.

Appendix A.

DEPOSITS OF BEDROCK.

Island of Montreal.

No. 1. North side of isle Perrot, Potsdam formation. Outcrops of fine to coarse-grained, yellowish brown to reddish sandstones are exposed along the St. Lawrence river from the village of Isle Perrot Nord to the east end of Sherrington park. Alternate beds of fine-grained, quartzitic, and coarse-grained sandstone enclosing bands with pebbles up to ¼ inch, are exposed to a depth of 5 yards in a quarry measuring 125 yards by 100 yards. The fine-grained material, which would make a fairly durable roadstone, amounts to about one-third of the whole face. The coarse-grained sandstone has proved to be unsatisfactory where used in water-bound macadam construction.

The beds vary in thickness from 6 inches to 2 feet. Approximate strike of beds is north 50 degrees east with a dip at low angle to southeast. Main joints strike northwest, dip 90 degrees, and are crossed by another set at right angles.

Stone was formerly quarried for canal construction by the General Construction Company. The quarry is now idle. The present owners are Quinlan and Robertson of Montreal. Quarry floor is dry for greater part of summer and near enough to river shore to make transportation of product by water feasible. The amount available is great. Sample tested, see Table I.

No. 2. One mile east of Sherrington park, isle Perrot. Potsdam formation. Outcrops of thin-bedded, medium to coarse-grained, white to yellowish brown sandstone. The deposit extends on either side of the road and is mostly covered with light bush. The stone is fresher and more even than in No. 1. About 500 cubic yards were used in one section of a water-bound macadam road on isle Perrot, where the traffic is very light. The road was examined after one year of service. Though the roadbed has kept its shape, the top stone screenings did not seem to have bonded. Sample tested, see Table I.

No. 3. Ste. Anne-de-Bellevue. Beekmantown formation. Flat outcrops of dolomite and magnesian limestone are exposed east of the Senneville road on a suburban subdivision owned by A. H. Maher. The stone is fine-grained, steel bluish grey, with irregular streaks of dark, fine material and calcite crystals. Five feet of it are exposed in a quarry 50 yards by 40 yards in extent. Overburden 6 inches to 1½ feet of sandy clay. The beds dip to northwest with vertical joints running north 10 degrees to 30 degrees west and north 80 degrees east. The amount of stone available is limited. Land values are high and the ground-water level lies close under the upper surface of the stone so that quarrying would be expensive. Some of this stone was used in the construction of a section of the Senneville road (bituminous macadam) a few years ago, and more recently in the construction of a cement concrete road about one-half mile long passing through the outcrop area. In both cases the stone proved to be fairly durable. The results of laboratory tests upon this material are given in Table I.

Nos. 4 and 5. Small outcrops of stone resembling that in No. 3 occur north of the village of Ste. Anne, on the McDonald Agricultural College and McClosh farms. In both places there is an old opening from which stone has been obtained for building purposes. The amount available is apparently small and the chances for quarrying are poor.

No. 6. One and a half miles north of Ste. Anne. Beekmantown formation. About 14 feet of impure, magnesian limestone and dolomite are exposed in a quarry located on the east flank of a ridge running lengthwise on Henry Morgan's stock farm. The average character of the stone is fine-grained, bluish grey, weathering yellowish brown, with calcite crystals and thin streaks of dark material. Some of the layers also contain pockets of black cherty material. The upper 1½ feet consist of fine-grained, white sandstone overlain by 1 to 2 feet of boulder clay. The beds lie nearly flat and vary from 6 inches to 1½ feet in thickness. The stone is much jointed, partly fresh, partly weathered. About 14,000 cubic yards have been excavated, and used largely in the construction of one section of the Senneville road (bituminous macadam) and of private roads on the stock farm. Sample tested.

Nos. 7 to 10. Between Baie d'Urfé and Beaurepaire stations. Beekmantown formation. A series of small outcrops of fine-grained, bluish grey magnesian limestone and dolomite, weathered to reddish grey on the surface. The more important lies on lot 5, town of Beaconsfield, and covers an area of 150 yards by 150 yards. There is very little chance for quarrying.

No. 11. Côte Ste. Marie, lot No. 179. Beekmantown formation. Stone similar to that seen in Nos. 7 to 10, occurs in a small outcrop about three-quarters of a mile north of Ste. Marie road.

No. 12. Ste. Geneviève parish, lot No. 229. Chazy formation. About one-quarter mile south of Anse à l'Orme, small outcrop of fine to medium-grained limestone. The amount available is small.

Nos. 13 and 14. Cap à l'Orme, Ste. Geneviève parish, lots Nos. 230 and 236. Beekmantown formation. Small outcrops of fine-grained dolomite weathering to reddish grey. The extent of deposit in both cases is small.

No. 15. Town of Beaconsfield, lot No. 170. Beekmantown formation. About one-quarter mile south of Ste. Marie road, 5 feet of fine-grained, bluish grey dolomite are exposed in a small opening along the edge of a bush. The stone is thin-bedded, weathering to yellowish brown, and contains crystals of calcite. It lies nearly flat. A small quantity of it was used by farmers to repair earth roads.

No. 16. Town of Beaconsfield, lot 19. About one mile west of the station road, on the north side of the new highway. Owner: Hon. J. L. Perron, Montreal. Beekmantown formation. Dense, light bluish-grey dolomite breaking into sharp angular fragments. Beds varying from 8 to 16 inches in thickness and separated by thin layers of dark shales are exposed to a depth of 8 feet in an irregular-shaped quarry. The stone is fresh except in the upper 3 feet where it is much weathered. The overburden consists of 1 to 2 feet of dark clay. The beds strike north 65 degrees east with slight dip to southeast. The main sets of joints run north 75 degrees east and south 65 degrees east. About 3,000 cubic yards of stone has been quarried and used in the construction of bituminous macadam roads in the town of Beaconsfield since 1914. More stone can be easily obtained. The deposit forms a slight elevation extending a few hundred feet westward and northward. Samples were collected separately from the north and the south wall of the quarry; the results of laboratory tests indicate that this stone has a remarkable resistance to both abrasion and impact. It is a very durable road stone and can be considered of better quality than any of the other sedimentary rocks encountered in the district.

No. 17. Town of Beaconsfield, lot 18. Chazy formation. South of the railway an area measuring 100 yards by 30 yards where outcrops of limestone are seen. Stone weathered on the surface.

No. 18. North of the railway, lot 21. Another outcrop area of Chazy limestone, 180 yards by 28 yards in extent. Very coarse-grained limestone weathering dark grey. The deposit located in a light bush forms a ridge which reaches about 15 feet in height.

No. 19. Town of Beaconsfield, lot 25. On the Allan farm. Chazy formation. In an old quarry 36 yards by 20 yards, about 11 feet of thin-bedded stone exposed. Coarse-grained, bluish grey limestone with shaly partings. The beds dip slightly to southeast, with vertical joints running north 15 degrees east and north 75 degrees west, not very far apart. The deposit, 300 yards by 200 yards in extent, lies along the edge of a bush one-half mile from the railway. The overburden is light. Some of this stone was used for rough building stone. Rather soft road material.

No. 20. Pointe Claire parish, lot 162. Immediately south of Ste. Marie road. Chazy limestone outcrops along the edge of a ridge rising to about 25 feet. The stone resembles that in Nos. 18 and 19. Six feet of it is exposed in places. The overburden is thick.

No. 21. Village of Pointe Claire. Black River formation. Owner: Grand Trunk Railway Company. An extensive deposit of limestone occurs one-quarter mile south of the railway and three-quarters of a mile north of lake St. Louis. The limestone forms a ridge standing about 35 feet above the general level of the country and extending in an east-west direction over a distance of three-quarters of a mile. The width of the ridge ranges from 100 to 300 yards.

The central part of the ridge for a distance of 600 yards has been entirely removed, and on both sides of the road leading from the village to the station, the stone exposed in a straight cut wall, 35 feet high, consists of 10 feet of dense to fine-grained, light-coloured

limestone containing calcite crystals, overlain by 25 feet of very fine-grained, dark, splintery limestone with shaly partings. In the upper part of the wall the layers are not well-defined, but the lower beds are massive. Two main sets of vertical joints strike northeast and southeast.

At different intervals of time extensive quarrying operations have been carried on by the Grand Trunk Railway Company and large quantities of dimension stone obtained for the construction of bridge piers. A few years ago crushed stone was produced by the McLeod Construction Company of Montreal, for a filtration plant at Pointe St. Charles. The quarry is at present idle. The western part of the ridge is now occupied by a golf club, but large quantities of stone are available east of the station road. There the clean level floor of the old quarry would favour a renewal of operations. Sample tested.

No. 22. Village of Pointe Claire. Quarry owned and operated by Leon Charlebois and W. Chetagne. Black River formation. Quarry located at the southeast end of limestone ridge described in No. 21. In a 13-foot exposure the stone in the upper 9 feet consists of very fine-grained, dark, splintery limestone in irregular beds with shaly partings. The lower stone consists of dense to medium-grained, light reddish grey limestone with calcite crystals and veinlets. Approximate size of pit: 65 yards by 30 yards by 2 yards = 3,900 cubic yards. Overburden: 1 to 2 feet of sandy clay. The beds dip slightly to southeast and are cut by vertical joints trending southeast, east-west, and north 20 degrees east. Quarry drains by itself.

Crushed stone was produced in 1914 for the construction of bituminous macadam roads in the village of Pointe Claire. The equipment consists of one jaw crusher 9 by 15 and accessories. Fourteen men were formerly employed, but only seven men were engaged in operations in the summer of 1916.

The deposit is continuous to the old Grand Trunk Railway quarry to the northwest, and large quantities of stone are available by working it in that direction. To the east the ridge flattens and no outcrop is seen. This material has a smaller per cent of wear than the average for limestone, but it is brittle. Tarvia roads built with it in 1914 and maintained were in fair condition in 1917. Sample tested, see Table I.

No. 23. Pointe Claire parish, lot 32. Black River limestone. Small outcrops 300 yards north of railway and 200 yards east of St. Charles road. The stone resembles that in Nos. 21 and 22. No advantageous features for future development.

No. 24. Pointe Claire parish, lot 143. Owners: Gédéon Meloche, farmer. Black River formation. Limestone ridge standing nearly 25 feet above the general level of the surroundings and extending easterly from St. Charles road for a distance of 600 yards and over a width of from 50 to 75 yards. The top beds have been quarried to a small extent near the owners' house. They vary from 6 inches to 2½ feet in thickness. The stone is fine-grained to dense, dark coloured, with veinlets and crystals of calcite. Below this, alternate beds of dense, dark, and coarse, lighter coloured fossiliferous limestone are partly exposed over a thickness of about 15 feet. Approximate strike of beds: north 10 degrees east, dip a few degrees southeast, direction of vertical joints north 20 degrees east and east 45 degrees south. Not less than 50,000 cubic yards of stone can be obtained with facilities for quarrying. Samples of both the dense and the coarse limestone were tested.

Nos. 25 and 26. Pointe Claire parish. Black River limestone occurs on lot 126 in a small outcrop 25 yards by 10 yards, about one-half mile west of St. Jean road. On lot 119 it forms a small elevation, 200 yards by 50 yards in extent, lying one-quarter mile east of the road. In both places the beds lie flat, and the stone is weathered on the surface.

No. 27. Ste. Geneviève parish, lot 187. Owner: Adénai St. Denis. Chazy formation. Immediately west of St. Charles road, 10 feet of medium to coarse-grained, grey, fossiliferous limestone is exposed in an old quarry measuring 45 yards by 35 yards. The beds are nearly horizontal and from 6 inches to 2 feet thick. Two sets of joints trend respectively east-west and southeast. Outcrops are seen over an area of 300 yards by 200 yards, the amount available without trouble with drainage is great. This is part of an important deposit which lies on the crest of a ridge running east-west and rising to about 125 feet above rivière des Prairies, three-quarters of a mile to the north. Sample tested.

No. 28. Ste. Geneviève, lots 183 and 184. Owners: J. Lavigne and O. Laframboise. Chazy formation. Outcrops in a wood 600 yards east of St. Charles road and three-quarters of a mile south of the village. Grey, granular, medium-grained limestone with fossil remnants. The beds lie nearly flat and are moderately jointed. The top beds have been worked in several places to a depth of 6 feet for rough building stone. The deposit lies

on top of the ridge described in No. 27 and outcrops are seen over an area of 350 yards by 200 yards. Large quantities of debris and waste material are scattered through the broken-up outcrops. The amount of stone available is great, but quarrying would probably be expensive. Some of this stone has been used in the construction of a bituminous macadam road in Ste. Geneviève. The road after two years of service was in very good condition. Sample tested.

No. 29. Ste. Geneviève, lot 181. Owner: Orphyr Laniels, farmer. Chazy formation. Twenty-four feet of limestone is exposed in an old quarry, 57 yards by 46 yards, located on the slope of a ridge one-quarter mile south of the village. The character of the stone in the different layers varies from medium to very coarse-grained, highly fossiliferous, dark grey limestone, weathering reddish grey. The upper stone is thin-bedded, but the lower beds are massive. These beds are nearly horizontal, with joints running north 45 degrees east, and south 65 degrees east. The quarry has not been worked for many years but more stone can be obtained without trouble with drainage or transportation. Sample tested.

No. 30. Ste. Geneviève, lot 179. Half a mile south of village on the farm of Adélard Paiement. Chazy formation. Outcrops of limestone, resembling that in No. 29, are seen over an area of about 100 yards by 100 yards. Can be easily quarried. About 300 yards northwest of this, on lot 180 are other outcrops of same stone but with less chances for future development.

No. 31. Ste. Geneviève, lot 178. A quarter mile south of the village. Chazy limestone similar to that described in No. 29 occurs on the slope of an elevation. The exposures are small, but over an area of 300 yards by 100 yards the bedrock is apparently close to the surface.

