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NOMININGUE AND SICOTTE MAP-AREAS, LABELLE AND GATINEAU COUNTIES

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GEOLOGICAL SURVEYS BRANCH

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GEOLOGICAL REPORT 23

NOMININGUE AND SICOTTE MAP-AREAS

LABELLE AND GATINEAU COUNTIES

by

E. Aubert de La Rüe



QUEBEC
RÉDEMPTI PARADIS
PRINTER TO HIS MAJESTY THE KING

1948

POUR CONSULTATION SEULEMENT
MINISTÈRE DE L'ÉNERGIE ET RESSOURCES
DIVISION DES DONNÉES GÉOSCIENTIFIQUES
5700, 49^e AVENUE, BUREAU LOCAL A-201
CHARLESBOURG (QUEBEC)



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Labelle and Gatineau Counties

by E. Aubert de La R e

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NOMININGUE AND SICOTTE MAP-AREAS

LABELLE AND GATINEAU COUNTIES*

By E. Aubert de La Rüe

INTRODUCTION

Location and Area

The report that follows deals with two adjacent areas, totalling about 765 square miles, which were mapped by the writer in 1939 (1) and 1940 (2). The more easterly of these, the Nomingue area, lies between 46°23' and 46°35' north latitude and 75°00' and 75°31' west longitude. Extending northwestward from this is the Sicotte area, between 46°30' and 46°43' north latitude and 75°30' and 76°04' west longitude. Its southeast corner overlaps the northwest corner of the Nomingue area, and within this overlap is situated the village of Mont Laurier.

The mapping included the whole of Kiamika, Pope, and Sicotte townships, the major portion of Turgeon, Loranger, Montigny, Boyer, Campbell, Robertson, Aumond, Egan, and Lytton, and a narrow strip of Rochon, Bouthillier, Dudley, Rivard, Gravel, Major, Baskatong, and Mitchell.

Means of Access

The area is easily accessible. The village of Mont Laurier is the terminus of a Canadian Pacific Railway line from Montreal, 120 miles directly to the southeast. The Abitibi highway (routes 11 and 58) from Montreal to Senneterre closely parallels the railway between Nomingue, at the southeast corner of the area, and Mont Laurier, and continues northwestward across the entire area. From the south, highway No. 35, starting at Buckingham (20 miles east of Ottawa), follows Lièvre river, passing through Mont Laurier and continuing northward past Ferme Neuve toward Ste-Anne-du-Lac. To the west of this, a highway (part of route 11) from Hull follows the valley of Gatineau river northward and at Maniwaki divides into three branches, all of which eventually join the Abitibi highway. Within the present area, these roads pass, respectively, through Stè-Famille-d'Aumond, Bois Franc, and Montcerf.

Within the area there are fairly numerous secondary roads serving the several villages and settlements as well as lumber camps and some lakes on which there are fishing camps. Some sections of the area, however, are heavily wooded and without roads. This is particularly the case in parts of Turgeon, Boyer, and Montigny townships, in the Nomingue area, and throughout most of Pope and Sicotte townships, in the Sicotte area.

*Translated from the French.

(1) For references, see end of report.

Field Work and Acknowledgments

The base-maps used in the field were enlargements to the scale of half a mile to one inch of map-sheets 31 I, N.W. (Mont Laurier), 31J, S.W. (Maniwaki), and 31K, N.E. (Tomasine) of the National Topographic Series, Department of Mines and Resources, Ottawa, the scale of which is two miles to one inch (1 : 126,720). Aerial photographs of the country west of Mont Laurier, kindly made available by the Department of Mines and Resources, were also very helpful in the mapping of the western (Sicotte) half of the area.

In mapping the geology, traverses by pace-and-compass were run at suitable intervals across most of the area, more closely spaced in sections where rock exposures are numerous than where they are sparse or lacking, as in the heavily wooded country already referred to. Canoes were used for examination of outcrops along the shores of lakes. It was found that, throughout the area as a whole, outcrops are relatively plentiful, and locally they are abundant.

Along and adjacent to the principal river valleys, and surrounding some of the lakes, there are extensive unconsolidated Pleistocene and Recent deposits, and these are shown on the accompanying geologically coloured maps. Elsewhere, the consolidated rocks are indicated on the maps as continuous over the whole area. To have outlined only the actual outcrops would have needlessly confused the maps. The locations of the principal outcrops that were observed and examined will be sufficiently apparent from the symbols for strike, dip, etc., that appear on the maps, and by the nature of the lines - solid or broken - that mark contacts between different formations.

During the 1939 field season, the writer had, as senior assistant, J. Claveau, of Quebec, student at Queen's University, who was largely responsible for the mapping of Montigny and Boyer townships and the environs of David lake. M. Michaud, of Ecole Polytechnique, Montreal, and G. Gagnon, of Laval University, Quebec, were junior assistants, and toward the end of the season Robert Matte, of Val Barrette, was employed as guide. In 1940, the party included R.A. Brown, senior assistant, René Béland, of Queen's University, and Edmond April, of Ecole Polytechnique, junior assistants, and Rémy Plante, of Mont Laurier, cook. All fulfilled their respective duties in a very satisfactory manner.

Dr. F. Fitz Osborne, McGill University, spent several days with the writer in June, 1939, in the country between Lachute and Mont Laurier. On this and on other occasions during the course of the work, his guidance and suggestions in connection with the interpretation of the geology were extremely helpful and greatly appreciated.

Rock specimens collected in the course of the field work were studied by the writer in the petrographical laboratory of Laval University, where facilities were kindly extended by L'Abbé W. Laverdière, Secretary of the Faculty of Sciences and Head of the Department of Geology and Mineralogy, and Dr. Carl Faessler, Professor of Mineralogy.

Previous Work

In 1928, A.R. Chesley and J.H. Ciley made a reconnaissance survey along and adjacent to the Montreal-Mont Laurier railway line, the chief purpose of which was the search for commercial deposits of limestone, and in their report (3) they described several occurrences of limestone in Campbell township. In 1932, F. Fitz Osborne (4) studied the Guénette granite stock and described the granite quarries then operating in the Guénette district and at Mont Laurier. Apart from these local studies, there was, prior to the writer's investigations, very little detailed information available concerning the geology of the area described in this report.

The Labelle-L'Annonciation area immediately to the east was mapped by Osborne in 1934 (5), and in 1935 and 1936 he mapped other areas farther to the southeast (6, 7, 8). His reports and accompanying maps give an excellent description of this part of the Laurentian plateau and provide useful points of comparison with the present area, which is, geologically, the continuation of the areas mapped by Osborne.

The country immediately north, west, and south of the area here described has not yet been geologically mapped. To the south, the nearest areas that have been studied are the Maniwaki district, by M.E. Wilson (9), and the Upper Gatineau region, by J.A. Retty (10).

A monograph by R. Blanchard on Les Laurentides (11) contains observations on glaciology which are of interest in connection with the present area, and some information on the economic aspects of the Mont Laurier district is given in a volume by the Rev. Father L. Taché on Le Nord de l'Outaouais (12).

GEOGRAPHICAL SUMMARY

Topography

The area lies in the Laurentian highlands and displays the topographic forms usually to be found in this very old and deeply eroded upland, which forms the southern margin of the Canadian Shield. Certain parts of the area are distinctly rugged, but on the whole elevations here are somewhat lower than is customary in 'Laurentian' country.

The general range in elevation is of the order of 500 to 600 feet, with the main valleys 600 to 700 feet above sea level, the numerous lakes and alluvial plains at 700 to 900 feet, and the hills rising to 1,200 feet. However, the elevations of both valleys and hills are considerably higher than this in two sections of the area.

One of these more mountainous zones extends through Boyer and Montigny townships and the eastern part of Campbell. Here, lac Saguay and Bédard and Guénette lakes lie in depressions at elevations of, respectively, 1,078, 1,109, and 1,054 feet, amid hills which, north of lac Saguay, rise to 1,500 feet. West and east of this high

ground the elevations are progressively lower: Lièvre river, at Mont Laurier, is at 702 feet, and Nomingue lake, to the east, has an elevation of 812 feet.

It is noteworthy that this exceptionally rugged country around Guénette and Lac Saguay is not underlain exclusively by rocks strongly resistant to erosion. It is possible that its relatively high elevation is the result of a late local doming of the Laurentian plateau, as has been suggested by R. Blanchard for other similar districts of the Shield.

Even more mountainous is the northern part of Pope township, west of Ferme Neuve, where mount Sir Wilfrid* rises to a height of 2,569 feet above sea level**, overtopping all hills within a radius of fifty miles. Viewed from the south, its summit presents an even, horizontal sky-line, being relatively flat for an east-west width of about two miles, beyond which the sloping flanks spread far out in all directions and particularly toward the south, where they reach almost to the village of Mont Laurier. This mountain owes its exceptional relief to the fact that all the rocks of which it is composed are highly resistant to erosion: it is an excellent example of a monadnock. On the western side of its summit, where it attains its greatest height, is an old forestry tower of the International Paper Company, and on the eastern side is a 75-foot observation tower that was erected by the James McLaren Company, Limited. From this tower, on a clear day, one may obtain an uninterrupted view of the country for eighty miles around. It is reached by a trail from the lowland - a walk of about three hours.