No. 32. Ste Geneviève parish, lots 241 and 242. Black River or Trenton formation. Outcrops of very fine-grained, dark limestone resembling that of No. 24, are seen in an area measuring 300 by 20 yards and located at 300 yards west of St. Jean road. The beds dip slightly to east. The top of the outcrops is about 10 feet above the general level of the country, the overburden is light.

No. 33. A similar outcrop occurs on lot 169. The extent of the deposit is approximately 400 by 200 yards, but chances for quarrying are poor.

No. 34. Ste. Geneviève parish, lots 286, 287, 288. Black River or Trenton formation. A number of small outcrop areas lie about three-quarters of a mile west of St. Rémi road. The exposures show fine to medium-grained, dark bluish limestone with occasional calcite crystals and veinlets. The outcrops vary in size from 30 by 30 to 150 by 150 yards and lie flat. Chances for future development are small.

No. 35. Ste. Geneviève parish, lots 128, 135, and 151. Black River or Trenton formation. Several small outcrops of dark, fine-grained limestone with bands of coarser material between rivière des Prairies and Ste. Geneviève road opposite the east end of Isle Bizard. These are flat-lying outcrops.

No. 36. Black River or Trenton limestone is also exposed south of the road on lots 80 and 81 and about one-half mile east from there on lot 289 near St. Remi road. In each occurrence the outcrops are small and of no importance.

No. 37. Ste. Geneviève parish, lots 46 and 47. Trenton formation. Immediately east of the Canadian National Railways crossing at Roxboro, dark limestone of irregular texture occurs on either side of the road. The outcrops are flat and are crossed by a dyke, running northwest, 2½ feet wide, of very dark porphyritic igneous rock. The limestone exposed is fresh but the chances for quarrying are poor.

On lot 75, one-half mile north of the road, 12 feet of Trenton limestone are exposed in a cut along the Canadian National railways. The stone is thin-bedded, fine-grained, and of a dark colour. It is partly weathered in the upper layers and contains many shaly partings. Extent of deposits 100 yards by 50 yards. A few hundred yards east, on lot 62, a small hillock stands about 15 feet high, on the slope of which are exposed outcrops of breccias. These are composed of fragments of Palæozoic sediments enclosed in an igneous paste. This material is not suitable for road building.

No. 39. Cartierville, lot 73. Immediately south of the village on both sides of the highway leading to St. Laurent, Chazy limestones have been quarried for many years. The quarry on the west side of the highway is the property of H. Cousineau and is now rented to the Canadian National Railways Company. The stone has been successively worked by Joseph Lapointe, Demers and Lafranboise, and R. T. Smith and Company for dressed building stone, curbs, and crushed stone.

The quarry is 60 yards by 40 yards in size, with its working face extending to south and west. The total thickness of the exposure is 18 feet. The stone is coarse-grained, light grey, highly fossiliferous, with occasional calcite crystals and thin, irregular streaks of darker material. The beds are massive and range up to 2 feet thick. They lie nearly flat and are more jointed in the upper part of the wall than in the lower part. The main joints run west 20 degrees north.

Water-bound macadam roads built with this material in 1914, were in poor condition in 1917. The road-bed was dusty and had worn into a very uneven surface. The village streets treated with an asphaltic carpet also showed a good deal of deterioration and numerous pot-holes. It is believed that with proper maintenance and better methods of construction more satisfactory results can be obtained. Sample tested.

No. 40. Cartierville. Chazy formation. Quarries on the east side of the St. Laurent highway and to the west of the electric railway. Owners: E. Lecavalier, St Laurent, and the Corporation of Montreal. The stone has been removed to a depth of from 5 to 15 feet over an area of approximately 200 yards by 100 yards. Successively, Jos. Lagacé, Paul Chartrand, G. Clermont, and E. Bergeron were engaged in the quarrying and dressing of building stone, but all workings are at present abandoned. The stone is identical with that described in No. 39. There is an overburden of 1 to 5 feet of sandy clay. Several thousand cubic yards available without difficulty. Sample tested.

No. 41. Cartierville. East of Monkland blvd. and 1 mile south of Côtain blvd. Outcrops of fine-grained, bluish grey, Chazy limestone, quite fossiliferous, with fine dark streaks. Small opening from which stone was obtained for the surfacing of Monkland blvd. (water-bound macadam). Two narrow dykes of dark, fine-grained, igneous rock are seen cutting through the limestone. The difference in resistance to wear and toughness of these two types of rock which happened to be quarried together is well shown by the uneven wearing surface of the road.

Bordeaux. Chazy formation. Several small quarries have been worked for building stone, one on either side of the Canadian Pacific railway within one mile of the station. The more important of these are the old Perrand and Audy quarry now owned by J. Rhéaume and the Montreal Prison quarries. The first quarry is 60 yards by 25 yards by 4 yards = 6,000 cubic yards in size. The limestone is medium-grained, greyish, and differs from that of Cartierville. The beds are 2 to 3 feet thick and contain numerous undulating parting planes. Crossbedding is well shown by the unequal weathering of some of the layers. The beds dip a few degrees northwest, well-marked vertical joints run south 25 degrees east and north 65 degrees east.

The two openings worked for the construction of the Montreal prison, measure respectively 80 by 40 by 5 = 16,000 cubic yards and 70 by 50 by 5 = 17,500 cubic yards. The first is closely adjoining the quarry described above, the second lies a few hundred yards to the south. The stone is the same as in Rhéaume's quarry, but it occurs in thinner layers, some of which are much weathered, and it contains more shaly partings. More stone is to be had from either one of these quarries, but not without drainage trouble. One sample taken from Rhéaume's quarry has been tested.

No. 43. St. Laurent. Quarry of Messrs. Carrière and Deguire. Chazy formation. The quarry lies to the east of the town of St. Laurent and immediately west of the line of the Jacques Cartier-Union branch of the Grand Trunk railway. The excavation is 110 yards by 90 yards by 9 yards = 89,100 cubic yards. The stone, which for the greater part is thinly bedded, varies in texture from very fine to very coarse, with veinlets and crystals of calcite. The beds are nearly horizontal, much jointed, with many shaly partings. There is an overburden of 4 to 6 feet of boulder clay. The product is ashlar and crushed stone. The crushing plant has a capacity of 500 tons per day. It includes one No. 6 and one No. 3 Allis-Chalmers crusher with accessories. At the time of visiting, six men only were engaged in the operations. Sample tested.

South of the track lies the quarry formerly operated by Francis Dufresne and now abandoned. It is said to be 65 feet deep but is now full of water. About one-quarter mile northwest of No. 43, similar stone occurs on the property of Mr. Lamère. Six feet of it is exposed in a small opening with standing water.

No. 44. Lachine. At the north end of Summerlea avenue. Owner: Alphonse Latour. Trenton formation. In a quarry 150 yards by 30 yards in extent, 9 feet of dense, dark blue, brittle limestone. The stone is fresh but contains interbedded thin layers of soft, dark shales. It has been successively quarried for road metal by Henderson and Ladouceur,

Leclair and Archambault, contractors of Lachine, and has given fairly good results in water-bound and bituminous macadam streets. Its durability can be compared with that of "blane noir" quarried in Montreal.

At the intersection of Lasalle street and 10th avenue, and a short distance from there to the north, there are openings from which the corporation of Lachine has obtained material for foundation work. The stone differs from that described above. It is uneven in texture, thinly bedded, with numerous shaly partings. It is of poor quality.

No. 45. Villeray Quarry Company, Limited, 838 du Rosaire street, Montreal. Chazy formation. There were several quarries in St. Denis ward, but most of them have long been abandoned, chiefly because the stone had been removed to a depth beyond which profitable quarrying was impossible. Nearly all of them have been filled in and built on. East of Boyer street small openings adjoining the Villeray quarry were recently worked by jobbers and controlled by the Villeray Quarry Company, Limited, but at present only two openings are worked. Both building stone and crushed stone are produced. In the main quarry the stone exposed totals to 35 feet in thickness. The lower 8 feet consist of massive beds of coarse-grained, light grey limestone. On top of this are alternate massive beds of very fine to medium-grained, brownish grey limestone. The stone is fresh.

At about 15 feet from the surface, one layer of igneous rock, 14 inches thick, occurs nearly parallel with the bedding of the limestone. The rock called camptonite is fine-grained and of a greenish colour.

The limestone beds strike approximately east-west and dip 10 degrees south. Vertical joints, 5 to 8 feet apart, run east 15 degrees south, and north 20 degrees east. The excavation from which material is obtained for crushed stone is 55 yards by 50 yards by ten yards = 27,500 cubic yards in size, but the upper beds have been worked for dimension and cut stone over much larger areas to the north and southeast. The quarry is connected with a siding of the Montreal Tramways Company. The equipment consists of one No. 5 Gates crusher, electrically operated, and accessories. The plant has a capacity of 500 tons per day. The output for last year was 30,000 tons. Sample tested.

No. 46. North of Côte St. Michel road and west of Montée St. Michel, on the farms of L. Limoges and M. Lapierre. Chazy formation. In an irregularly shaped quarry, on the side of a slight rise from the general level of the country, limestone is worked for ashlar and cut stone by O. Martineau and Fils, Jules Petitjean, and O. Limoges. From 10 to 20 feet of stone is exposed in a working face extending for about 300 feet. The stone in the upper 5 feet is thin-bedded, dense blue, probably Trenton limestone. It is somewhat weathered. The lower stone, which looks more like Chazy, consists of massive beds of medium and coarse-grained, bluish grey, fossiliferous limestone. The beds vary from 10 inches to 3 feet in thickness and have a pronounced banded structure. The total volume of stone taken out amounts to not less than 35,000 cubic yards, and more stone can be obtained. Sample tested.

No. 47. Côte St. Michel. Quarry located east of Montée St. Michel on the farm of Z. Pesant, operated by Quinlan and Robertson Company of Montreal. Trenton formation. In an excavation 50 yards by 60 yards by 6 yards = 18,000 cubic yards, alternate beds of medium-grained, grey limestone with dark shaly partings and of thin-bedded, dense, dark blue limestone, very brittle and of an irregular structure. The stone as a rule is fresh. The beds are nearly horizontal with vertical jointings in north-south and east-west directions. Interbedded with the limestone at about 3 feet from the surface is a sheet 3 feet thick of felsparide fourchite. The rock is fine-grained, dark grey, and massive. Quarry opened in 1914 for the construction of Pie IX boulevard (bituminous macadam). Samples of both limestone and igneous rock tested.

No. 48. One-quarter mile north of Côte St. Michel road, west of Pie IX boulevard. Trenton formation. In an old quarry, 30 yards by 15 yards, nearly filled up with water, medium-grained, grey limestone is exposed with an interbedded layer, 14 inches thick, of fine-grained igneous rock similar to that described in No. 47 but more weathered.

No. 49. Half a mile north of Côte St. Michel road and one-quarter mile east of Pie IX boulevard. Trenton formation. Outcrops of medium to coarse-grained limestone are seen over an area 170 yards by 225 yards.

No. 50. One-quarter mile east of No. 49. Flat-lying outcrops of rather fine-grained, dark-coloured, dyke rock. Extent of deposit 300 yards by 60 yards.

No. 51. South of Côte St. Michel road and east of Montée St. Michel. On a suburban subdivision owned by the Ross Realty Company of Montreal. Trenton formation. Old openings now filled up with water. Interbedded, very fine-grained, dark blue and medium-grained, grey limestone. Thin-bedded stone of irregular structure, with shaly partings.

No. 52. Côte-des-Neiges. Palæozoic formation. Immediately west of Côte-des-Neiges cemetery and a few hundred yards north of Decelles street. Outcrops of coarse-grained, dark-coloured essexite. The rock will probably never be quarried here for road material but a sample was taken and tested in order to gather information on the durability of this type of rock, which forms the main body of mount Royal.

No. 53. Outremont. Corporation quarry. Palæozoic formation. The quarry is located at the foot of the slope of mount Royal at the east end of Maple Wood avenue. It was worked for many years, the nepheline-syenite obtained from it being used as road metal in the city of Montreal. The nepheline-syenite is medium-grained, grey in colour. It is intruded between the essexite of the mountain and the Trenton limestone which here underlies the plain. It cuts through both rocks, sending apophyses into the essexite of which it also holds many inclusions, and metamorphosing the blue, fossiliferous limestone into very coarse-grained, white marble. By working the cliff a 125-foot wall was developed, with 130 yards of nepheline-syenite exposed along the working face. No less than 100,000 cubic yards of stone were excavated. All workings have long been abandoned. Samples of each one of the three different types of stone occurring in this quarry were tested. It will be seen from the results of tests that uniform syenite such as occurs in the upper part of the cliff is more durable than the uneven variety of this rock near its contact with the essexite, of which it holds inclusions. The coarser-grained variety of marmorized limestone also proved to be much softer than the finer-grained one.

No. 54. Outremont. Stinson Reeb Builder Supply Company's quarry. Palæozoic formation. Disturbed and metamorphosed Trenton limestone with dykes and small stock-like intrusions of igneous rocks related to the nepheline-syenite occur about mount Royal in Outremont. In places the intrusive rocks contain fragments of the limestone through which the magma passed in its upward course. These limestone fragments have been more or less changed from their normal blue colour to white and in some cases have been recrystallized. An area within which these breccias are well developed, is situated to the south of St. Catherine road and extends from Rockland avenue through the Golf Links to Mount Royal heights.

North of Ducharme street, on west side of Rockland avenue, intrusive into the limestone is a small body of nepheline-syenite of an irregular shape which has been quarried for road metal by the Stinson Reeb Company. The outcrops at that point form a small ridge extending west. The quarried wall is 100 yards long and 15 yards high, with 15 yards of the syenite exposed. The rock is massive, fine-grained, greenish grey, and contains pyrite. It is extremely tough and breaks with sharp angular edges. The amount of available rock is problematic because of the irregular nature of the body and the difficulty of quarrying it separately from the contact limestone. Sample tested.