It is difficult to determine the main directional trends of the present topography. Mount Sir Wilfrid, the main peak, which stands separate from all the rest, is elongated directly east-west, but all the important valleys in the area trend north-south and the chains of hills which border them have about the same direction. Elsewhere, the numerous rounded summits, which often are ill-defined, have an even more confused alignment.

Winding alluvial plains appear in many places between the mountains. Some are pronounced widenings of the principal valleys, recent or pre-glacial. Others are old lake depressions, entirely or partially down-warped, in which the existing lakes are evidence of bodies of water which formerly covered much greater areas.

*Although "Sir Wilfrid" is the name assigned to this mountain on the published Mont Laurier topographic map-sheet, it is invariably referred to by the people of the district as 'Montagne du Diable'. This is evidently a very old-established name for the mountain; it appears, for example, on the map issued by the Department of Crown Lands of Quebec in 1882.

**Altitudes in Quebec North of the St-Lawrence River; Geodetic Survey of Canada, Pub. No.42, 1935, p.74.

Lakes and Rivers

There are about 250 lakes in the map-areas. Many of them are small, in reality nothing but ponds. In general, the streams which connect these lakes are too narrow and rocky to be navigable by canoe, except in a few places. Some of the lakes, the deepest ones, lie in rocky basins; others, fewer in number, are situated amidst alluvial deposits.

Nomingue lake and lac des Iles - which are the largest lakes of the region, each about six miles long - and the huge artificial lake known as the Baskatong reservoir, lie only partly within the areas mapped. Two large arms of the Baskatong reservoir - Philomène bay and baie au Sable, each seven miles long - are included. The largest lakes which lie entirely within one or other of the two map-areas are Pope lake, in the township of the same name, and lac des Ecorces (Bark lake), in Campbell township. Each is four miles long. Next in size are Gauvin lake or lac Vert, in Campbell township, François lake, in Kiamika, and Castor-Blanc lake, in Aumond, each with a maximum dimension of rather less than two and a half miles.

There is no doubt that Rouge lake and Crozat lake on either side of Lièvre river, two to three miles below Kiamika village, were once a single lake, and that the two Nomingue lakes also were at one time not separate lakes.

To facilitate the driving of logs in the spring, the level of most of the lakes has been raised slightly by means of rude dams and, as a consequence, it is difficult to travel along their banks, which are cluttered with dead trees. The construction of the Baskatong reservoir caused the water in the two large bays - Philomène and au Sable - to rise 55 feet, drowning a large area of forest and inundating adjacent farm lands. Dead trees which are still standing at a considerable distance from shore are a hazard to canoe travel.

Certain long, narrow depressions now occupied by sand plains were formerly river channels. Such must be the origin of the plain which stretches for more than six miles just west of Mont Laurier. This old channel, which at one time was occupied by a lake, must have been part of an important pre-glacial valley which, farther toward its head, joined with the northwest-southeast depression in which Pope lake and baie au Sable now lie.

Similar sand plains extend for four miles west and northwestward from Nomingue; for about the same distance southward from Ferme Rouge, at the junction of Lièvre and Kiamika rivers; and east and southward from Grand Remous, in Aumond township. A number of others, smaller in size, are dotted through the area (see accompanying maps).

Gatineau and Lièvre rivers, two of the most important tributaries of the Ottawa, flow southward through the area in parallel valleys some 20 miles apart. The imposing Gatineau, the more westerly of these rivers, flows in a valley which is mostly rocky and narrow. Its course

is broken by falls and rapids, which make it an important source of electric power in its lower reaches. Its tributary from the west, the Désert, which joins it at Maniwaki, is an astonishing contrast. It flows, for the most part very slowly, and with innumerable meanders, ox bows, and ox-bow cut-offs, through a wide, fertile valley. The Lièvre, flowing in a shallow valley, is relatively straight. Except for a few rapids at and a little above Mont Laurier, its course is rather slow. In summer, large sand bars are exposed in this wide, shallow river. A tributary of the Lièvre, the Kiamika, enters lac des Ecorces east of Mont Laurier and, after leaving the lake, flows due south to join the main river a little south of the village of Kiamika. It has several rapids and a fair-sized fall a little below lac des Ecorces, but beyond these its current is slow, its course winding, and its valley wide and fertile.

In the eastern part of the area, the only stream of note is Sawga river, which flows southeastward into Little Nomingue lake.

Population and Settlements

The total population of the two map-areas is estimated at 12,000, the large majority of whom are French-Canadian. However, south of Philomène bay in Sicotte township, and along Désert river in Lytton township, there are a number of families of Irish descent.

The population is unevenly distributed. Some districts, and especially the main valleys, where settlement dates from upwards of fifty years ago, are so well populated, that people are even beginning to migrate northward towards Abitibi, particularly from some of the ranges of Pope township, a little west of the Lièvre. Elsewhere, as in Turgeon, Kiamika, and Lytton townships, settlers have been established but a few years and are still engaged in clearing the land. There are, however, large tracts, aggregating at least 50 per cent of the area as a whole but chiefly in the western half, that are heavily wooded or very rough and swampy, and these are entirely unoccupied. Such tracts are to be found particularly in northern Boyer and western Turgeon townships, and occupying much of Pope and Sicotte.

The chief centre is Mont Laurier, on Lièvre river, with some 3,000 inhabitants. It is the (Labelle) county seat. Twelve miles upstream is the village of Ferme Neuve, with a population of about 600. In the extreme east of the area, Nomingue, which is becoming increasingly popular as a summer resort, has about the same population. Montcerf, in the Désert valley, and Bois Franc, about four miles southeast of it, are the two main villages in the western part of the area. With the exception of Kiamika, formerly important because of the lumbering industry, all the villages are located along the Montreal-Senneterre highway. Westward from Nomingue these are: Lac Saguay, Guénette, Lac-des-Ecorces, and Val Barrette, as well as the hamlets of Loranger, Bédard, and Brunet. West of Mont Laurier should be mentioned St-Jean-sur-Lac and Grand Remous, the latter an important crossroads settlement and the

last Laurentian village until settlements in Abitibi county, about 200 miles to the north, are reached. In addition, there are a number of farms scattered along secondary roads, such as the Chapleau road that leads from Nominuingue to Kiamika.

Resources

Logging, though of less importance today than in the past, is still the main industry of the region, especially in the country west of Mont Laurier, where work in the logging camps gives employment to many people.

The forest is predominantly mixed timber, with deciduous and coniferous trees about equally abundant. It is still dense in some sections of the area, but in others has been terribly depleted by forest fires, of which the most serious occurred at least twenty years ago.

White pine logging was once very active, especially along the Gatineau, but today hard wood (birch, ash, and maple), is the main cut, and is shipped to Montreal. Some soft wood (spruce and fir) is logged, part being used for building purposes and the rest for pulp. For the latter use, a large amount of poplar is also cut. A certain amount of sawn lumber and fire wood is also produced, the latter chiefly maple and white birch.

The Gatineau and the Lièvre play a very important rôle in the log 'drive'. All the soft wood destined for the big sawmills and pulpmills of Hull and Buckingham is floated down these rivers.

Each village has at least one sawmill, there being, altogether, about twenty in the area. These furnish lumber for local use and ship the surplus to Montreal.

Farming and livestock raising are next in importance to logging. Both are carried on in the valleys and alluvial plains. The most productive farms are around Nominuingue, lac des Ecorces, along the Lièvre and its tributary the Kiamika, and, in the west, in the valley of Désert river. In the last-mentioned locality, the settlement is almost seventy years old. The valley of the Gatineau, which in many places is rocky and relatively narrow, is less favoured in this respect. The agricultural products do not suffice, however, for the needs of the people living in the area, especially in the matter of market garden produce. It would certainly be profitable to intensify this production. Very little wheat is grown and yields are poor. The principal farm products are potatoes, buckwheat, hay, and field corn. Part of the hay crop is sold to neighbouring lumber camps. In addition, a little maple sugar is produced, but only for local use, as the sugar bushes are small.

Enough hogs, sheep, and cattle are raised to permit shipments to the stockyards at Montreal. Chicken raising is also practised. Butter from creameries at Nominuingue, Mont Laurier, and Ferme Neuve is sent to Montreal.

Trapping, once a prosperous industry, has

lost much of its importance. However, some trappers still operate in the unsettled, forested country north of the Abitibi highway.

A tannery at Mont Laurier and a spinning mill on the Kiamika just below lac des Ecorces, near the village of Val Barrette, are the only factories in the area. A charcoal oven was operated for a short while a few years ago at Saint-Jean-sur-Lac, but the attempt to sell its product in Montreal was unsuccessful.

There has been some production of industrial minerals from deposits in the area - mica in the Gatineau valley and the country to the west, feldspar at Mont Laurier, and graphite at Guénette - but the properties concerned have been idle for some years. Stone quarries have been opened at a number of places, but at the present time only two are operating, the Brodie and Beauregard granite quarries, both north of Guénette. The known mineral occurrences of the area are discussed in the closing section of this report.

For the past decade or more, the popularity of this part of the Laurentians - especially between Nominique and Mont Laurier - as a summer and holiday resort has been steadily growing. Every year, increasing numbers of visitors from Montreal and elsewhere are attracted to the shores of lakes Nominique, Saguay, des Ecorces, Gauvin (lac Vert), and others. Many of the lakes, especially along the Chapleau road, are owned by fishing clubs. The lakes west of Mont Laurier, which are in general less picturesque, do not enjoy the same measure of popularity.

Water Power

A power plant at Mont Laurier makes use of a fall of seventeen feet obtained from the damming of l'Original (Moose) rapid, and produces 700 horsepower*. There is talk of raising the height of the dam. Kiamika river is dammed at two places near the discharge of lac des Ecorces. At the first dam, power is obtained for operating the 'Talon Lainage' spinning mill; at the other, a short distance down stream near the Val Barrette-Mont Laurier road, is a small power plant which supplies current for local lighting purposes. It produces only 175 horsepower from a head of 22 feet, and could easily produce more.

Power for lighting the village of Lac Saguay is obtained from a small plant which uses the overflow from lac Saguay No.3, whose level has been raised several feet.

*The figures for horsepower given here and in the paragraphs that follow were supplied by the Quebec Streams Commission, 1941, bringing up to date the information given in "List of Water Powers in the Province of Quebec, 1928", prepared jointly by the Dominion Water Power and Reclamation Service, Dept. of the Interior, Ottawa, the Quebec Streams Commission, and the Hydraulic Service, Department of Lands and Forests, Quebec.

A 55-horsepower plant at Chute Rouge, on range-line V-VI of Lytton township, furnishes power for operating a sawmill. The dam on Désert river, which is here very narrow and its bed rocky, is twelve feet high. By raising it, the capacity of the plant could be increased.

As noted on an earlier page, the southern part of Baskatong reservoir projects into the map-area. When constructed in 1927, this was the third largest artificial reservoir in the world. Its purpose is to regulate the flow of the Gatineau, on which, farther downstream, are three major power developments, at Paugan, Chelsea, and Farmer's Rapids, the last only three miles upstream from the point where the Gatineau enters Ottawa river.

The reservoir represents an enlargement of the former Baskatong lake, whose level was raised by construction of several large concrete structures and earth dams. The main structure is the Mercier dam, at the foot of Bitobi rapids, about 30 miles upstream from Maniwaki or 115 miles from the Ottawa river. It is 1,728 feet long and has a maximum height of 96.5 feet. As a result of this engineering project, the water level, which in the former Baskatong lake was 677 feet above sea level, has been raised 55 feet, to 732 feet above sea level. The area of the lake, formerly 21 square miles, was increased to 115 square miles, and the volume of water thus retained is 95 billion cubic feet. This is sufficient to ensure a minimum flow for the Gatineau of 9,000 cubic feet per second at Chelsea*.

GENERAL GEOLOGY

General Statement

The consolidated rocks of the area are all of Precambrian age. The oldest are metamorphosed sedimentary rocks of the Grenville series, which are widely distributed, particularly in the eastern (Nominique) half of the area. Cutting these are numerous large and small intrusive masses, of diverse composition, of rock which is commonly more or less gneissic. While it is certain that these intrusive rocks are not all of the same age, their actual age relationships remain in doubt. This is due, in part, to lack of exposed contacts, and in part to the ill-defined nature of most of the observed contacts. The problem is complicated by magmatic differentiation in some of the bodies, and by the occurrence in many places of composite gneisses, or migmatite, produced through assimilation and interchange of material at contacts between the intrusives and the Grenville rocks they have invaded.

In assigning, in the following table of formations, an age sequence to the several types of intrusive met with, recourse has been had to such features as degree of gneissosity or schistosity - recognized as a not very reliable criterion of age - and lithological similarity of the rock of one mass to that of another or to intrusive rocks of known age occurring in nearby areas. For example,

*Quebec Streams Commission, 16th Annual Report, 1927.

the assumption seems warranted that some, at least, of the intrusive rocks occurring in the present area are to be correlated with the Morin series of Osborne (7, pp.17-19; 8, pp.418-419).

Table of Formations

CENOZOIC	QUATERNARY	Fluviatile and lacustrine deposits (boulders, gravel, sand, clay)
		Glacial and fluvio-glacial deposits (moraines, boulders, sand)
<u>Long period of erosion</u>		
PRECAMBRIAN		Basic and lamprophyric dykes (some of which may be older than the alkaline syenite)
		Alkaline syenite, aplite, micaceous pyroxenite
		Gabbro and norite
		Pink Guénette granite
		Pink biotite syenite
	MORIN SERIES	Quartz syenite and granite, generally porphyritic (with some augen gneiss, pink granite, pegmatitic granite, pegmatite, and quartz diorite)
		Various granites, leucocratic and fine grained types predominant; associated aplite and pegmatite
		Banded fine-grained grey granite, hornblende granite, quartz diorite
	<u>Intrusive contact</u>	
	GRENVILLE SERIES	Paragneiss, migmatite Quartzite Amphibolite Crystalline limestone Metamorphic pyroxenite

Grenville Series

General Note

Neglecting unconsolidated Pleistocene and Recent deposits, almost three-quarters of the area is underlain by rocks of the Grenville series. Under the influence of fairly intense regional metamorphism, these originally argillaceous, calcareous, and arenaceous sediments have been converted into gneisses, amphibolites, crystalline limestones, and quartzites. Large sections of the area, as in Loranger and Lytton townships, are underlain almost entirely by such rocks. On the other hand, in Sicotte and Pope townships, they are subordinate in quantity to the intrusive rocks that have invaded them.

A single member of the series, as for example gneiss, may form a relatively wide band, continuous for several miles along its strike. In the present area, however, such occurrences are exceptional. Usually, the outcrops show alternation of narrow bands, or thin beds, of two or more members of the series. Such alternations and repetitions are obviously, in some cases, the result of the intense deformation the series has undergone, but they are to be seen in numerous outcrops where the beds are little disturbed, apart from uptilting. Excellent examples are furnished by outcrops along the Gatineau, below the Mercier dam, in which there is repeated alternation of beds or bands of gneiss, quartzite, and limestone, all perfectly concordant. It is evident that, during the period of sedimentation, not only did the nature of the material being deposited change from time to time, but that there was frequent repetition of deposition of each particular type of sediment.

As a general rule, however, outcrops of Grenville rocks, far from showing such regularity, present great complexity due to structural deformation. For example, beds of relatively plastic limestone have been drawn out and deformed to the point where they completely enclose beds of the more resistant gneiss or quartzite, which are now found as discrete lenses in the limestone. Similarly, in the east part of lot 57, range V, Robertson township, may be seen inclusions of graphitic gneiss in graphitic limestone which are undoubtedly of tectonic origin.

The Grenville rocks have been invaded by granitic and other intrusive bodies, some of considerable size. In many places, blocks of the sediments which were caught in the magma during its emplacement, or which are remnants of the roof beneath which the magma consolidated, appear as inclusions or inliers within the intrusive rock. Conversely, small intrusive bosses, and more particularly dykes and dykelets, chiefly aplite and pegmatite, are common within, and indeed are a characteristic feature of, the Grenville rocks; and, it may be noted, their usually distorted and broken condition bears eloquent witness to the amplitude of the movements which have so profoundly folded and distorted this great series of metamorphic rocks. Such injected material, in many outcrops, makes up as much as, or more than, 50 per cent of the rock, leading to obvious difficulties in mapping. Outstanding examples

of this may be seen in outcrops on lots 47 to 52, range III, Aumond township, which consist of an astonishing mixture of limestone and pink granite, and northeast of Bois Franc, on lot 57, range I, Egan township, where quartzite has been heavily injected by pink aplite, the latter forming a network which encloses blocks of quartzite. In occurrences of the type here referred to, contacts between the invaded and intrusive rock are sharp. There has been little or no granitization of the sedimentary rock, a feature which distinguishes these mixed rocks from migmatite, described in the section that follows.

On the accompanying maps, outcrop areas in which the rock is chiefly or wholly limestone are given a distinctive colour. Other members of the Grenville series are not differentiated by colour, but appropriate symbols indicate the nature of the predominant rock in the principal outcrops.

Paragneiss and Migmatite

Paragneiss.-Gneisses are the most extensively developed rocks of the Grenville series as represented in this area. Some of these gneisses are quite easily recognizable as paragneisses of sedimentary origin; others closely resemble intrusive orthogneisses, with which they may be associated.

The paragneisses all have well marked banding and schistosity, but they are of variable appearance and composition. Mineralogically, they may be classed or named with the prefix plagioclase, amphibole, pyroxene, biotite, garnet, sillimanite, or graphite, according as one or other of these minerals is a major or important constituent. Commonly, thin bands of quartzite, amphibolite, and limestone are intercalated with the gneiss.

In many occurrences, the gneiss, and particularly the sillimanite and graphitic types, contain finely disseminated pyrite or pyrrhotite and, as a result of the oxidation of these iron sulphides, they have a characteristic rusty weathering, which aids in their recognition. Due to the same cause, such rocks tend to disintegrate or 'rot' somewhat rapidly under atmospheric weathering, and in hot, humid weather they may emit a pronounced sulphurous odour, as was particularly noticeable in the old workings of the Guénette graphite mine.