No. 55. Neighbourhood of Rockland avenue and Ducharme street, Outremont. Stock piles of metamorphosed Trenton limestone, breccias, and fine-grained dyke rocks (camptonite) obtained from street excavations through the area described in No. 54. This material is used by the city of Outremont for foundations or lower courses in street paving. Samples of the various types of rock were tested. The metamorphosed limestone, whether it contained igneous fragments or not when tested was much tougher than the ordinary limestone.

No. 56. Northeast flank of mount Royal, Outremont. Trenton formation. Cliffs and outcrops of fine to medium-grained, dark blue limestone, thin-bedded, much disturbed and cut by numerous dykes of igneous rock. It is not possible to quarry this stone for commercial purposes. Small quantities, however, are obtained from street cuts and used in road work by the city of Outremont. One sample taken from cut on Spring Grove avenue was tested.

No. 57. Jos. Gravel's quarry, 1551 Chambord street, Montreal. Trenton formation. The quarry lies east of Chambord street and north of Fleurimont street. It is 200 yards in length by 75 yards in width and is from 25 to 45 feet in depth. In the deepest part of the quarry at the northeast angle a bed of sandy dolomite is reached. The rock is fine-grained

and of a greenish colour. Over this lies 4 feet of dense, light buff-coloured limestone, overlain by 9 feet of thick-bedded, uneven, fine to medium-grained dark blue limestone with few shaly partings. The upper stone has been entirely removed over this property. It is quarried to the north in an adjoining quarry and will be described in No. 58.

The beds dip slightly to east and are crossed by sets of joints running north and northeast. The total output of the quarry is crushed stone. At the time of visiting fifteen men were employed and a jaw crusher operated by steam power was at work. The capacity of the plant is 120 tons per day. Samples tested.

No. 58. Montreal, Stinson Reeb Builders Supply Company, Limited, Bellechasse and Chambord streets, 903 Read building, Montreal. Trenton formation. This company operates on the northern part of Gravel's quarry, where the upper beds of the formation are quarried for crushed stone. The upper 20 feet, which have been removed over an area of about 75 by 50 yards, consist of irregular, thin-bedded, dense to medium-grained, black and grey limestone with numerous wavy, shaly partings. Interbedded with these are two layers of 14-inch and 16-inch thick, fine-grained, dark-coloured, igneous rock. Below this are 8 feet of more even, dark, fine-grained to dense limestone forming two benches from which stone is now obtained. The quarry floor in the deepest part of the quarry to the south is about 15 feet above that of Gravel's quarry. A small crushing plant can supply 100 tons per day. The stone has been tested, see Table 1.

No. 59. Martineau quarry. O. Martineau et Fils, operators, 371 Marie Anne street, Montreal. T. A. Morrison and Company, selling agents, 201 St. James street, Montreal. Trenton formation. Extensive quarries occupy the area bounded to the south by Carriere street, to the east by Marquette street, to the north by Beaubien street, and to the west by the Gravel and Stinson Reeb quarries. The stone is worked for both building stone and crushed stone purposes. The excavations on the northern part of the property are now abandoned. The thin-bedded, upper stone of the formation which here reaches nearly 35 feet, has been removed throughout nearly the entire property, but at the south end of the property large quantities of stone are available from the lower beds of the section exposed, which still underlies the quarry floor over an area of 5,000 square yards in the southwest corner of the quarry. The upper stone is thin-bedded, uneven, fine to medium-grained, black and grey limestone containing numerous shaly partings, the lower 8 to 10 feet consist of coarse-grained, highly fossiliferous, grey limestone in massive beds separated by wavy black partings (Plate I). The stone is fresh and rather uniform in texture. These beds dip about 10 degrees east, they are cut by two series of joints, the first running north 80 degrees east, and the second running east 10 degrees south from 5 to 15 feet apart. The limestone formation is crossed there by many dykes of igneous rock (maenaite) much weathered to a rusty colour.

Large quantities of good building stone have been produced. The company has a well-equipped mill where seventy stone-cutters millmen were formerly employed. The crushing plant consists of two Austin No. 6 and one Champion No. 5 crushers with accessories. Total capacity, 500 tons a day. A siding connects the quarry with the Montreal Tramway Company's lines. The greater part of the stone available has been taken out but there is stone for several years more. Samples were taken and tested, see Table 1.

No. 60. Montreal. The De Lorimier Quarry Company, 1952 Iberville street, Montreal. Trenton formation. Quarry on west side of Iberville street, a few hundred yards north of Masson street. Size of pit: 150 yards by 70 yards by 10 yards = 40,500 cubic yards. The quarries are located on the southern edge of a ridge running east-west. The working face is 38 feet high at the northern end where the summit of the ridge has been reached. The stone throughout the total thickness exposed is thin-bedded, uneven, black and grey limestone of irregular structure and strongly laminated (bastard limestone) similar to the upper stone in Nos. 57, 58, and 59. Over the entire property area the total thickness of limestone has been removed leaving a nearly level clean floor, and according to owner's information not more than 30,000 tons of limestone are available from the present working face. It is planned, however, to quarry at a lower level. The stone here dips slightly to southeast, vertical joints north 15 degrees east and east 5 degrees south. Two dykes of fine-grained, greenish igneous rocks 1 to 1½ feet wide, running north-south and east-west, are shown on north and east walls. A bed of impure sandstone is reached in the bottom of the quarry and 3 feet of it is exposed in a test pit made at the southeast corner where the pumping is done. The rock is dark greenish grey, fine-grained with feldspar crystals.

The equipment consists of two Acme crushers No. 3, electrically operated, and accessories. Fifteen men are employed. In one year 60,000 tons have been produced. Capacity of plant 200 tons per day. The crushed stone according to size is quoted at: 2 and 2½ in ½ 85 cents, 1¼ inch 90 cents, 1 inch $1, ¾ inch $1.10, ½ inch $1.25 per ton. Dust 90 cents per ton. Rubble 60 cents f.o.b. quarry. Samples of both limestone and impure sa[illegible]one were taken and tested, see Table I.

No. 61. Montreal. J. Rogers' quarry, 1701 Iberville street, Montreal. Trenton formatio[illegible] This property [illegible] situated east of Iberville street and north of Masson street. It lies opp[illegible]site the opening of the De Lormier Quarry Company. The quarry is 140 by 85 yar[illegible]s in extent and has reached a depth of 37 feet at its north end. The stone is thin-bedded, very [illegible]even in texture and structure, and contains numerous shaly partings. It includes both black and grey limestone (typical bastard limestone). These beds dip at a low angle east a few degrees south and are quite similar to those across the road, described in No. 60. Clear sets of joints 6 to 10 feet apart run north 10 degrees west and north 35 degrees east. The amount of stone available is great and the amount of stripping for several hundred feet northward and eastward would not exceed 5 to 6 feet. A small Gyratory crusher No. 6 is installed but has not been in operation for some time, all quarrying being done in the southern quarry described below. One sample of this typical limestone, known locally as "bastard stone," was tested, see Table I.

No. 62. Jas. Rogers, 1701 Iberville street, Montreal. Palæozoic formation. In a quarry measuring approximately 200 yards by 45 yards by 10 yards = 90,000 cubic yards, both Trenton limestone and tinguaite (bane rouge) are quarried for crushed stone. In the northern half of the excavation bane rouge can be seen at the top to a depth varying from 3 to 8 feet (Plate III.A). It has been removed over the area of the present opening. Beneath the bane rouge dense, black, thin-bedded limestones have been excavated to a depth of from 15 to 20 feet. To the south, the igneous sheet reaches a maximum thickness of 30 feet over a width of 125 feet and may be seen for the whole height of the 30 feet of working face at the southeast angle. The rock is massive, fine-grained, dark grey with a greenish tint, and contains scattered glittering needle-like phenocrysts. It is uniform in texture except near the contact with the limestone where it is of a darker colour and somewhat glassy. In places the rock is altered to a whitish colour. The examination of a stock pile of crushed stone to be used as concrete aggregate revealed that it contained 30 per cent of such material.

The Trenton limestone which underlies the "bane rouge" is dense black, somewhat shaly and brittle. It occurs in thin layers separated by soft, black-coloured shales. The beds of this formation dip slightly to east. They are much fractured and disturbed near the bane rouge. They are crossed by narrow dykes of the eruptive rock either parallel to or across the bedding in various directions. The mass of the igneous rock which still overlies the limestone south and east of the present working face, can be estimated to several thousand cubic yards. The plant consists of two electrically-operated Austin crushers, No. 5 and No. 3, and 1 Symons crusher No. 21. Drilling is done by the use of a well drill. The capacity of the plant is 350 tons per day. In 1913, the output was 70,000 tons. The crushed stone is valued at from 80 cents to $1.25 per ton in the quarry. Samples of limestone and of both fresh and altered "bane rouge" were taken and tested, see Table I.

No. 63. Morrison Quarry Company. O. Martineau et Fils, operators, 371 Marie Anne street. T. A. Morrison and Company, selling agents, 204 St. James street, Montreal. Palæozoic formation. This quarry is opened on the southern edge of an extensive belt of bane rouge (tinguaite) immediately south of Masson street and north of the Canadian Pacific Railway Angus shop. The bane rouge forms a distinct ridge rising above the surrounding level, and lying in a northeast direction. The excavation in the form of a trench along the southern edge of the outcrop, is 125 yards long by from 15 to 50 yards wide. Quarrying is advancing northward. A total height of from 20 to 30 feet of bane rouge is exposed. The rock is massive, fine to medium-grained, and of a greenish colour. In places near the contact with the underlying limestone, as in No. 62, where the rock is much disturbed and fractured, it is altered to a whitish colour. Taken as a whole this is a fresh stone and a first-class road material. The outcrop is 125 by 75 yards in extent and the amount available on the land leased by the company is at least 75,000 cubic yards, and probably as much as that can be had from the next property to the west. From here to about 300 yards in a northeast direction the sheet dips downward and is apparently covered with many feet of clay. It outcrops again near Masson street, Nos. 64 and 65.

The equipment includes two large steel boom derricks and cranes, bucket elevators, one No. 8 Austin crusher operated by one 75 horse-power motor, and five No. 5 Champion crushers operated by 25 horse-power motors. The plant has a capacity of 1,300 tons per day.

The igneous sheet is underlain by dense, thin-bedded, black limestone, called "bane noir." The limestone beds are much disturbed and folded; they contain many shaly partings. All of the bane rouge is quarried for crushed stone, but some of the limestone is sold as rubble. The crushed stone is quoted at 85 cents to $1.25 per ton according to size. The quarry has rail connexions with the Canadian Pacific railway and the Montreal Tramway lines. Samples of both bane rouge (tinguaite) and limestone were taken and tested, see Table I.

No. 64. Fireproof Crushed Stone Co. Company's quarry, Masson street, Montreal. Palæozoic formation. The quarry lies immediately south of Masson street. It is roughly 70 yards by 40 yards by 10 yards = 28,000 cubic yards in size. The total thickness of the sheet of tinguaite overlying the black Trenton limestone and described in No. 63, is well exposed in a straight cut wall (Plate II). The rock, except in the lower 2 feet where it is dark and glassy and somewhat porphyritic, is uniform in texture for the whole thickness ranging from 25 to 40 feet. It is a little coarser-grained than in Nos. 62 and 63 and of a lighter colour. There is none of the whitish altered rock such as seen in Nos. 63 and 64. The underlying limestone is identical with that in No. 63. It forms the quarry floor and about 8 feet of it is exposed beneath the bane rouge at the northeast angle. The amount of bane rouge to be had from here is not less than 50,000 cubic yards. A good steel derrick of 5 tons capacity and two jaw crushers having a capacity of 300 tons a day are installed. Quarry operations were suspended a few years ago. The stone was tested and results are given in Table I.

No. 65. Antoine David's quarry. Masson and Bourbonnière street, Montreal. Palæozoic formation. From 20 to 40 feet of bane rouge are quarried in a working face progressing south and west. About 30,000 cubic yards solid rock have been excavated for the producing of crushed stone, and probably several times as much is available. The rock is the same as in 64, and the underlying limestone which here also forms the quarry floor, is the hard, dense black limestone seen in Nos. 62, 63, and 64. The plant is equipped with a No. 3 Austin crusher electrically-operated and of a capacity of 100 tons per day. A gasoline well drill is used for drilling. Fifteen men are engaged. Crushed stone is sold at 85 cents to $1.25 per ton according to sizes. The results of tests on samples from here are given in Table I.

No. 66. Maisonneuve. East of Pie IX boulevard, about opposite Masson street. Owners: The Order of the Christian Brothers. Palæozoic formation. A few years ago bane rouge was quarried here by the corporation of Maisonneuve and large supplies of paving material obtained. In an excavation 100 yards square about 10 feet of bane rouge is exposed, but, on account of standing water, it was not possible to see if the underlying limestone had been reached. The rock is not as fresh as in the preceding numbers. It is much fractured and altered to a whitish colour. The outcrop extends from Pie X boulevard to about 135 yards eastward where it was quarried. At that point it forms a small ridge which ends abruptly. The outcrops have an average width of 90 yards. This is likely the southeast end of the tinguaite sheet which outcrops at intervals to the west. To the north the overburden is apparently thick. However, the rock comes up again to the surface over a small area near Rosemont boulevard.

No. 67. Maisonneuve Quarry Company Limited. Jos. Rhéaume, operator, 2855 Rosemont boulevard, Montreal. Trenton formation. The property is situated in Côte Visitation north of Rosemont boulevard and east of Pie IX boulevard. The quarry is about 200 yards by 150 yards by 8 yards = 240,000 cubic yards. Bane rouge, which overlaid the limestone to a depth of 40 feet when the quarry was opened, has been entirely cleared over the area of the present openings. It appears as a 2 to 3-foot layer intruded between the limestone beds in the upper part of the north and west walls. To the south 5 to 10 feet of it is exposed overlying the limestone. The limestone is typical of the variety called "pierre batarde." It occurs in irregular and fractured thin layers separated by numerous wavy and contorted dark shaly partings. It varies in texture and colour from dense black to medium-grained grey, and is highly fossiliferous. The beds strike north 35 degrees east with a slight dip to the south. The quarry is worked essentially for crushed stone and is provided with an extensive plant consisting of one No. 7½ Austin crusher operated by one 100 horse-power motor, one No. 5 Austin crusher, and one No. 10 Dice crusher operated by two 50 horse-power motors, one compressor (delivering 427 cubic

feet per minute at 100 pounds pressure) actuated by one 100 horse-power motor, one centrifugal pump of 2,000 gallons per minute capacity. A gasoline 6-inch hole well drill is used for boring. Tracks are laid in a radiating manner from the crushing plant to the working faces. The cars are lifted by an electric hoist and discharge automatically between the two larger crushers. A siding connects the property with the city electric railways.

The plant has a capacity of 1,200 tons per day. Large quantities of stone from here have been used in the construction of the Montreal-Quebec highway and in Maisonneuve street pavements. Rubble is valued at 60 cents per ton in the quarry, crushed stone at 85 cents to $1.25 f.o.b. quarry siding.

Results of tests upon samples from here are given in Table I.

No. 68. The Wm. Joseph Poupore Company, 464 Nicolet street, Montreal. Trenton formation. The quarry property is bounded by Forsythe, Hochelaga, and Nicolet streets. The excavation is 150 yards by 125 yards. About 6 feet of bane rouge (fourchite) has been removed over a much greater area than that of the present quarry. Beneath the bane rouge the excavation has been extended to a depth of 25 feet in thin-bedded, dense black, nodulous limestone. The beds strike northeast, and dip 7 degrees southeast. No more of the bane rouge is available, but more limestone can be obtained. However, the built-up character of the surroundings would probably prevent a renewal of operations.

No. 69. Longue Pointe. Canada Cement Company, Limited. Trenton formation. Thin-bedded, brittle, dense black limestone was quarried until three years ago north of the Canadian National Railways line. The excavation is roughly 250 yards by 200 yards by 6 yards. The beds dip to the east at an angle of 20 degrees. The quarry is on the slope of a ridge extending northward and outcrops are seen over a distance of 100 yards. The formation contains many dark shaly partings interbedded with the layers of limestone. The upper 2 feet are weathered. The quarry is crossed by a dyke of igneous rock running northwest, and a sill of the same rock measuring 150 yards by 100 yards by 1½ yards can be seen in the bottom of the excavation. More stone is to be had but much pumping will have to be done.

No. 70. Longue Pointe. St. Jean de Dieu asylum. Trenton formation. Halfway between the asylum buildings and the Canadian National Railways line 12 feet of limestone are exposed in a quarry 100 yards by 60 yards. Thin layers, 2 to 6 inches, of dense b[illegible] brittle limestone separated by partings with occasional bands of coarse, lighter [illegible] fossiliferous limestone. Wavy and irregular structure, much fractured. Upper [illegible] thered. Dip 20 degrees east.

[illegible]1. Longue Pointe. Three-quarters of a mile north of St. Jean de Dieu asylum, on the east side of road. Palæozoic formation. Flat-lying outcrops approximately 200 yards by 100 yards in extent, of massive, fine to medium-grained, greenish grey, tinguaite. The rock has been excavated to a depth of 2 to 5 feet over a small area. It is fresh and closely fractured horizontally and vertically. The amount available is problematic and depends on the thickness of the sheet. This could be determined by a test pit. The rock is tough and would probably make a good road material.

No. 72. Montreal East. Quarry owned by the municipality of Montreal East and operated by the Durocher Construction Company, Limited. Trenton formation. Rubble and crushed stone are produced from the thin layers of the dense black limestone in a quarry 90 yards by 75 yards by 6 yards = 40,500 cubic yards in size, situated east of Pointe aux Trembles crossroad. The stone is uniform throughout the total height of the quarry wall. F[illegible] in the upper 4 feet it is fresh, somewhat shaly, and breaks into sharp angular fragments with conchoidal fractures. The beds dip slightly to east. Clear vertical joints approximately 15 and 50 feet apart run north 25 degrees east and east 25 degrees south. Two 3-foot dykes, 30 feet apart, cross the formation here in a northwest direction. The dyke rock is fine-grained, dark grey with olive green, glassy minerals. It is very tough. A small crusher is at work and the product is used in municipal works by the municipality of Montreal East. Electric railway connexions. Samples of both limestone and dyke rocks were taken and tested; see results of tests in Table I.

No. 73. Town of Pointe aux Trembles. Cyrille Durocher's quarry. Trenton formation. Thin-bedded, dense black limestone resembling that in No. 27 is quarried along the edge of the ridge, one mile north of the river-road. About 10 feet of it is exposed in a quarry measuring 50 yards square.

Nos. 74-75-76. Parish of Pointe aux Trembles. Trenton formation. Small outcrop areas of thin-bedded, dense, dark limestone.

No. 77. Rivière des Prairies. Immediately west of crossroad and one-quarter mile south of river-road. Trenton formation. Several small outcrops of fine-grained, dark blue limestone on the slope of a ridge. The overburden, as a rule, is thick.

No. 78. Rivière des Prairies. Palæozoic formation. Fine to medium-grained, dark-coloured, igneous rock occurs on the river shore at a point opposite Rivière des Prairies crossroad. Outcrops are seen over an area of 150 yards by 15 yards, but the rock lies at a level which will not permit excavation.

No. 79. Rivière des Prairies. J. Desjardins' quarry. Trenton formation. Quarry located three-quarters of a mile east of the village and one-half mile south of the river. Size of pit: 80 yards by 30 yards by 4 yards = 9,600 cubic yards. Uneven to fine-grained, dark, thin-bedded, somewhat shaly limestone with bands of medium-grained, grey, fossiliferous limestone. Resembles stone in Nos. 60 and 61. This material was used in the construction of water-bound macadam roads in the parish of Rivière des Prairies. It has given satisfactory results under moderate traffic condition after two years of service. Results of tests are given in Table 1.

Nos. 80 and 81. Rivière des Prairies. Neighbourhood of the Reparation chapel. Trenton formation. Several small outcrops of thin-bedded, dense to fine-grained, dark limestone. In a few instances from 6 to 12 feet of it is exposed in old openings of small extent. The limestone contains many shaly partings, the upper part is much weathered. More stone can be obtained.

Isle Bizard.

No. 82. Isle Bizard. Near southwest end of isle Bizard, lot 150. Occurrence of Palæozoic breccia. This occurrence forms a hillock about 15 feet high with an area of 50 yards by 25 yards. The rock is composed of an igneous paste enclosing numerous fragments of sandstone, limestone, biotite granite, etc., all of which are more or less altered. The matrix is of a greenish grey colour weathering to rusty brown. This rock is soft and not suitable for road metal.

No. 83. Isle Bizard. At the northwest end of isle Bizard on the farm of Mr. Noel Wilson, and along the shore of the island, Beekmantown dolomites outcrop in a few occurrences. The stone apparently lies flat and is weathered on the surface to yellowish brown. Chances for quarrying are poor.

No. 84. Isle Bizard. Isle Bizard, lot 145. Owners: M. M. Wilson and Ladouceur. Chazy formation. Outcrops of fine-grained, thick-bedded, dark grey limestone. Surface exposures are seen over an area of about 50 yards by 40 yards, and the deposit over a much greater area is covered with only a light overburden. Some of this stone has been used by farmers to make lime.

No. 85. Isle Bizard. Northwest side of isle Bizard, lot 131. Another occurrence of Palæozoic breccia which forms a hillock 140 yards by 50 yards rising to 55 feet. The rock resembles that in No. 82. Not suitable for road purposes.

No. 86. On lot No. 125, one-half mile east of north-south road. Chazy formation. Coarse-grained, dark grey limestone outcrops at intervals on the slope of a ridge 250 yards south of road on the farm of Janvier Clement. In an old quarry 65 yards by 10 yards by 2 yards = 1,300, the following succession of beds is exposed:

	Feet.
Coarse-grained, dark grey limestone containing shells in rather massive beds....	5
Finer-grained, bluish grey limestone somewhat weathered with iron oxide present in thin layers with irregular bedding planes.....	2

The beds are nearly horizontal with many vertical jointings running north 45 degrees west and at right angles to that. The quarry has been abandoned for many years and the walls are weathered to dark brownish-grey. Shells and fossils are well shown in the weathering. Some of this stone was used for the construction of the Carillon canal. More stone can be obtained without much trouble, for local use. It resembles that of No. 47 and should be of the same quality.

No. 87. Isle Bizard. On the south shore of lake of Two Mountains, lot No. 124. Chazy formation. Owner: Mr. Roussin. Beds of Chazy limestone are exposed along the shore for a distance of a few hundred feet and in one instance form a cliff showing the following variation:

	Feet.
Medium-grained, dark grey limestone of a granular texture, with veinlets of calcite; resembles the limestone south of Ste. Geneviève.	
Thin-bedded, coarse, dark grey limestone, highly fossiliferous and somewhat weathered, like No. 47	4 to 5
Very coarse, light-coloured limestone mostly made up of fossil fragments changed into pink calcite	1½

Blocks were also obtained from these beds for the Carillon canal. As road material, it is a soft stone.

No. 88. East end of isle Bizard. Trenton formation. Very fine-grained to dense, dark blue limestone occurs at intervals at the east end of the island. The deposits form several humps on the road, but the bedrock is thickly covered on both sides. A better developed exposure is to be seen on lots 95 and 96, on the farm of Mr. Damase Boileau. The deposit forms a small ridge 150 yards by 150 yards with apparently light overburden. Bare outcrops are seen in a depression north of the ridge. The stone is fresh and brittle and occurs in rather thin beds cut by abundant jointings, running average south 75 degrees east. The amount available is doubtful, but it could be used advantageously for macadamizing the roads in this part of the island. The hauling distance to road is three-quarters of a mile.

No. 89. Isle Bizard. Lots Nos. 39, 73, and 74. Chazy formation. Coarse-grained, dark grey limestone outcrops upon the crest of a ridge about three-quarters of a mile north of village which extends east-west on both sides of the road. On west side of the road, on the farm of J. D. Théoret, there is an old quarry measuring 20 yards by 22 yards by 2 yards = 880 cubic yards. An ascending section made on the south wall is as follows:

	Feet.
Coarse-grained, dark grey limestone containing large shells and pink calcite crystals, somewhat weathered in places to reddish grey with iron oxide products present	2
Medium-grained, more uniform, dark grey limestone with tendency to become reddish grey due to the iron oxide present, in rather massive beds	5
Coarse-grained, lighter coloured limestone composed of calcite crystals. Much weathered in places and soft	1
Overburden of boulder clay	1 to 3

The beds dip slightly to northeast and there are many vertical joints with direction south 45 degrees east and north 45 degrees east. The amount of stone available from this deposit is great. The deposit forms a ridge over 500 yards in length and from 100 to 200 yards in width, over which outcrops are seen at intervals. The overburden, however, in some instances is thick. More stone can be obtained easily from the old quarry by the road. The stone has been tested, see page 19.

Isle Jesus.

No. 90. Isle Jesus. Southwest end of isle Jesus. Trenton formation. Beds of fine-grained, dark blue limestone are exposed along rivière des Prairies over a distance of one-quarter mile, opposite Dutchman rapids. There is no opportunity for quarrying.

No. 91. Ste. Dorothée. T. Gauthier's quarry. Operator, Elie Dubreuil. Beckmantown formation. About 2 miles northwest of village of Ste. Dorothée, magnesian limestones weathering to brownish are obtained in a quarry 40 yards by 20 yards by 4 yards = 3,200 yards. Lower 4 feet, uneven, fine to medium-grained, grey limestone overlain by dense, somewhat shaly, impure limestone, thin-bedded and much fractured, the upper layers being much weathered to brownish. Eight men were employed in quarrying and a portable jaw crusher operated in connexion with water-bound macadam road construction in Ste. Dorothée parish. One sample taken and tested.

Nos. 92 and 93. Ste. Dorothée parish. Beckmantown formation. Flat-lying outcrops of fine-grained, grey dolomites or magnesian limestone weathered on the surface to yellowish brown. There is some opportunity for quarrying in No. 93.

No. 94. Ste. Dorothée. Alphonse Convrette's farm. Black River formation. One mile north of the village along the edge of a bush, there is a quarry from which about 3,000 cubic yards of stone have been taken out for road metal. Limestone is exposed to a depth of 12 feet, of which the lower 4 feet are massive beds of dense blue, splintery fresh limestone. The upper stone is thin-bedded, dark, dense, shaly limestone somewhat weathered to brownish with interbedded shaly partings. Outcrops are seen over an area of 100 yards by 75 yards. The beds are nearly horizontal. Vertical joints trend north 75 degrees west and north 15 degrees to 35 degrees east. Southeast of the quarry massive beds 2 feet thick of dense blue, brittle limestone are exposed on the surface. More stone is to be had from here. The quarry is hard to get at and hauling has to be done in winter. One sample was collected and has been tested, see Table 1.

Nos. 95 and 96. Ste. Dorothée, one-half mile to one mile north and northwest of village. Pakeozoic formation. Hillocks of breccias of similar character to those on isle Bizard, Nos. 82 and 85. The rock is not suitable for road building.

No. 97. Ste. Dorothée. Camille Laurin's farm immediately east of village. Palæozoic. Important outcrops of fourchite. The rock is fine-grained and dark-coloured. It is massive, of columnar structure, and forms a sheet extending on either side of the road and covering an area of 100 yards by 100 yards. On the north side of the outcrop the rock has been quarried to a small extent for road metal. The thickness of the sheet at that point is 15 feet (Plate III B). The rock is fresh throughout and is exposed in a straight cut wall 200 feet long. It presents hardly any variation. The igneous sheet is underlain by much weathered, shaly limestone. There is a good opportunity for quarrying here. One mile of road built of this material after two years service is still firm. The rock apparently does not wear quickly and cements well. Facilities for transportation to the road which lies close to the present working face, the absence of stripping, and the high value of the rock as road material, recommend its use. The rock resembles "banc rouge" somewhat. It tested similarly, see Table 1.