It is rare, in this area, to find mica schists associated with the paragneisses, but in an outcrop on the north side of the Mont Laurier-Senneterre highway, on lot 54, range V, Lytton township, a band of friable mica schist, 150 feet wide, was seen, lying between gneiss to the southeast and pegmatite to the northwest. The schist is cut by stringers of pink aplitic granite and includes some irregular lenses of limestone which contains large crystals of sphene.

Migmatite.-Rocks are met with presenting all stages of transition from true paragneiss, through gneisses in which there has been more or less lit-par-lit injection of granitic material, to extreme types in which there has been complete admixture of the two rocks through assimilation.

ation of the gneiss and interchange of its material with the magma, with production of a composite gneiss, or migmatite. In the field, it is often difficult to decide whether a particular outcrop should be regarded as chiefly paragneiss or chiefly intrusive orthogneiss. In some instances, bands of intercalated quartzite may be present, but these are not necessarily proof that the rock as a whole should be regarded as Grenville, since bands of quartzite, little or not at all altered, have been observed as inclusions within granitic rock of unquestioned intrusive origin. On the whole, the distinction is largely a matter of personal interpretation. On the accompanying maps, the migmatite is included with the Grenville rocks, the principal outcrops or occurrences being indicated by a special symbol.

In the eastern half of the area, outcrops of these highly granitized gneisses are abundant to the north, east, and west of the hamlet of Lac Saguay; north of Val Barrette, along the south shore of Gauvin lake (lac Vert); and to the east of Brunet, along the south shore of lac des Ecorces. West of Mont Laurier, they may be seen in Robertson and Egan townships (south of Montcerf and north of Bois Franc, and especially along the Gatineau valley), and in Sicotte and Lytton townships (between Lion rapids - not far downstream from the Mercier dam - and Grand Remous). In many of these occurrences, feldspathic lit-par-lit injections, and narrow veins of aplite and pegmatite, in the gneiss are highly contorted, displaying what has been termed 'ptygmatic folding'.

Granitization of amphibolite has produced a basic type of migmatite. Good outcrops of such rock may be seen along the rapid stream that drains Pope lake into baie au Sable, in the west part of Pope township. Others, not shown on the map, are to be found west of Lièvre river, between lots 41 and 46, range II, Pope township, where closely spaced bands of amphibolite-migmatite lie within granite.

Quartzite

Most of the quartzites are grey, glassy-looking rocks, which, in addition to quartz, contain feldspar and small flakes of brown mica, the latter often aligned in parallel bands. Other minerals usually present are muscovite, garnet, pyrrhotite, and pyrite. The pyritiferous quartzites have a rust-stained surface and commonly occur with rusty weathering gneiss. Very rarely, the quartzite has been completely recrystallized, with elimination of all impurities, and consists of quartz alone, as in some outcrops at Montagne Blanche (White mountain), north of Philomène bay, in range VIII, Baskatong township.

In some occurrences, where thin bands of quartzite are interbedded with less competent rocks, they have undergone considerable deformation. Thus, on lot 37, range IV, of Pope township, beds of quartzite one foot wide, intercalated in closely folded paragneiss, have been disrupted and dragged out so that they now appear in the gneiss as small, discrete lenses of quartz. In general, however, the quartzite, because of its greater strength,

has been less deformed than the other Grenville rocks, especially where it is in fairly thick beds.

In many places, stratification can still be observed in the quartzite. It is particularly clear where, between successive quartzite beds, there are very thin bands of gneiss, representing argillaceous 'partings' in the original sandstone. Such a well stratified quartzite can be seen in an outcrop in the east part of lot 36, range VII, of Robertson township. The quartzite, which here has a pale pink colour due to the presence of large numbers of tiny garnet crystals, is in beds about one foot thick separated by beds two to six inches thick of sillimanite-, garnet-, or graphitic-gneiss.

Being the most resistant rocks of the area, the quartzites have best withstood erosion and in many places their outcrops have the form of steep-sided hills. In almost all areas of more than average relief, one may expect to find quartzite. The outstanding example of this is mount Sir Wilfrid, in the northern part of Pope township, the whole of whose almost flat summit, measuring three miles by a mile and a half, is quartzite - the largest and most homogeneous occurrence of this rock in the area. The quartzite is continuous, except for occasional narrow intercalations of gneiss, such as that at the foot of the forestry tower on the eastern summit, or of limestone, as in an outcrop three-quarters of a mile southeast of the tower.

Relatively large bodies of quartzite occur also in the vicinity of Lac Saguay (Boyer township), and in that part of Egan township lying between Bois Franc, Sapin lake, and the Gatineau valley.

Amphibolite

In comparison with the other members of the Grenville series, the amphibolites are but slightly developed. At the same time, however, they are widely distributed in their occurrence. Doubtless they are, in the main, metamorphosed sedimentary rocks, but in part they may represent basic lavas that were interbedded with the Grenville sediments. Ordinarily, they are closely associated with the gneisses, and, like these, they are in places much granitized and intruded by a host of small dykes of aplite and pegmatite. As already suggested, such highly granitized amphibolite may well be termed migmatite.

Amphibolite also occurs quite commonly as inclusions in porphyritic quartz syenite, granite, or other intrusive rock. Such inclusions, closely spaced and many of them of large size, are a striking feature of the gneissic, normally light coloured, granites in Pope, Sicotte, and Robertson townships. Because of their frequent large size, it is sometimes difficult to be sure, in the case of isolated outcrops of amphibolite, whether they are large inclusions in some intrusive body, or whether they represent bands within a body of Grenville rock.

The amphibolites are dark green to almost black rocks, generally but slightly schistose and often

quite massive. Some consist entirely of hornblende; others contain more or less quartz, feldspar, pyroxene, or mica, and grade over to amphibolitic paragneisses, with which they are often interbanded. In many occurrences, the bands are closely spaced and narrow, and may be very rich in garnet; in others, they are extremely wide, as for example that forming a low ridge which extends in a north-south direction through the west part of lots 34 to 36, range II of Pope township.

The hill which runs through Normingue village is composed chiefly of almost black amphibolite which, locally, is very coarse grained. In addition to hornblende, it contains hypersthene and garnet. The hypersthene is in prismatic crystals, several inches long, and is very abundant in some facies of the rock. The strike of the schistosity is N.25°E., about parallel to the trend of the hill.

An unusual type of amphibolite, containing abundant sphene, occurs north and east of Castor-Blanc lake, in Aumond township and the west part of Robertson, at the margin of a large mass of pink syenite. The sphene is in light brown crystals, up to an inch and more in length. Other minerals present in the rock include one or more of the following: calcite, quartz, feldspar (generally plagioclase), scapolite, diopside, biotite, and epidote. North of Castor-Blanc lake, and notably in the middle of range VI of Aumond township, there are several good outcrops of this 'sphene amphibolite' along and adjacent to the Mont Laurier-Maniwaki highway. It includes lenses of crystalline limestone and is cut by aplite dykes and by a dyke of pink granite of the Guénette type. This amphibolite has presumably resulted from metamorphism of beds of impure limestone. Locally, it has a pegmatitic texture, as on lot 54, range VII of Aumond township, where the outcrops extend over a length of 500 feet.

Crystalline Limestone

The crystalline limestone of the Grenville series ordinarily contains some magnesium, and in some occurrences is actually dolomite. However, it is not possible by visual inspection in the field to distinguish the pure calcium rock from the dolomitic types. For the purposes of this report, all the carbonate rocks of the Grenville series will be referred to as 'limestone'.

The limestone being a soft and easily eroded rock, most of its outcrops are found in the main valleys. In the eastern part of the area, the Lièvre and its tributary, the Kiamika, have exposed large bodies of the rock along their respective valleys, the former between Mont Laurier and Ferme Rouge, the latter between lac des Ecorces and Kiamika village. Some of these bodies can be traced for more than a mile. In most of them, the limestone is interrupted from place to place by intercalations of quartzite and paragneiss, and is cut by numerous dykes of granite and pegmatite. In places, as on lot 15, range I of Campbell township, so many contorted, branching stringers of pegmatite cut the limestone that they form the bulk of the outcrop. A wide zone of limestone apparently without intrusions and without interbeds of gneiss or quartzite crosses the Mont Laurier-Wabasse road on lots 20 to 23,

range IV of Bouthillier township. Farther to the north-east, in Campbell township, there are several bodies of limestone along the line of the Canadian Pacific railway between Campeau and Boyd lake and also east of Swap lake.

The limestones have a much wider development in the western than in the eastern half of the area, and their principal outcrops are easily accessible from the roads. The Mont Laurier-Senneterre highway crosses several large masses of the rock, some of them several miles long, as in ranges IX, X, and XIII of Robertson township, range VIII of Aumond, ranges IV to VI of Sicotte, and ranges I to V of Lytton. There are numerous bodies also along and adjacent to the road from Grand Remous to Sainte-Famille-d'Aumond, which follows the east side of the Gatineau, and along the road that leads eastward from Grand Remous to Bois Franc. In the extreme west, large bodies of limestone are exposed in the valley of Désert river.

The limestone is rather coarse grained - so much so in places as to resemble vein calcite rather than limestone. A good example of such rock may be seen in outcrops a mile and a half south of lac des Isles, on lots 22 and 23, range IV of Bouthillier township, where the rhombohedra of calcite measure up to two inches in diameter. As a consequence of the coarse texture, and also of the easy cleavage, softness, and solubility of the calcite, the rock is friable and disintegrates rather rapidly on exposure. Weathered surfaces, grey or yellowish-grey in colour, are rough and are frequently traversed by solution channels. On fresh surfaces, the rock is usually greyish-white, but in some occurrences, as on lots 7 and 8, range J of Campbell township, it is pure white. Locally, it is yellow, pink, and even red, as it is, for example, in outcrops on lot 36, range II of Lytton, and in the slightly schistose occurrence on lot 43, range I of the same township. In some places, the grey limestone is cut by veins of coloured calcite. Thus, the limestone exposed in the big highway-cut north of Gatineau lake (range X, Robertson) contains veins and nodules of green calcite, and a very impure and partly silicified limestone in the big quarry near the Mercier dam, in the southeast corner of Mitchell township, is cut by veins of pink calcite.

As a rule, the limestone contains a variable amount of minerals, chiefly silicates, developed by regional or contact metamorphism. Phlogopite and biotite are very common in small flakes evenly distributed through the rock. Graphite occurs in similar fashion. Muscovite is much rarer, but flakes two to three inches across are found in a limestone outcrop along the road which follows the south shore of lac des Ecorces (Campbell township). Diopside is fairly common, either in small, well-formed green crystals or in irregular grains; frequently, the crystals have rounded edges and corners and a brilliant, oily lustre, as though they had undergone incipient fusion. The same is true of apatite crystals, which generally have a pale blue colour. Other minerals observed include tremolite, scapolite, feldspar, quartz, pyrite, pyrrhotite, and serpentine. The serpentine, which is grey, yellow, or green in colour, is in grains (completely replaced diopside crystals) or in irregular masses. More unusual is the presence of spinel, in small grains of a bluish-mauve colour; they are sometimes accompanied by chondrodite.

In some occurrences, the silicate and other minerals are concentrated along parallel planes within the limestone, thus giving the rock a banded appearance. It is most unlikely that this banding corresponds to the original stratification, which has long since been obliterated by the complete recrystallization of the rock.

Diopside and feldspar, the latter in small whitish masses, also occur in irregular aggregates a few inches in diameter, and these are accompanied by micaceous nodules. They form more or less contorted bands in the limestone, and are sometimes greatly deformed and broken. By their presence, one may gain a much clearer conception than would otherwise be possible of the complexity and severity of the forces to which the limestone has been subjected. These silicate nodules, being harder, less soluble, and hence more resistant to erosion, than the containing rock, usually stand out in relief on weathered surfaces.

A peculiar feature of some of the limestone is that, when pulverized, it emits a garlic odour. As examples may be mentioned the limestone occurring with micaceous pyroxenite on lots 22 and 55, range III of Lytton township, and the veins of red calcite already referred to as cutting limestone in the quarry near the Mercier dam. The very coarse grained graphitic limestone on lots 22 and 23, range IV of Bouthillier township, gives off a faint bituminous smell when struck.

In this map-area, the limestone seems to be the member of the Grenville series most favourable as host rock for certain minerals of economic value, for it is the limestone that contains the pyroxenite lenses in which deposits of phlogopite, apatite, and molybdenite have been found. For this reason, the approximate location and outcrop area of the principal bodies of limestone has been indicated on the accompanying maps by a distinctive colour.

Metamorphic Pyroxenite

In many places in the area, rock composed entirely or predominantly of pyroxene is closely associated with rocks of the Grenville series, and most commonly with limestone. In some occurrences, this 'pyroxenite' forms lenses up to several hundred feet long interbanded with the limestone, but for the most part it is in relatively small bodies down to mere nodules a few inches to a few feet in diameter or length. These latter are particularly numerous where the limestone has been intruded by pegmatite.

The pyroxenite, however, is not invariably associated with limestone. Rarely, it is interbanded with paragneiss, as for example on lot 27, range X of Robertson township, where it is cut by dykes of aplite and hornblende pegmatite; and in some localities it is included in intrusive granite gneiss, as on lot 75, range III of Egan township, where phlogopite-bearing pyroxenite enclosed within a small body of orthogneiss was formerly worked for mica.

The small lenses and nodules in limestone are generally white in colour, but in the larger bodies the

rock is usually some shade of green, or occasionally grey or greyish-white. The rock is granular, with no vestige of schistosity, and in some occurrences it is rather friable. The grain is very variable, from medium to extremely coarse, in which individual crystals may measure several inches in diameter. The main constituent of the rock is invariably diopside, white in the small nodules, but elsewhere, the shade depending on the content of iron. Other minerals usually present include calcite, quartz, feldspar, phlogopite, apatite, and pyrrhotite. In some localities, pyrrhotite is abundant, notably in an old mica prospect in lot 52, range I of Aumond.

There has been much controversy concerning the origin of the 'pyroxenites' that occur here and elsewhere in the general region in close association with the limestone and other members of the Grenville series. Some observers have regarded them as basic intrusive rocks. Others believe they are of metamorphic origin, derived from high-magnesia limestones of the Grenville series under the influence of acidic intrusives, particularly pegmatites. An excellent summary of the views of the opposing schools has been given by de Schmid (Spence) (13, pp.256-277; 14, pp.39-41). The consensus of modern observers is that the rock is of metamorphic origin, and, to distinguish it from normal igneous pyroxenite, M.E. Wilson (9, pp.32-35) has introduced the name 'metamorphic pyroxenite'. From his work in the present area, the writer is of opinion that the occurrences of pyroxenite discussed in the foregoing paragraphs are all of metamorphic origin.

It is of interest to note that Savornin (15), who studied the phlogopite-bearing pyroxenites which occur in Madagascar under conditions very similar to those in the southwestern part of Quebec Province, concluded that they, also, are of metamorphic origin, formed by reaction of an acidic magma with calcareous sedimentary rocks.

The metamorphic pyroxenites are of particular economic interest because, in some places, they are the host rock for deposits of phlogopite, apatite, and molybdenite. They are best developed in sections of the area where the Grenville rocks are predominantly limestone - that is, along the valley of Kiamika river in the eastern half of the area, and along Désert river in the western half.

Intrusive Rocks

Grey Banded Granite, Hornblende Granite, Quartz Diorite

Banded orthogneiss occurs at a number of localities within the area. In outcrop, the bodies of this rock are all relatively small, and almost without exception they are found in low-lying country. The rock is usually fine grained, and the banding is more pronounced than in any of the other gneissic granites of the area.

In most occurrences, the rock is pale grey or faintly pinkish and contains abundant quartz together with biotite, microcline, and orthoclase, minor plagioclase, and some microscopic intergrowths of quartz and feldspar (micropegmatite); but in some of the bodies that

project from the alluvial plain between Nominuingue and Montigny lakes the rock is hornblende gneiss or quartz diorite gneiss.

There are many outcrops of these rocks near Nominuingue, usually in the form of rounded knobs that project from the sandy deposits of the alluvial plain. In outcrops along the west shore of Nominuingue lake, on lot 55, range IV of Loranger township, the rock is cut by narrow dykes of pegmatite and grades over to migmatite. Farther west, on range C of Campbell township, north of Guénette, several bodies of the well banded gneiss intrude the Grenville rocks, and there are some small isolated bodies along the valley of Kiamika river. South of Brunet, scattered outcrops probably represent a continuous body which may extend considerably farther south than indicated on the map, since numerous blocks of banded orthogneiss are met with between lots 42 to 50, range III of Kiamika township in the hilly country, underlain by Grenville rocks, that separates the Kiamika and Lièvre valleys. Still farther west, outcrops of the banded gneiss, with in some places associated migmatite, occur in the vicinity of Ferme Neuve, in the northeast corner of Pope township, and also at the south end of Howard lake, in the same township.

A reconnaissance by the writer (16) along the Mont Laurier-Senneterre highway, opened in 1940, showed that banded orthogneiss and migmatite are by far the commonest rocks along the stretch of the road northwestward from the present map-area to the Ottawa river.

These orthogneisses are believed to be the oldest intrusive rocks in the area. They are perhaps to be correlated with the very similar gneisses of the Lacoste series as defined by Osborne (5, pp.22-23) in the Labelle-l'Annonciation area. On the other hand, it is equally possible that they are the equivalent of the ancient 'Laurentian' or Mont Tremblant gneiss (17, pp.42-44; 6, pp.62-63; 8, pp.416-417). Unlike the younger granites, these orthogneisses occur as relatively small bodies in close association with migmatite, not as great batholiths.

Morin Series

Granites of Various Types

There is every reason to believe that most of the granite which has intruded the Grenville in the area here under review belongs to the Morin series, as this has been defined by Osborne (7, pp.17-19; 8, pp.407-434) in that part of the Laurentians lying to the southeast. The granites grouped in this series are of varied appearance and mineral composition. This may be in part the result of variation in the amount of material assimilated by the magma during its invasion of the generally magnesian limestone beds of the Grenville series, with consequent local increase in basicity of the magma, as shown by the presence in the rock of more calcic plagioclase and of more abundant ferromagnesian silicates than normally.