One-quarter mile north of this deposit are other flat-lying outcrops of similar stone but of a porphyritic texture. Chances for quarrying are poor.

No. 98. Abord-à-Plouffe west-south road on the farm of J. Berthiaume. Chazy formation. Five feet of fine-grained, bluish grey limestone is exposed in a small opening from which stone was obtained for the construction of water-bound macadam road. More stone is obtainable but the overburden soon gets thick.

No. 99. Abord-à-Plouffe. On the farm of Nap. Clermont. Chazy formation. Coarse-grained, bluish grey, fossiliferous limestone is exposed in a quarry 80 yards by 45 yards by 3 yards = 10,800 cubic yards. The stone is fresh but rather soft. It occurs in thin layers in the upper 5 feet. Below it is more massive. This stone was used in the construction of bituminous macadam roads in the village of Abord-à-Plouffe in 1913. Potholes have formed in the road-bed. Considerable repairing was done during last summer. More stone can be obtained from the quarry, but not without 3 to 4 feet of stripping. The bottom of the quarry lies also below the ground-water level and there was 3 to 6 feet of standing water when visited. The results of laboratory tests upon this stone are given in Table 1.

No. 100. Laval rapids. Gedeon Clermont's quarry. Chazy formation. The stone here is finer-grained than in No. 99 and of a more irregular texture. It also contains many fossil shells. The exposure is small and is soon thickly covered with many feet of overburden. Enough stone was quarried here for the construction of one mile of water-bound macadam road from Laval Rapids station westward along the river. The road built in 1913 was in good condition when visited (1917). Laboratory tests have shown that this stone is tougher than that in No. 99. See Table 1.

Nos. 101, 102, and 103. One mile east of village of St. Martin. Group of quarries owned by Elie Bigras, Alma Gauthier, and Damien Bigras. Chazy formation. Medium to coarse-grained, bluish grey limestone. The beds are from 1½ to 5 feet thick with well-spaced jointing. These beds have been worked to a depth of 6 to 8 feet over several large areas. The principal product has been curb stone for the city of Montreal.

A few years ago Plouffe, Lagacé, & Company operated a quarry for crushed stone on the property of Alma Gauthier. The pit is 100 yards by 60 yards by 4 yards = 24,000 cubic yards in size, the stone exposed in the upper half of the wall being similar to that described above, and that in the lower half being thinly-bedded, very fine-grained limestone. The beds lie nearly horizontal, vertical joints running north 15 degrees east and east

10 degrees south. The stone was used in the construction of about 10 miles of water-bound macadam roads in St. Martin parish. The results of laboratory tests have shown that the fine-grained stone which occurs in Gauthier's quarry (102) wears less and is tougher than the coarse-grained stone to be found in Elie and Damien Bigras' quarries (101 and 103). The road built with this stone shows that it wears fast but evenly and cements well.

Large quantities of stone are available from either one of these properties. The results of tests are given in Table I.

No. 104. Côte St. Elzéar 1 mile west of Canadian Pacific Railway line. Owner: Godfroi Lecavalier. Chazy formation. Small quarry where road metal was obtained. Very coarse-grained, reddish to light grey, fossiliferous limestone. This stone is soft but roads built of it show that it has a high cementing power. More stone can be had but the quarry has to be drained. Stone tested, see Table I.

No. 105. North of Belle Rivière road, 2 miles south of Ste. Rose, on the farm of Honoré Joly. Palæozoic formation. Bare outcrops of fine-grained, dark-coloured igneous rock extending over an area of 180 yards by 130 yards. The rock is in places porphyritic and shows large crystals of hornblende. It is rusty weathering. This stone, known under the name of monchiquite, would make a durable road material. It is very tough and can be compared with the rock in Nos. 97 and 128. Several thousand cubic yards of it are available.

No. 106. Laval rapids. East of Canadian Pacific railway line. Small outcrop areas of medium to coarse-grained Chazy limestone.

No. 107. Pont Vian. Probably Trenton formation. Scattered, small outcrops of fine-grained, grey, fossiliferous limestone. Not much opportunity for quarrying.

No. 108. Village Bélanger. Chazy formation. Immediately east of the village on the south side of a ridge, stone has been quarried for several years for building and curb stone. In a 25-foot exposure the upper 8 feet consist of very coarse-grained, light-coloured, fossiliferous limestone; below, the stone occurs in massive beds and ranges from medium to fine-grained, dark grey in colour. The limestone contains some dark bandings and veinlets of calcite, but it is free from shaly partings. Large quantities are available with fair opportunity for quarrying. The stone has been tested. It is evidently soft, see Table I.

No. 109. South of St. Martin road, between St. Martin station and village Bélanger. A number of small outcrop areas of coarse Chazy limestone. The deposits lie flat, and the chances of development are poor on account of location.

No. 110. Cap St. Martin. The St. Laurent Quarry Company, Limited. Chazy formation. A short distance east of St. Martin Junction and extending for about a mile in that direction is an extensive ridge of limestone ending abruptly to the north. The Quebec line of the Canadian Pacific railway passes north of this escarpment, along which are situated the foregoing quarries. The St. Laurent Quarry Company operates an extensive quarry at the northeast end of the bluff east of the Ste. Rose concrete highway. The present working face of the quarry is 125 yards long and 10 yards high. Not less than 25,000 cubic yards have been excavated. To the east is another opening measuring 70 yards by 40 yards by 9 yards = 28,000 cubic yards, now abandoned. The stone is light to dark grey and medium to very coarse in texture. The beds range up to 3 feet in thickness. The entire output is crushed for concrete and road purposes.

The stone exposed in the lower part of the face is thin-bedded, very fine-grained, greenish grey limestone of a sugary texture. Alternate massive and thin beds of medium to very coarse-grained, light grey, fossiliferous limestone occur in the remaining part of the wall. Most of the stone shows distinct wavy banding in dark lines. Some of the layers contain considerable secondary calcite crystals. The beds strike north 50 degrees east with a slight dip to southeast; vertical joints run north 50 degrees east and north 40 degrees west. The plant consists of one Austin No. 5 crusher and three Austin No. 3 crushers, with a capacity of 700 to 800 tons per day. Steam power is used. The product is directly loaded into cars on a siding from the Canadian Pacific railway. From 50 to 60 men were formerly engaged in the operations, but during last summer only 10 men were employed.

Crushed stone is sold at from 80 cents to $1 per ton f.o.b. siding. Stone from here was used in the construction of a large part of the Montreal-Quebec highway between Montreal and Three Rivers, in Sault-au-Recollet and Ste. Rose concrete roads, and in bitulithic pavement in Lachine. The stone was tested, see Table I.

No. 111. Immediately south of the St. Laurent quarry described above, there are some five or six small quarries which formerly produced curb and dressed building stone. The company owns a strip of land here from which a certain amount of debris is hauled to the crusher across the road. The upper beds of the formation, which have been worked to a depth of from 6 to 20 feet, show well-marked crossbedding. The limestone is medium-grained, dark grey. One sample was taken and tested.

No. 112. Cap St. Martin. Isaie Desormeaux' quarry. Chazy formation. This quarry lies to the southwest of the St. Laurent quarry. In a 12-foot wall are exposed alternate massive beds, of very coarse-grained, light grey, highly fossiliferous and dark grey, fine-grained limestone. Fine cut stone was formerly made, but all workings have been suspended. Stone tested, see Table I.

No. 113. On the west side of the main highway. Owner: I. Desormeaux. Quarry has been abandoned for many years. The old working face extends along the north side of the ridge over a distance of 250 yards, and is 20 feet high. The limestone varies from very fine-grained, brownish grey to very coarse, dark grey. It is highly fossiliferous and occurs generally in thick beds showing a strongly developed lamination. The amount of stone to be had from here is great. Stone tested.

No. 114. Cap St. Martin. L. Paquette's quarry. Chazy formation. This quarry lies to the west of the above. It is opened in the same stone that has already been described for Desormeaux' quarry, but to a lower level. The upper layers have been worked for building stone to a depth of 10 feet over an area of 50 yards by 50 yards. Below this are massive beds of harder limestone ranging from medium to very coarse-grained. Nearly all of these beds contain numerous streaks of fine, dark material, but it is more durable material than the upper stone. This difference in durability is shown by the results of tests upon samples that were taken, see Table I.

No. 115. St. Elzéar de Laval. Chazy formation. Several outcrop areas of small extent. Fine to medium-grained, grey limestone weathered on the surface to reddish grey.

No. 116. St. Vincent de Paul. Ulric Sauriol's quarry. Trenton formation. Quarry opened in the face of the bluff overlooking the river 2 miles west of the village. The bluff is about 100 feet high at that point. The upper stone is fine-grained, shaly, thin-bedded, dark limestone containing many fossil remnants. About 9 feet of it have been quarried but the total thickness reaches nearly 50 feet. Below this are massive beds of even, medium-grained, dark grey limestone exposed on the working face to a depth of 12 feet. Below this to the level of the water are thin layers of brittle, dense, dark blue limestone. The total output was made into fine cut stone. More stone can be obtained, but the quarrying would probably be expensive. A small jaw crusher is installed in view of producing crushed stone from the debris for the resurfacing of water-bound macadam roads along the river. Results of tests upon samples taken here are given in Table I.

No. 117. South of the Canadian Pacific Railway line 2 miles west of St. Vincent de Paul. Trenton limestone has been extensively quarried for building stone and crushed stone. Besides several small openings made by individual operators, there are the abandoned quarries of the Standard Quarry Company, Limited, and of Nap. Brunet, Montreal. The stone varies from fine to medium-grained with argillaceous layers disposed irregularly in the beds. In the upper half of a 25-foot exposure the limestone is rather thin-bedded. The lower stone occurs in massive beds up to 4 feet thick. Large quantities of stone are available from the deposit. Its value as road metal can be compared with that of No. 119.

No. 118. St. Vincent de Paul. Palæozoic. North shore of rivière des Prairies. One and a quarter miles upstream from the ferry in the lower part of a cliff about 100 feet high, four igneous beds (camptonite) are intercalated in the limestone, just at the contact of the Black River and Trenton. The thickest of these beds is 32 inches and is exposed in the form of a platform covering an area of 60 yards by 75 yards just below the highwater mark (Plate IV A). The rock is massive, fine to medium-grained, and dark-coloured, weathering rusty. Because of its location the rock could not be quarried except during low water, and would have to be loaded directly into scows. Laboratory tests have shown that it would make a durable road metal.

Nos. 119 and 120. St. Vincent de Paul. E. Jolicœur's quarry. Trenton formation. Immediately northwest of the village of St. Vincent de Paul are two old openings adjoining each other. In the western pit is exposed 5 feet of medium-grained, dark grey, fossiliferous limestone overlain by 5 feet of thin-bedded, shaly, very uneven, dark limestone. In the eastern opening the stone is mostly all thin-bedded, very uneven, and contains numerous black shaly partings. The beds strike north 20 degrees east, slight dip east 20 degrees south. Vertical jointing is not continuous through the layers and not well defined. The upper stone is much fractured. More stone can be obtained without difficulty from both excavations. Samples of both varieties were taken and tested. The thin-bedded shaly limestone (120) proved to be of inferior quality. See Table I.

No. 121. Immediately south of the Canadian Pacific Railway line and one mile west of St. Vincent de Paul station. Laurin and Leitch, Engineering and Contracting Company, are erecting a large crushing plant in which electricity will largely be used for hauling and for operating the various labour-saving appliances. The capacity of the plant is to be 8,000 cubic yards a day. A 210-foot high steel-framed building, with concrete bins of a capacity of 12,000 cubic yards, mounted on concrete piers, is now under completion. The company holds two farms. The overburden is light and at frequent intervals outcrops are seen. The Trenton limestone here resembles that described in Nos. 117, 119, and 120.

No. 122. St. Vincent de Paul. Quebec provincial penitentiary quarry. Chazy formation. The quarry lies about 1½ miles southwest of the penitentiary buildings to which it is connected with rails. About 10 feet of limestone is exposed in an excavation 100 yards by 50 yards. The stone in the lower 5 feet is thick-bedded, coarse-grained, light grey, highly fossiliferous. The upper stone is finer-grained and much darker. It contains a good deal of dark lamination. The overburden ranges from 4 to 6 feet of clay. The stone is used for private purposes in and about the penitentiary. One sample taken and tested.

No. 123. About three-quarters of a mile west of No. 122 on St. Elzéar road. A small quarry 100 yards by 65 yards by 3 yards =19,500 cubic yards, formerly owned and operated by Roger Brenerge. It now belongs to Mrs. H. Archambault. The stone is identical with that in No. 122. It was largely used in the construction of water-bound macadam roads in St. Vincent de Paul parish. This stone is apparently a soft road material but wears uniformly and binds well. Roads built with it in 1913 and 1914 were in fairly good condition at the end of last summer. This stone tested very uniformly with that of No. 122. See Table I.

No. 124. North of St. Elzéar road. Chazy formation. Outcrops of coarse-grained, grey limestone extending over large areas.

No. 125. On either side of Montée Auclair, north of St. Elzéar road, are several occurrences of Chazy limestone resembling that in Nos. 122 and 123. It has been quarried to a small extent on the property of Louis Auclair for road purposes. Farther north near Côte des Perron road, outcrops of dense, dark blue, probably Trenton limestone.

No. 126. Côte des Perron. Trenton formation. Several outcrops of interbedded, medium-grained, dark grey and dense dark blue limestone. There is an old opening by the road about one mile west of Montée Auclair, which could be quarried for local road construction without difficulty. The value of this material can be compared with that of No. 127.

No. 127. Two miles north of St. Vincent de Paul on the Terrebonne road. Trenton limestone outcrops on the farm of G. Legris over an area of 800 yards by 400 yards. The upper stone is medium-grained, dark grey, somewhat weathered and soft. It is underlain by dense to fine-grained, dark blue, brittle limestone, a few feet of which is exposed in a small opening a few feet below the top of the outcrops immediately south. The beds strike north 60 degrees east and dip a few degrees southeast. Could be developed. One sample of the fresh, blue limestone was taken and tested.