Blocks of the Grenville, many of considerable size, were also caught up by the magma, without under-

going very appreciable change. They now appear as inclusions of gneiss, quartzite, and amphibolite, which are more or less abundant in most of the granite masses.

The granite that is here correlated with the Morin series occurs as masses of batholithic size, as smaller stock-like bodies, and in the form of clear-cut dykes and irregular branching dykelets, which may be not more than a few inches thick. Most of these very numerous dykes are aplite or pegmatite, but some of them are true granite. The lit-par-lit injections which are so common in the paragneisses belong, in part, to this series.

It has been possible to outline only the larger bodies on the accompanying map. The fact must not be lost sight of, therefore, that in almost all sections of the area that are shown as underlain by members of the Grenville series, these are cut by large numbers of granite dykes.

Three bodies or areas of granite of important size are outlined on the Nomingue sheet. One lies across the northwestern parts of ranges D to G of Campbell township. The other two are near the south boundary of the map-area, one south of the Chapleau road between range VII of Montigny township and range XII of Kiamika township, the other in ranges III and IV of Bouthillier township.

In each of these bodies, the rock is more or less strongly gneissic. Typically, it is medium to fine grained, and pinkish-grey in colour. Less commonly, the grain is relatively coarse, as it is in outcrops on lot 22, range IV, Bouthillier township, where the granite is porphyritic and contains yellow feldspar.

In the vicinity of Guénette (Campbell township), the most common type is a very fine grained, grey, biotite granite which forms numerous small bodies. This grey granite is also very common elsewhere, notably on Latour island, in lac des Ecorces, and on the high ground in ranges II and III of Boyer township. In this section, the biotite in this grey granite is seen to enclose minute crystals of zircon, which are surrounded by pleochroic haloes. Muscovite and tourmaline are infrequently present as accessory minerals.

Outcrops of very pale granite of coarse grain, with large crystals of white feldspar a noticeable constituent, are common in the Kiamika valley below lac des Ecorces. The rock consists chiefly of microcline and quartz, with but little mica, and contains tourmaline in small crystals as a common accessory. Similar granite occurs south of Boyd lake and forms numerous dykes in the Lièvre valley between Mont Laurier and Ferme Rouge.

The largest mass of granite in the area is in the Sicotte map-sheet, where it underlies most of Pope township and extends westward into Sicotte, its east-west length, from the Lièvre River valley to Philomène bay, being about eighteen miles. In general, the rock has a fairly uniform appearance throughout this extent. Other granitic bodies, of lesser size than, but with the same general characteristics as, those of the mass in Pope

township, occur in Robertson and Aumond townships.

In general, the granites of the Sicotte map-sheet are paler and tend to be more aplitic than those east of Mont Laurier. They are all gneissic, but, because of the paucity of coloured minerals, this feature is not always very evident. These calcic and alkaline granites of low mica content are mostly pale pink or grey coloured rocks, but the pink colour is commonly only superficial, fresh surfaces of the rock being mostly pale grey. The grain is usually fine, but fairly coarse grained types were seen in some places.

These granites are composed chiefly of microcline, orthoclase, and perthite. Some of the thin sections examined contain also albite and oligoclase. The usual mica is biotite, but it is always in very minor amount and may be entirely lacking. Where present, it is often in small clots. In some outcrops, as for example, those near Ferme Neuve, the only dark mineral in the rock is magnetite, in disseminated grains. The quartz in much of the granite occurring in Pope township is bluish and slightly opalescent. It may be present in large amount, or it may be entirely lacking, the rock thus passing to a syenite without any appreciable change in appearance. This has been observed at several places, notably in outcrops one-third of a mile northeast of Ceci lake (Sicotte township). Evidence of crushing was seen in several thin sections of the granite from Pope township.

Another feature of this granite, to be seen in outcrops in ranges VII, VIII, and IX of Robertson township but not in the one in Aumond, is that it contains many inclusions of amphibolite of irregular shape and of various sizes. Some of these inclusions have frayed margins, but in general their boundaries against the granite are sharp. It sometimes happens that the amphibolite is in thin, parallel bands, giving the rock a well banded appearance. This is especially noticeable in outcrops in Sicotte township between Cowie lake and baie au Sable, as well as on the east side of the big island in Philomène bay and on lot 45, range V of Sicotte. In this last locality, the bands of amphibolite, from one to a few inches wide, are often disrupted, giving an appearance that may be likened to a string of lenticular black beads.

Migmatite zones were noted at several places in these granites. Besides the one already mentioned in the Lièvre valley, there are others along the south shore of Baskatong lake, between Philomène and au Sable bays. As these migmatites underlie only small areas, they have not been shown on the map.

Porphyritic Quartz Syenite and Related Intrusives

On the maps accompanying this report, three large areas and a few of smaller size are indicated as underlain for the most part by porphyritic quartz syenite. This syenite is very similar to the Pine Hill syenite that occurs in the west part of the Lachute map-area and is a late facies of the Morin series of intrusives.

The three main masses of porphyritic syenite are somewhat elongated in a north-south direction, and each of them extends along this trend beyond the limits of the present map-area. Within the area, the smallest has a length of about six miles and the largest, ten miles. One of these bodies is in the middle of Montigny township, another extends from the north shore of Gauvin lake to Lièvre river, and the third underlies the central part of Sicotte township, surrounding Philomène bay. On its western side, this last body does not quite reach to the valley of the Gatineau, which is cut into Grenville rocks, and to the east it is separated from baie au Sable by a zone of granite.

The porphyritic quartz syenite is a gneissic rock of quite coarse grain, with phenocrysts of microcline, up to two inches in length, which are usually pink - rarely yellow or greyish-white. In the body in Sicotte township, they are seldom more than an inch long and are bluish-grey in the centre and pink around the edges. Biotite is very abundant and surrounds many of the large feldspar crystals; it is to this mineral, and to hornblende which almost invariably accompanies it, that the rock owes its dark colour. Sphene is commonly present as an accessory mineral. Locally, the rock contains so much quartz that it might well be classed as granite.

Some facies of the rock, while still retaining the gneissic structure, are non-porphyrific and, as a consequence, are relatively richer in ferromagnesian minerals than the typical rock. Such rock is found much more commonly in the Sicotte mass than in those in the Nomingue map-area. It accompanies the porphyritic type, especially in the north part of ranges I, II, and III, and also occurs in outcrops by itself, as on lot 43, range II.

The feldspar phenocrysts in the porphyritic syenite are commonly oriented with their length parallel to the gneissic structure of the rock which, as a result, has much the appearance of an augen gneiss.

Microscopic examination of the syenite shows that it has been subjected to severe dynamic stresses. In numerous thin sections of the rock that were examined, the crystals or grains of the constituent minerals were seen to be bent, broken, and crushed, with the feldspar phenocrysts cracked, deformed, and surrounded by a mosaic of granulated or recrystallized material. In some occurrences, as in Montigny township, the rock has been so crushed that it must be considered a mylonite.

Around the margins of the bodies, it is common to find lit-par-lit injections of syenite in the bordering paragneiss. These are of quite an unusual type. They are characterized by large crystals of microcline, developed by magmatic emanations. It was found that the presence of such crystals in the paragneiss, which is habitually fine-grained, is a sure indication of the proximity of a syenite intrusion. Similar large feldspar crystals were seen also in amphibolite inclusions, in the syenite. Such inclusions are by no means rare and are particularly numerous in outcrops of the syenite along the newly built road in the south-east part of Sicotte township which leads from the Mont

Laurier-Senneterre highway to the lumber camps of H. Lafleur.

Along this road, which ends about one mile south of Cowie lake, there is a succession of excellent outcrops of the porphyritic syenite, and in one of these, near the Lafleur camp, the syenite is seen grading into pinkish-grey granite of the same type as that of the large body in Pope township (which the writer correlates with the Morin series). This would suggest that the porphyritic syenite and the pinkish-grey granite are of the same age. Poor exposures on the south slope of mount Sir Wilfrid also indicate this relationship. However, final decision as to the relative ages of the two intrusions must await more definite field evidence.

In many places, the porphyritic quartz syenite and related rocks are cut by dykes of more acidic type. Pegmatite dykes containing some tourmaline and generally poor in mica are especially numerous in Campbell township between Barges lake and Mont Laurier, and also in Sicotte township. In places in the latter district they contain hornblende. Some less coarsely crystalline dykes of pink pegmatitic granite, also low in mica, have a width of several tens of feet. A good example of such a dyke may be seen one mile northeast of the Castor fire tower, on range IV of Sicotte township.

The rock most commonly associated with the porphyritic syenite is a pink, fine grained granite which, in many of its outcrops, is very similar in appearance to the Guénette granite, to be described later. Masses of this pink granite, some of fairly large size, lie within most of the bodies of porphyritic syenite and, in most of these occurrences, the granite appears to cut the syenite. In others, as on lot 55, range III of Sicotte township, the contact between the two rocks is of such a nature that it is difficult to determine which is the younger. The same is true on lot 13, range III of Campbell township, not far from lac des Ecorces, where the syenite and the pink granite seem to be contemporaneous.