No. 128. An important outcrop of tinguaite lies in the form of a sill on the northern edge of outcrop No. 127. The rock is exposed over an area of 350 yards by 75 yards and forms a ridge rising from the road to about 35 feet west of it. The ridge ends abruptly to the north and a total thickness of 10 feet is exposed. At the foot of the escarpment the underlying limestone is exposed. The rock is fine-grained, dark-coloured, with occasional phenocrysts of light-coloured, glassy mineral. Very little variation is noticeable.

It is massive and extremely tough. It has apparently the same dip north 60 degrees east as the overlying limestone described in No. 127. The stone could be easily quarried starting operations from the northwest end where the total thickness of the sheet is exposed in a straight cut wall. At least 80,000 cubic yards are available. Laboratory tests upon samples of this rock have shown that it would make a first-class road material. The deposit lies one-half mile west of the Canadian Pacific railway and 2 miles north of St. Vincent de Paul.

No. 129. Two and a half miles north of St. Vincent de Paul. Several small outcrop areas of Trenton limestone resembling that in No. 127.

No. 130. Three miles north of St. Vincent de Paul on the Terrebonne road are several old quarries now idle. The most southern quarry on the east side of the road is that of O. Lapierre. A short distance northeast of this, to the north of the road, is that of Charbonneau Frères. This quarry produced dressed stone for several years. The stone is fine to medium-grained, dark grey Trenton limestone with irregular, clayey partings weathering to yellowish. The beds range from 1 to 2½ feet in thickness. Large quantities of stone are available without trouble. The outcrops have been broken over a large area and many thousands of cubic yards of stone can be obtained from piles of debris. The probable value of this stone as road metal is comparable with that of No. 132.

No. 131. Ridge of Trenton limestone running northeast about 1 mile west of the Terrebonne road. The overburden is thin and outcrops of fine to medium-grained, dark grey limestone are seen over large areas. Could be easily quarried. Many hundred thousands cubic yards available.

No. 132. St. Francois de Salles. Felix Labelle Quarry Company. Trenton formation. The quarry lies on the southeast side of the Terrebonne road at the northeast end of an extensive ridge of limestone which has been largely quarried for many years. In an irregular working face about 300 feet long, extending in a southerly direction, about 30 feet of limestone are exposed in two benches, the upper being a short distance in advance of the lower. The stone varies somewhat in character, but the average run of the quarry is medium to fine-grained, dark grey limestone with numerous fine, black, wavy, argillaceous lines from one-quarter to one inch apart. The stone is thick-bedded and particularly adaptable for heavy construction (Plate IV B). It lies nearly flat with rectangular widely spaced jointing running north-south and east-west. Blocks 4 to 5 feet thick and almost 20 feet square can be obtained. Large quantities of heavy stone were obtained for bridge and canal work, and more recently dressed building stone, rubble, and crushed stone were produced. The quarry is equipped with a complete stationary crushing plant of a capacity of about 500 tons per day, and is connected to the Canadian Pacific Railway line by a siding. It is now idle. Although most of the more advantageous material has been removed, large quantities of crushed stone are available. The results of laboratory tests upon samples of this limestone are given in Table I.

Nos. 133 and 134. St. Francois de Salles. Montreal Concrete Works Company, Limited, and The Kennedy Construction Company, Limited, of Montreal. Trenton formation. These two companies operate quarries adjoining the old Louis Labelle and Terrebonne Quarry Company's quarries, now abandoned. The working faces extend along the escarpment over a distance of 250 yards. The beds are exposed here to an average depth of 25 feet. The stone does not differ from that of No. 132 with the exception that it is a little finer-grained and contains less clayey lamination. Both companies are equipped to produce crushed stone and can supply from 350 to 400 tons a day. A siding connects the plants with the Canadian Pacific Railway Montreal-Quebec branch. Very large quantities of stone have been obtained here, particularly for purposes of heavy construction. The amount to be had is still great. Samples taken from both quarries have tested very similarly, see Table I.

No. 135. St. Francois de Salles. J. O. Labelle and Company. Operations were started two years ago. Half a mile southeast of No. 132 and immediately east of the Canadian Pacific Railway line. About 15 feet of limestone is exposed in an excavation 115 yards by 75 yards. The stone is thick-bedded, fine to medium-grained, bluish grey with streaks of dark fine material. It is fresh, of a closer texture, and more jointed than the stone in No. 132. The plant consists of one Austin crusher No. 5 and accessories. The total output is crushed stone. It is sold at 65 cents per ton f.o.b. Canadian Pacific Railway siding.

No. 136. Village of St. Francois de Salles. Trenton formation. To the west of the village, along riviere des Milles Iles outcrops occur of dense, dark blue, thinly-bedded and brittle limestone, with shaly partings. It was worked to a small extent for road metal 1 mile west of the Terrebonne road.

No. 137. Caughnawaga. Chazy formation. To the southwest of the village, thick-bedded, coarse-grained, bluish grey, fossiliferous limestone, resembling that of Ste. Geneviève, has been largely quarried in the past for bridge piers. The deposit forms an extensive ridge running south, and large quantities of stone are available, but not without from 2 to 5 feet of stripping. A few years ago, crushed stone was produced by the Bishop Construction Company, of Montreal. The crushing plant was installed on the wharf near the ferry and the product loaded directly into scows. There are several small openings which have been worked by the Indians of the reserve, but the most important is that of the Bishop Construction Company. It lies by the road one mile inland. All of these quarries are now idle

Appendix B.

Character of Deposits of Field Stone.

Island of Montreal.

Map No	Location	Average of whole deposit											Remarks
		Material over 1 foot. Per cent of				Material under 1 foot. Per cent of				Cubic yards of stone, diameter			
		Igneous	Sandstone	Dolomite	Limestone	Igneous	Sandstone	Dolomite	Limestone	Over 1 ft.	Under 1 ft.	Total	
1	East of Senneville, lots 4 to 10.	80	5	15	0	10	15	75	0	1,894	8,017	9,911	Dolomite is fine-grained, bluish grey, somewhat weathered to brownish colour on the surface. Igneous rocks are chiefly granite-gneisses and anorthosites
2	Côte Ste. Marie, lots 39 to 48	80	0	20	0	10	0	90	0	181	3,635	3,816	
3	Côte Ste. Marie, lots 50 to 62	53	0	47	0	5	0	95	0	708	5,520	6,228	
4	Three miles west of Ste. Geneviève, lots 220 to 229	55	24	31	12	16	10	53	21	1,051	2,744	3,795	Dolomite and sandstone are much weathered. Limestone is coarse-grained.
5													
6	Cap à l'Orme, lots 230-237.	35	40	25	0	10	16	66	8	1,259	9,289	10,548	Dense, light grey, partly weathered dolomite
7	Two miles west of Ste. Geneviève.	40	5	5	50	25	0	5	70	2,723	10,508	13,231	Coarse-grained, highly fossiliferous, grey Clazy limestone partly weathered on the surface to dark colour.
8	Ste. Geneviève, west of St. Charles rd.	10	0	0	90	4	0	1	95	5,987	24,132	30,119	
9	Ste. Geneviève, east of St. Charles rd.	15	0	0	85	7	0	0	93	9,954	24,534	43,488	
10	East of Baie d'Urfé sta.	57	0	43	0	10	0	90	0	172	1,601	1,773	Fine-grained, bluish grey dolomite, partly fresh, partly weathered
11	West and south of Beaurepaire sta.	40	0	60	0	0	0	100	0	197	687	884	
12	West and north of Beaurepaire sta.	35	0	65	0	5	0	95	0	542	4,459	4,901	
13	Southwest of Beaconsfield sta.	84	8	0	9	48	7	0	45	528	1,997	2,525	Igneous rocks are chiefly granite-gneisses. Limestone includes both fine-grained Black River and coarse-grained Clazy limestone
14	Northwest of Beaconsfield sta.	40	0	0	60	22	2	0	76	4,762	8,266	13,028	
15	One and a half miles north of Beaconsfield, east of St. Charles rd.	22	0	0	78	16	0	0	84	1,171	1,784	2,955	Dense, dark limestone, fresh

16–19	West side of St. Jean rd.	15	0	0	85	5	0	0	95	3,710	7,876	11,586	About 75 per cent of the limestone is fine-grained, dark Trenton.
20–21	East side of St. Jean rd.	25	0	0	75	10	0	0	90	5,482	19,462	24,994	
22	West of St. Rémi rd. 2 miles north of Valois.	85	0	0	15	55	0	0	45	288	160	448	Fine and coarse-grained limestone in about equal amount
23	West of St. Rémi rd. and south of Ste. Geneviève rd.	25	0	0	75	15	0	0	85	4,622	27,016	31,638	Fine and coarse-grained limestone in about equal amount
24	East side of St. Rémi rd.	75	0	0	25	25	0	0	75	1,473	2,652	4,125	Coarse-grained limestone predominates. Igneous rocks are composed of coarse granites, granite-gneisses, and garnet gneisses.
25	East side of St. Rémi rd.	87	0	0	13	53	0	0	47	2,349	2,604	4,953	
26	Saraguayville, south of Ste. Geneviève rd. and east of St. Rémi rd.	60	0	0	40	12	0	0	88	1,518	3,497	5,015	
27	Saraguayville, north of Ste. Geneviève rd.	25	0	0	75	15	0	0	85	7,926	38,558	46,484	Dark, fine-grained Trenton limestone
28	Two miles east of Saraguayville.	90	0	0	10	67	0	0	33	3,617	1,758	5,375	Banded gneisses and basic dyke rocks
29	St. Louis rd. 2½ miles southwest of Cartierville.	65	0	0	35	15	0	0	55	878	7,054	7,932	Limestone is weathered. Igneous, of same character as above
30	St. Louis rd. 1½ miles southwest of Cartierville.	30	0	0	70	18	0	0	82	280	1,934	2,214	Coarse-grained, grey Chazy limestone. Banded gneisses and light coloured anorthosites
31	Immediately south and southwest of Cartierville	35	0	0	65	25	0	0	75	1,975	7,998	9,973	
32	Côte St. Michel. West of Montée St. Michel	57	0	0	43	50	0	0	50	855	8,000	8,855	Limestone is generally coarse-grained. Igneous, includes granite-gneisses and dark basic dyke rocks.
33	North of Côte St. Michel road	48	0	0	52	35	0	0	65	1,224	10,624	11,848	
34	Sault-au-Récollet, east of Montée St. Michel.	65	0	0	35	35	0	0	45	215	340	555	
35	Bas du Sault, south of road	70	0	0	30	65	0	0	35	95	606	701	
										7,927	224,746	282,673	Total acreage for the island of Montreal

Isle Bizard

36	Southwest of village, lots 28-32	78	0	0	22	55	0	0	45	306	1,849	2,155	Igneous includes granite-gneisses, anorthosites, and some fine-grained dyke rocks. Limestone is coarse-grained.
37	Southwest of village, lots 15-25.	70	5	7	18	40	5	25	40	708	3,238	3,946	
38	Northwest end of island	80	10	6	4	50	10	21	19	1,710	6,200	7,910	Dolomite is fresh, especially No. 38

Character of Deposits of Field Stone—Concluded.

Isle Bizard—Concluded

Map No	Location	Average of whole deposit. Material over 1 foot. Per cent of				Material under 1 foot. Per cent of				Cubic yards of stone, diameter			Remarks
		Igneous	Sandstone	Dolomite	Limestone	Igneous	Sandstone	Dolomite	Limestone	Over 1 ft.	Under 1 ft.	Total	
39	Northwest of village, lots 9–39, 129–150	40	0	8	52	25	0	10	65	13,545	75,242	88,787	
40 and 41	East of village	50	0	0	50	30	0	0	70	3,753	16,561	20,314	Limestone is fine to coarse-grained. Igneous rocks are gneisses.
42 and 44	Northern part of island	30	0	0	70	25	0	0	75	2,377	12,115	14,492	Coarse-grained limestone. Igneous breccias are found in No. 44.
43	Northeast end of island	66	0	0	34	51	0	7	42	196	2,144	2,340	
										22,595	117,349	139,944	Total yardage in isle Bizard.

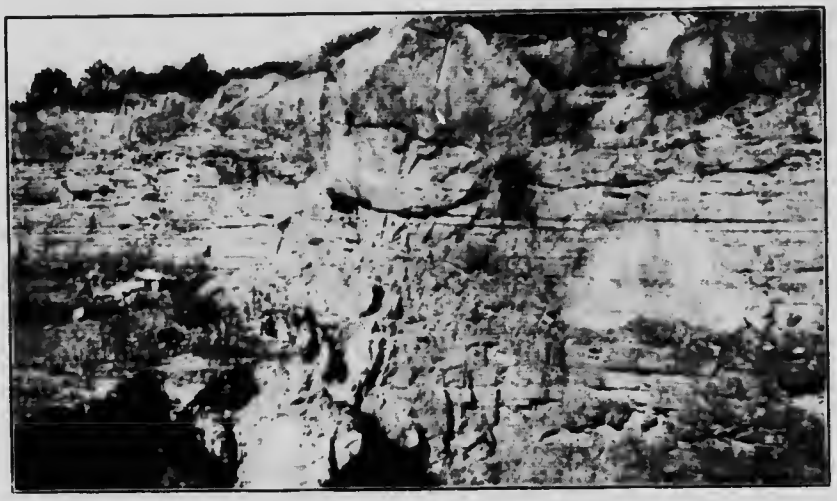
Isle Jesus.