In addition to the three main masses of porphyritic syenite, minor occurrences of the rock were observed in several localities. Reference has already been made to some small outcrops on the southern slope of mount Sir Wilfrid which seem to be genetically related to the aplitic pink granite assigned to the Morin series. The presence of numerous blocks of syenite at the foot of the mountain, to the east on lot 48, range IV of Pope township, and to the south around Antlers lake, leads to the belief that more detailed work would reveal a wider distribution of porphyritic syenite on the mountain than was observed by the writer.

Southwest of Pope lake, on lot 50, range XI of Robertson township, the Mont Laurier-Senneterre highway cuts through a body of grey quartz-hornblende syenite. The rock, which is less porphyritic than the usual type, is exposed for a length of 300 feet.

Also grouped with the porphyritic syenite is a confused assembly of rocks outcropping on ranges I,

II, and III of Lytton township, south of Darby lake. In some places, as for example on lots 19 and 20 of range II, the rocks closely resemble the normal porphyritic syenite, but elsewhere they grade over to very dark, basic gneisses, in part massive and in part strongly laminated and foliated, whose origin it is difficult to explain. The whole assemblage is cut by pink aplite which, in places, becomes a more coarsely crystalline pegmatitic granite lacking in mica, similar to the dykes in Sicotte township, already referred to.

Diorite is of very limited occurrence in the area, and only, it is believed, as a basic facies of the granitic and syenitic intrusives. Thus, the amphibole granite and quartz diorite in the vicinity of Nominungue are correlated with the grey banded gneissic granites. On the other hand, the body of diorite, a mile long, on the west side of the Lièvre just north of Mont Laurier, is correlated with the quartz syenite group. This diorite, containing a little quartz and abundant sphene, is rather coarse grained and very dark. The first outcrops appear near the Mont Laurier seminary. Northward from here, in range II of Robertson township, the diorite is seen to grade into amphibolitic gneiss with many inclusions of Grenville rock, and this, in turn, by increase in feldspar content and development of phenocrysts of feldspar, becomes, within a short distance, a porphyritic quartz syenite.

Pink Syenite

About the middle of the Sicotte map-area is a body of syenite of quite important size. It is six miles long from northwest to southeast, and is especially well exposed in the northeast corner of Amund township, north and east of Castor-Blanc lake. The Maniwaki-Mont Laurier highway passes from west to east across the middle of the body, and the Montreal-Senneterre highway crosses it near its north margin.

The writer has provisionally placed this intrusion in a group by itself, as it differs in some characteristics from the other syenites found in the region. It did not seem reasonable to correlate it with the alkaline syenites of Kiamika and Turgeon townships, to be described later. Also, by its general appearance and total lack of schistosity, it seems distinct from the porphyritic quartz syenite last discussed. However, as noted later, it is possible that it is an unusual facies of the latter. Apart from the main mass and a few nearby outcrops that are satellitic to it, the pink syenite was observed at only one other locality, five miles to the north, or one mile southwest of Cowie lake, in Sicotte township. At this place there is only a small, poorly defined occurrence which appears to be related to the porphyritic syenite so largely developed in this section of the area. Nowhere else were the two varieties of syenite seen in proximity.

The main body of pink syenite is remarkably homogeneous except for inclusions of Grenville rocks in its outer portions. Some of these inclusions are of good size, and gneiss, sphene-bearing amphibolite, and limestone are represented. The best exposed of the inclusions are near

the northeast margin of the body, in the road-cut on lot 60, range VIII of Aumond. Here, there is a mixed zone where bands of grey gneiss, which are highly feldspathic and much intruded by small dykelets of pink aplite, grade over to a migmatite and are enclosed by the pink syenite.

The syenite is a fine to medium grained rock, devoid of foliation, except locally around the margin of the mass. The feldspar is microcline together with a little plagioclase. Quartz is rare and, if present, is only in very small amount. Biotite is relatively abundant and quite commonly is partially altered to chlorite; it encloses crystals of zircon surrounded by pleochroic haloes. Hornblende is generally present. Sphene is common, occurring as small crystals in both the feldspar and the hornblende. The rock contains a little pyrite, and many of the joint planes traversing it are cemented by green epidote.

This syenite has much in common with one that occurs in Kensington township, near Maniwaki. According to Wilson (9, p.126), the rock there is pale pink in colour, contains biotite and hornblende, and lacks schistosity. However, it differs from that of Aumond township in containing large crystals of feldspar, which give it a porphyritic appearance.

As far as may be judged in the absence of exposed contacts, the pink syenite mass in Aumond township is bounded on three sides by Grenville rocks and appears to terminate on the south against a body of granite, whose age relationship to the syenite is not known. Dykes of pink aplite and of pegmatite cut the syenite body, particularly on lot 60, range VI. However, as such dykes are found intruding all the other igneous rocks of the area, they throw no light on the relative ages of the syenite and granite. Of more interest is an outcrop of typical Guénette-type granite on the south side of the Senneterre highway, half a mile west of Giroux lake, in Sicotte township. This outcrop lies within the area of outcrop of the pink syenite body, but, unfortunately, the two rock types are not seen in actual contact. If the granite, presumably a dyke, actually does cut the pink syenite, it would seem that the latter is to be regarded as a facies of the porphyritic quartz syenite.

Pink Aplitic Granite (Guénette Granite)

A very complete study of the Guénette granite mass was made some years ago by Osborne (4, pp.40-49), who believes it to be a huge dyke about one mile wide, with northeast-southwest strike, cutting vertically through the Grenville rocks. The writer, after having made numerous traverses across the mass, believes it to have a somewhat different form. It appears to be less regular in outline, and wider, than stated by Osborne, extending over range VII of Rochon township, A, B, and C of Campbell, and V and VI of Boyer. Its greatest dimension is about three miles. Isolated outcrops of the granite were seen elsewhere in Boyer township and as far eastward as range VII of Turgeon, four miles from the main mass, indicating that the intrusion continues for at least this distance toward the east-northeast.

Osborne gives the following description of the Guénette granite: "It is fine-grained and the constituent minerals tend to be rounded and without rectangular boundaries. They are microcline, quartz, albite, biotite, and muscovite, with small amounts of titanite, magnetite, apatite, allanite, tourmaline, and fluorite". The presence of allanite, a radioactive mineral, in grains surrounded by a slight red stain, is one of the particular characteristics of the Guénette granite.

The rock is somewhat gneissic. Although, as stated by Osborne, the grain is generally fine, it varies somewhat from one part of the body to another. A clean-cut joint system greatly assists quarrying operations.

Fine grained pink granite with little or no schistosity, closely resembling the Guénette granite, was seen in many places in the west part of the Sicotte map-area, notably in Aumond, Sicotte, Egan, and Lytton townships. In some of these occurrences, the granite is in well defined dykes, usually intruding Grenville rocks. Many of these dykes are too small to be shown on the map, but some have a width of a few tens to a few hundreds of feet. In general, their attitude cannot be precisely determined, because of limited outcrop, but, where readings could be taken of the strike, it was found in most cases to be within 15 degrees east or west of north. In other places, these pink granites occur as narrow, elliptical bodies which, in outcrop, usually have the form of steep-sided ridges, especially where they intrude the less resistant Grenville formations. One of these bodies, at Saint-Cajetan, in Aumond township, has a length of about a mile and a half, but none of the others exceeds half a mile in length. It is likely that the pink granite dykes which are so numerous in certain districts, notably in the northwest part of Lytton township and the southeast part of Mitchell, stem from one or other of these lenticular bodies.

There is certainly some relationship between all these fine grained pink granites in the western part of the area. Furthermore, all bear a more or less close resemblance to the granite at Guénette. All have essentially the same mineral composition. The feldspar is microcline, which may be accompanied by a little orthoclase and plagioclase. Quartz is generally abundant. Biotite - enclosing zircon crystals with pleochroic haloes - and muscovite are invariably present, and usually there is some secondary chlorite. The principal accessory minerals are sphene, fluorite (in small, mauve specks), and apatite. The writer did not observe allanite - present in the Guénette granite - in any of the thin sections he examined, but in most of them there are tiny red stains which may be the result of alteration of that mineral. Practically all these granites have a well developed joint system, such that the rock separates naturally into regular blocks, as it does at Guénette. The attitude of these joints, some of which are coated with epidote, varies somewhat from outcrop to outcrop.

Among the slight differences that were noted between the various pink granites must be mentioned colour: some are a little redder, others a little more



A.—The alluvial plain at St-Jean-sur-Lac (Robertson township) and the Mont Laurier-Senneterre highway. To the north, the granitic hills of Pope township and, in the right background, the summit of Mount Sir Wilfrid (Montagne du Diable).



B.—Gatineau river, looking upstream from the bridge on the Mont Laurier-Senneterre highway (boundary of Sicotte and Lytton townships).



C.—General view of Mont Laurier from the southeast. The part of the village seen in the foreground is built on a terrace of Lièvre river.