45	Southwest end of island	39	0	48	13	30	0	52	18	418	3,302	3,720	Much of the limestone and dolomite is weathered.
46	Two miles northwest of Ste. Dorothée	8	0	89	3	8	0	89	3	186	663	849	Dolomite is fresh.
47–48	West end of island, north shore	30	0	30	40	25	0	30	45	462	1,908	2,370	Fine-grained, light coloured, fresh dolomite. The limestone is weathered.
49–51	2 to 4 miles west of Ste. Rose	10	0	85	5	10	0	85	5	1,078	4,462	5,540	
52	South of No. 49	47	0	13	40	33	0	23	44	266	1,138	1,404	
53–54	North and south of village of Ste Dorothée	93	0	0	7	78	0	4	18	1,066	3,153	4,219	Igneous rocks are foliated gneisses and some fine-grained basic dyke rocks of dark colour.

55	Southeast of Ste. Dorothée.	60	0	10	30	35	0	20	45	6,076	30,068	36,144	Limestone includes both fine and coarse-grained types.
56 and 58	Abord-à-Plouffe.	25	0	0	75	20	0	0	80	9,376	20,072	29,448	Limestone is coarse-grained and much weathered in places.
57	Abord-à-Plouffe-West, south of road.	74	0	2	24	56	0	3	41	4,729	13,132	17,861	
59–61	1 to 1½ miles east of St. Martin.	15	0	0	85	10	0	0	90	920	3,761	4,681	
62–63	South of Côte St. Elzéar road.	45	0	0	55	40	0	0	60	499	3,469	3,968	Coarse-grained limestone, granite, granite-gneisses, and anorthosites.
64–66	North of Côte St. Elzéar road.	95	0	0	5	85	0	0	15	320	719	1,039	
67	Two miles south of Ste. Rose.	70	0	5	25	60	0	5	35	1,562	2,888	4,450	Igneous, includes a large proportion of dark volcanic rocks. Limestone is rather fine-grained.
68–69	St. Elzéar de Laval.	50	0	0	50	50	0	0	50	952	2,487	3,439	Medium-grained, bluish grey limestone, partly fresh, partly weathered. Igneous rocks are composed of granite, hornblende, and garnet-gneisses more or less weathered.
70	East of St. Martin sta.	32	0	0	68	23	0	0	77	380	2,493	2,873	
71	Laval rapids.	65	0	0	35	60	0	0	40	534	2,128	2,662	
72	Pont Viau.	55	0	0	45	45	0	0	55	222	1,854	2,076	
73	Southwest of St. Vincent de Paul	35	0	0	65	30	0	0	70	3,633	11,128	14,761	
74	2½ miles northwest of St. Vincent de Paul	65	0	0	35	30	0	0	70	2,973	8,658	11,631	
										35,652	117,483	153,135	Total yardage in isle Jesus.

PLATE II.

East wall in the Fireproof Crushed Stone Company quarry, south of Masson street, Montreal. Straight cut wall showing thickness of the tinguaite sheet overlying Trenton limestone (Map 1747, No. 64). (Page 6.)



A. J. Rogers' quarry. Northeastern part of excavation. Banc rouge can be seen overlying limestone. In other parts of the excavation the banc rouge is 30 feet thick (Map 1747, No. 62). (Page 6.)

B. Sheet of fourchite, 15 feet thick, east of Ste. Dorothée. The underlying limestone can be seen in the foreground (Map 1747, No. 97). (Page 6.)

A. Nor[t]. ...e of rivière des Prairies, 1½ miles above St. Vincent de Paul. Bed of camptonite ... ...as resisted erosion (Map 1747, No. 118). (Page 36.)

B. Felix Labelle quarry, St. François de Salles. Shows thick-bedded Trenton limestone quarried for dimension stone (Map 1747, No. 132). (Page 5.)

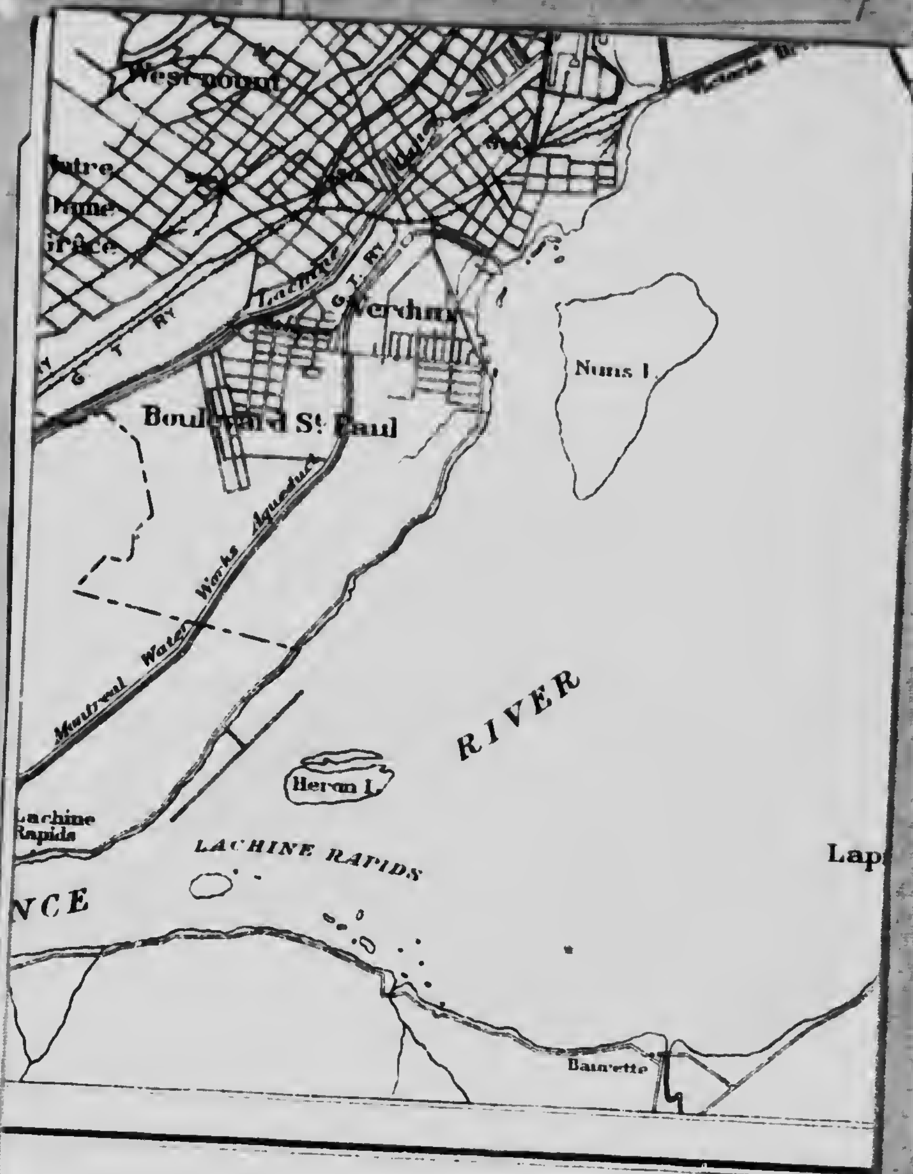
INDEX.

A.

B.

C.

D.


Westmount
Verdun
Boulevard St Paul
Nuns I.
Montreal Water Works Aqueduct
RIVER
Heron I.
Lachine Rapids
LACHINE RAPIDS
NCE
Lap

LEGEND

32

Areas containing many outcrops of bedrock
(Index figures referred to in Appendix A)

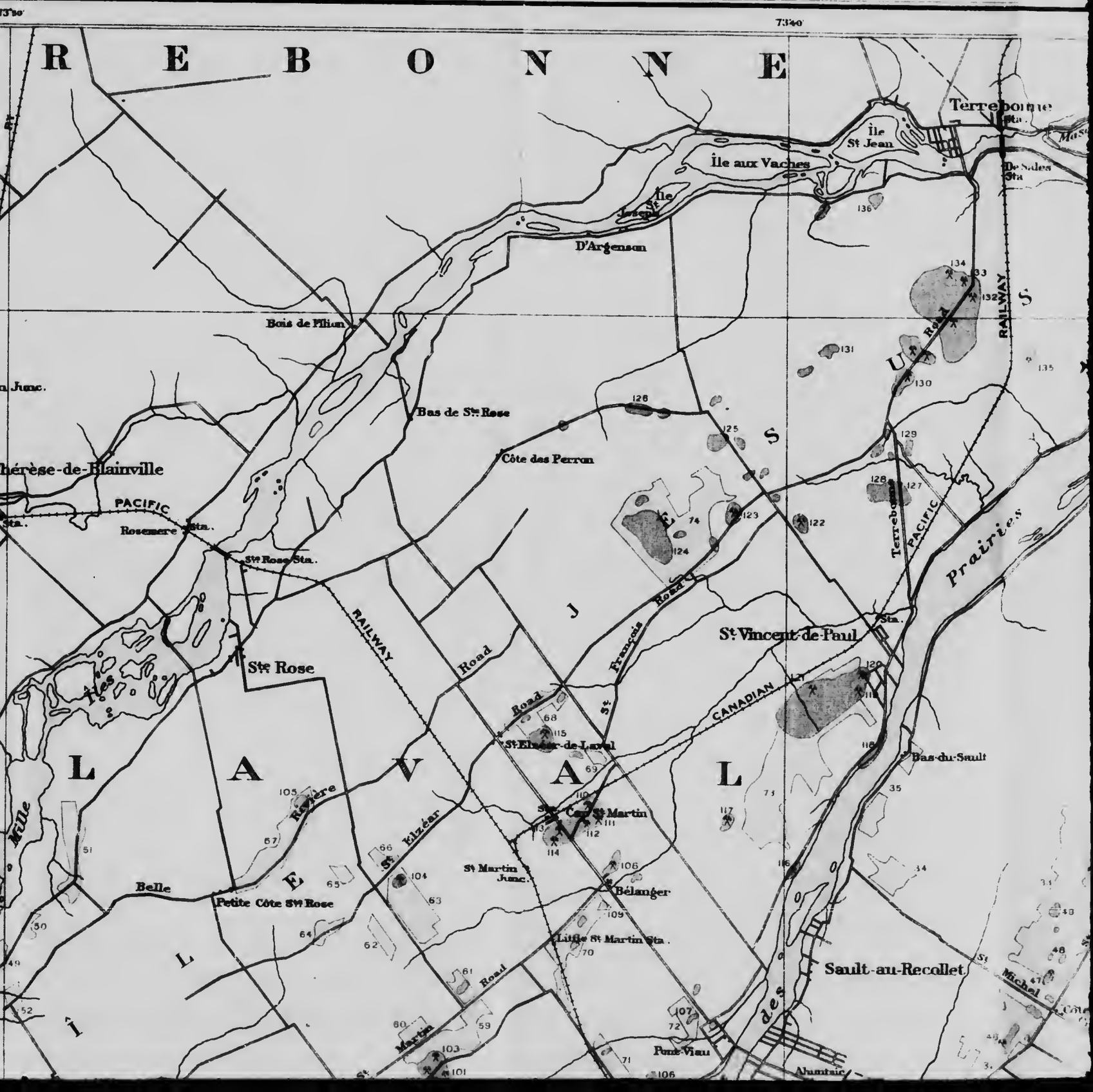
Canada
Department of Mines

HON. MARTIN BURRELL, MINISTER; R.G. McCONNELL, DEPUTY MINISTER

GEOLOGICAL SURVEY

WILLIAM McINNES, DIRECTING GEOLOGIST

Issued 1919



Canada

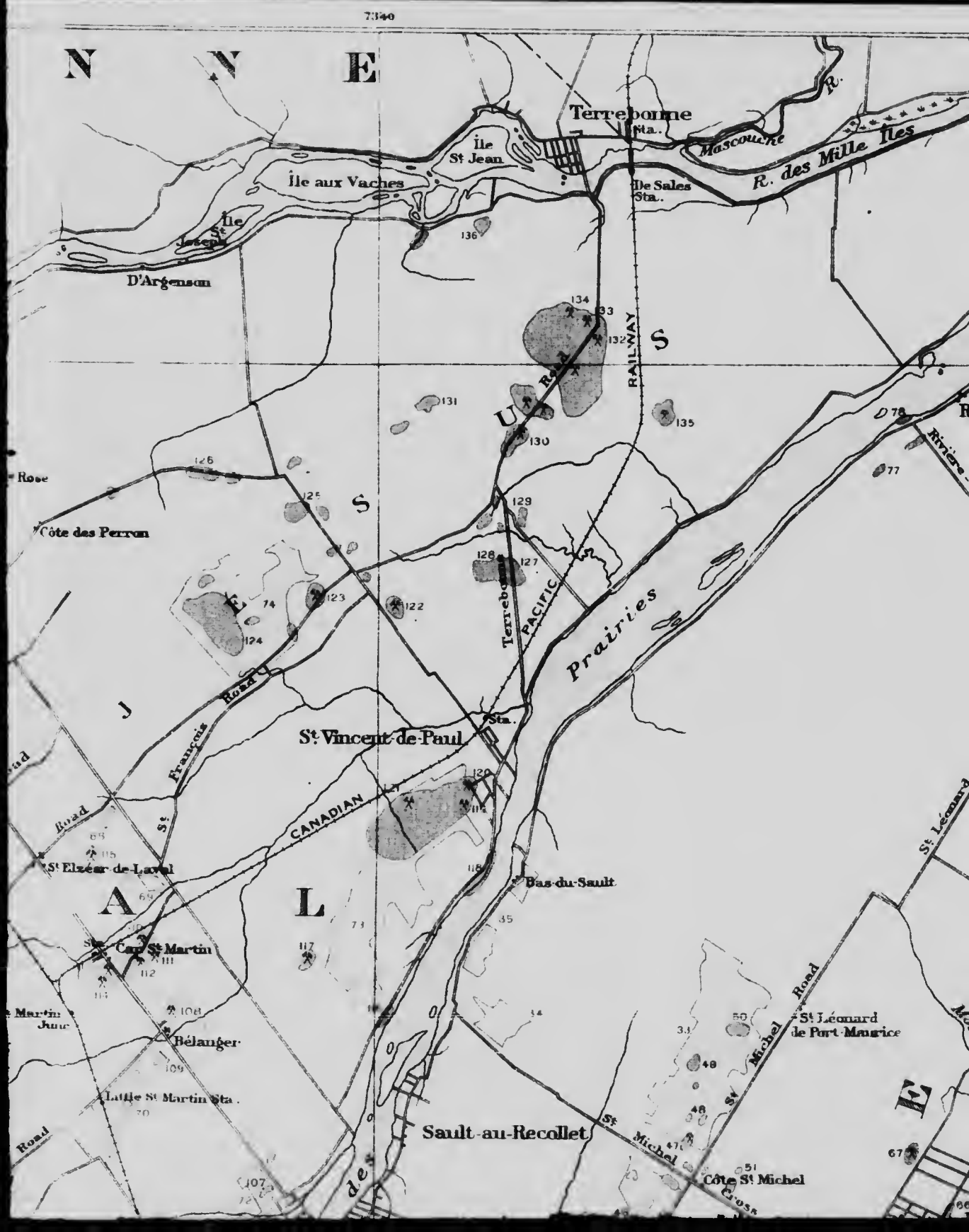
Department of Mines

[illegible] MINISTER — [illegible] DEPUTY MINISTER

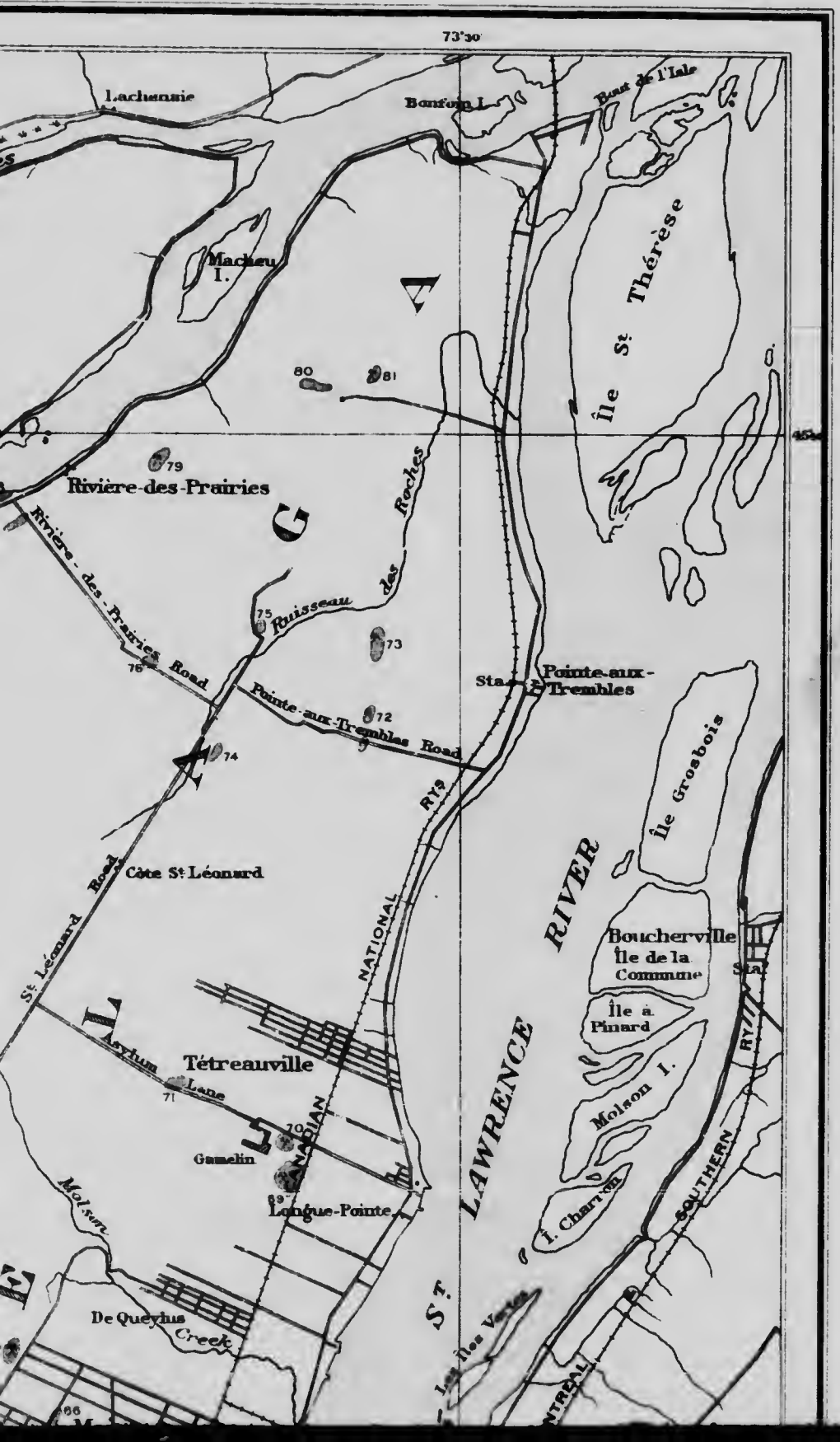
GEOLOGICAL SURVEY

[illegible] DIRECTOR

Issued 1919



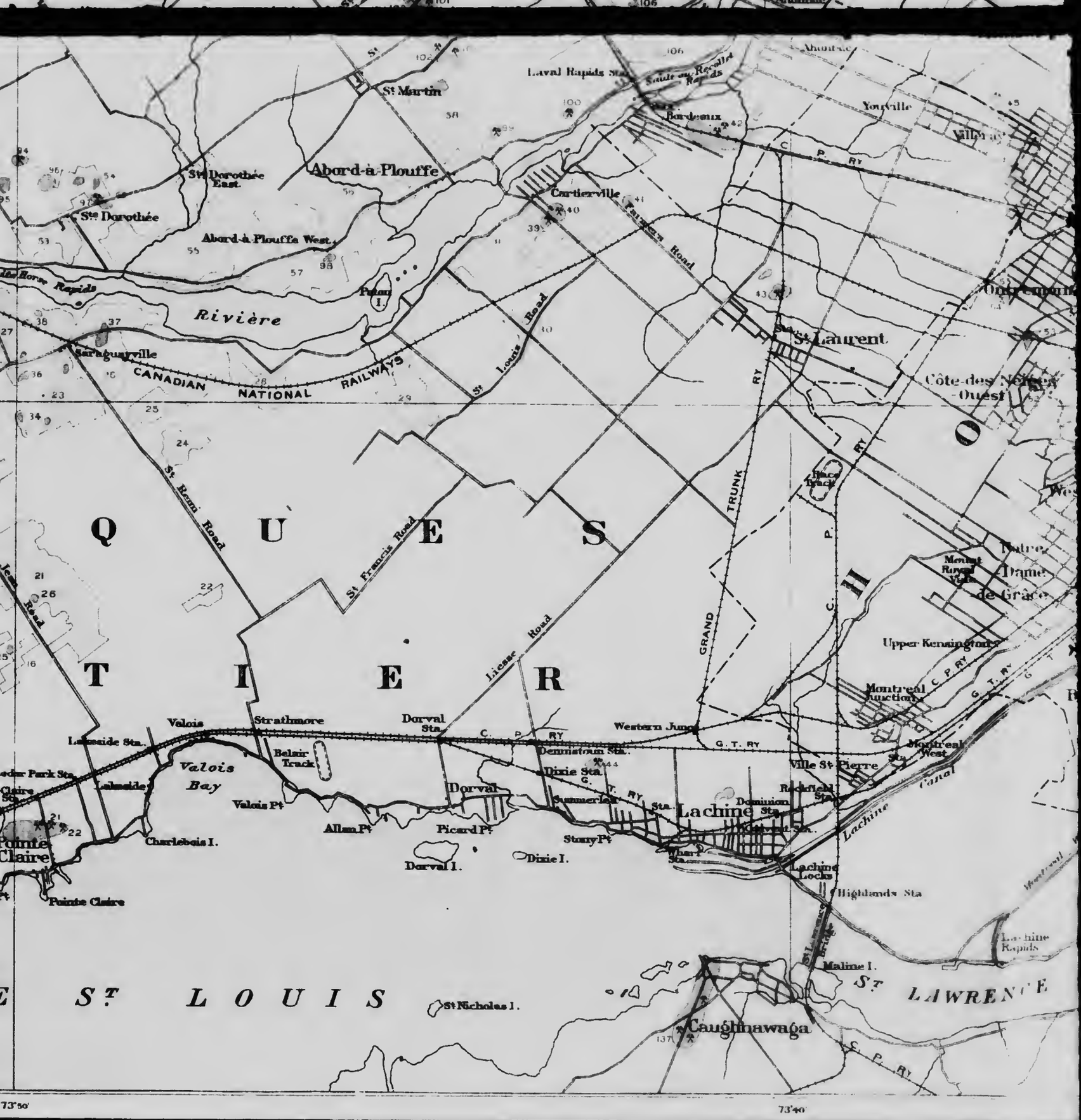
OUTLINE MAP


73°30'
Lachenaie
Bonfond I.
Bout de l'Isle
Macleu I.
Île St. Thérèse
80
81
79
Rivière-des-Prairies
Rivière-des-Prairies Road
Ruisseau des Roches
75
73
76
Pointe-aux-Trembles
Pointe-aux-Trembles Road
72
74
Côte St. Léonard
St. Léonard Road
Asylum Lane
Tétreauville
71
70
Gamelin
Longue-Pointe
69
Molson
De Queylus Creek
NATIONAL RY.
CANADIAN
ST. LAWRENCE RIVER
Île Grosbois
Boucherville
Île de la Commune
Île à Pinard
Molson I.
I. Charron
SOUTHERN RY.
Les Îles Vertes
66

Stone quarries

C-O. Senécal, *Geographer and Chief Draughtsman.*

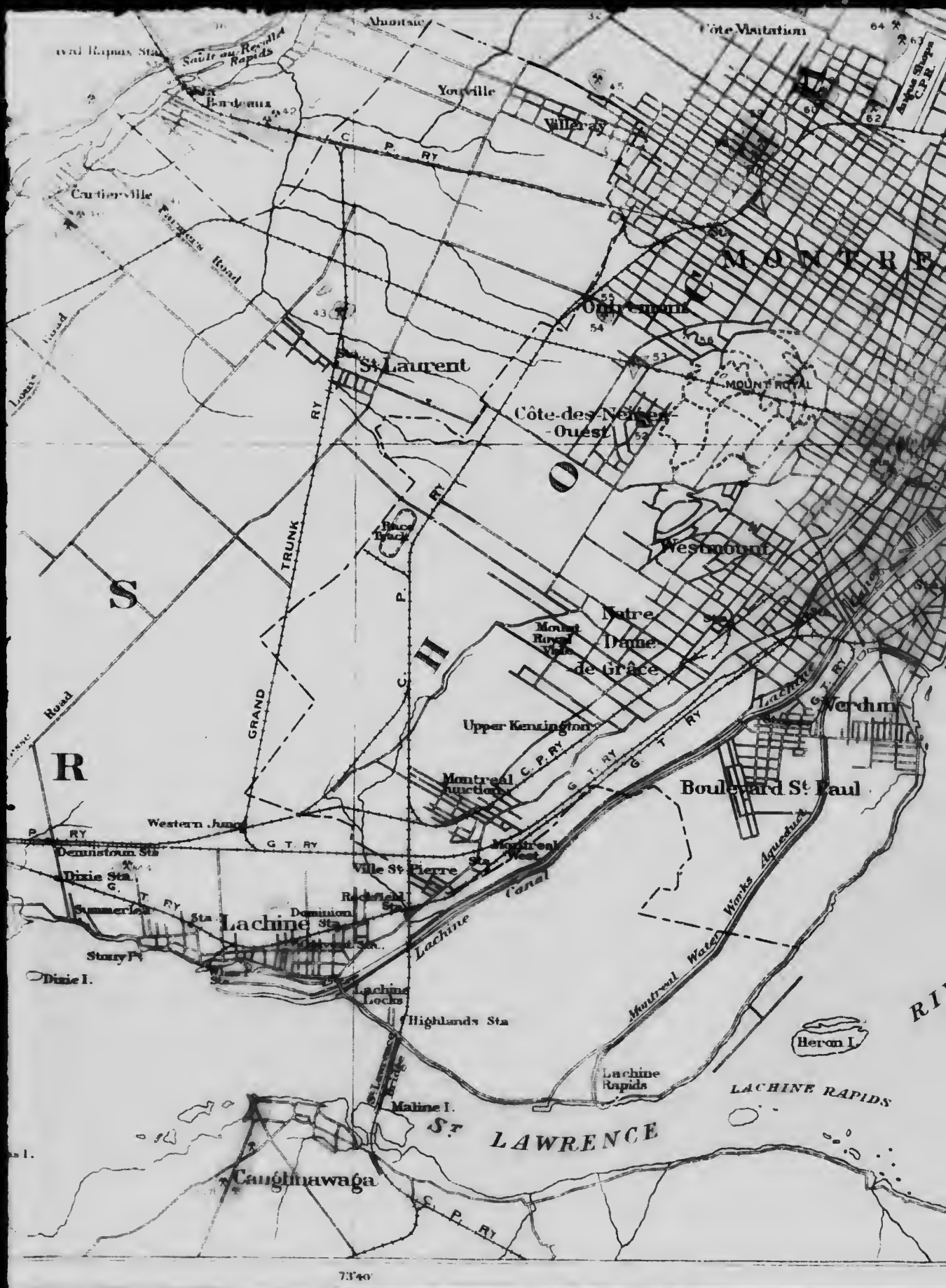
To accompany Memoir by H. Gauthier



STONE AVAILABLE FOR ROAD CONSTRUCTION IN THE CITY AND DISTRICT OF MONTREAL, QUEBEC.

Scale of Miles

½ 0 1 2 3 4 5



FOR ROAD CONSTRUCTION

TRICT OF MONTREAL, QUEBEC.

Scale of Miles

Publication No 1747