PLATE II

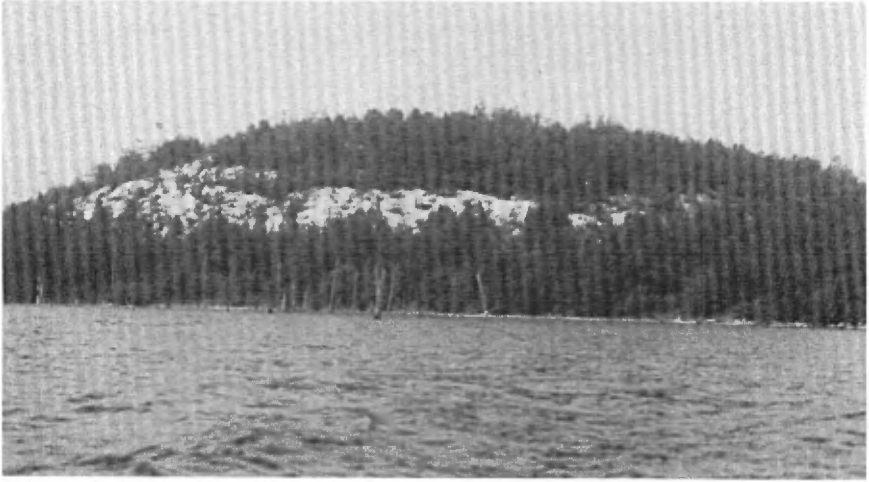


A.—Kiamika village, in the valley of the same name. In the background is seen the Laurentian peneplain underlain here by Grenville gneisses and quartzites.

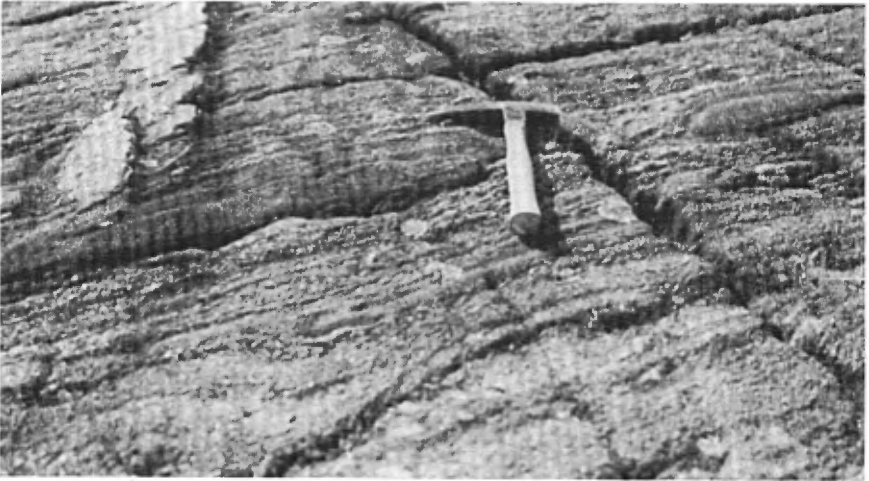


B.—The north slope of Mount Sir Wilfrid (2,569 feet), seen from Courtemanche lake (Major township).

PLATE III



A.—Montagne Blanche, on the west shore of Philomène bay (range VIII, Baskatong township).



B.—Garnetiferous paragneiss, with lenses of pyroxenite formed from bands that have been stretched and broken. One of these lenses is seen at upper right. At the left, a stringer of aplite normal to the banding and offset is seen. Lot 48, range VI of Robertson township.

PLATE IV



A.—Outcrop of limestone containing numerous inclusions of white pyroxenite which are more resistant to weathering and stand out in relief. Lot 27, range VI, Robertson township.

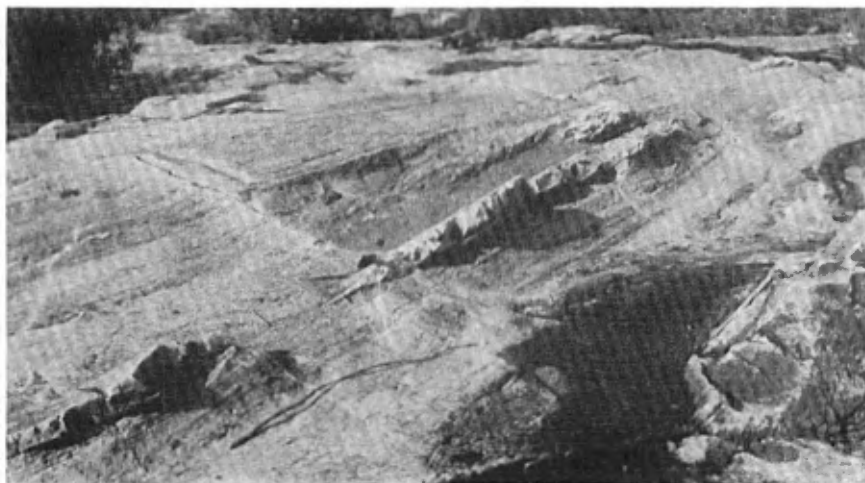


B.—Boulder of garnetiferous paragneiss. It is highly granitized and shows the pygmatic folds characteristic of the migmatites. Lot 48, range II, Pope township.

PLATE V



A.—Granitized paragneiss (migmatite) cut perpendicular to the banding by a stringer of aplite which contains angular fragments of gneiss. Lot 6, range VI, Sicotte township.



B.—Stretched and broken dyke of fine-grained, grey granite in Grenville limestone. West bank of Lièvre river, just below Mont Laurier.

PLATE VI

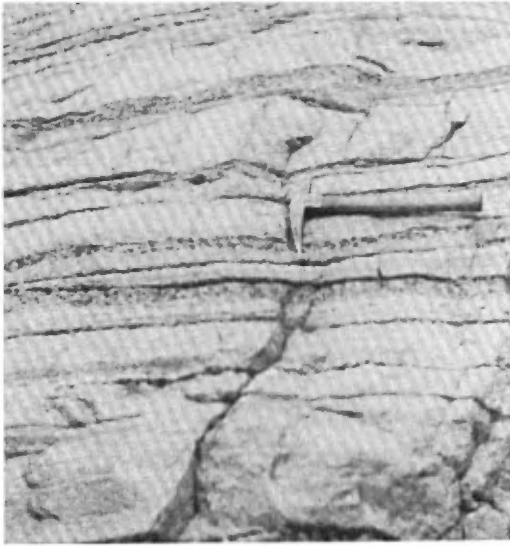


A.—Small concentrations of silicate minerals standing out in relief on the surface of an outcrop of limestone. East side of the Lièvre River valley (lot 12, range 1, Campbell township).

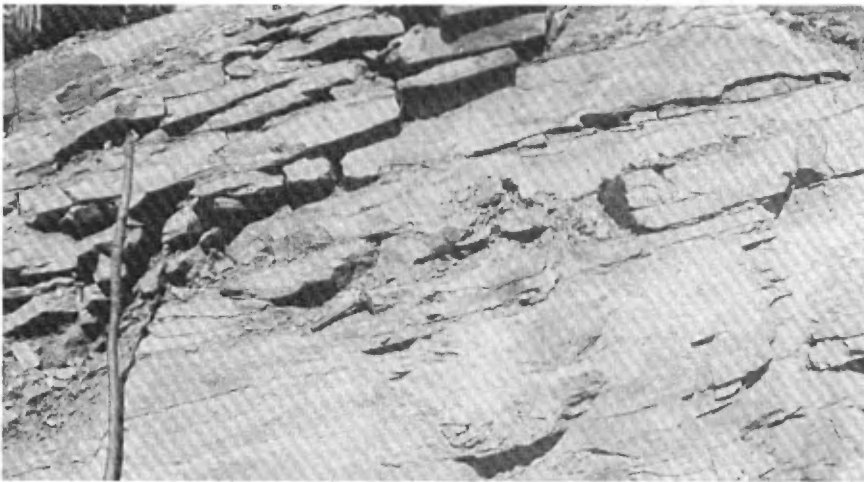


B.—Quartz syenite with inclusion of amphibolite, cut by aplite dykes, which are in turn cut by a pegmatite dyke. Lot 16, range VI, Sicotte township.

PLATE VII



A.—Alternating horizontal bands of quartzite and garnetiferous gneiss. Lot 36, range VII, Robertson township.



B.—Joints, giving the porphyritic quartz syenite an appearance of stratification. Cutting on the new Abitibi highway (lot 21, range IV, Campbell township).



A.—Outcrop of graphitic limestone on the Mont Laurier-Buckingham road. Lot 21, range IV, Bouthillier township.



B.—Dam on Lièvre river at l'Original rapids, at Mont Laurier. In the foreground, an outcrop of garnetiferous paragneiss.



C.—The Brodie quarry, from which is produced the pink Guénette granite. Campbell township.

greyish, than the type rock at Guénette. Also, because of variation in the amount of ferromagnesian minerals present in the rock, some occurrences are paler than the average, as is the rock exposed on range I of Egan township, west of Sapin lake. The little crystals of fluorite that seem to characterize these granites are lacking in some occurrences. The quartz content varies. For example, the narrow dykes that cross the road north of Castor Blanc lake, in the west part of range VI of Aumond township, and the larger body at Saint-Cajetan, which is well exposed along the Maniwaki road on lot 43 at the IV-V range line of the same township, are lower in quartz than is the rock elsewhere. The grain size, too, is subject to variation. Even in a single outcrop, the grain may range from fine to very coarse and almost pegmatitic.

The pink Guénette granite, as well as the numerous dykes and small bodies which the writer has correlated definitely with this intrusive, are most commonly found cutting Grenville rocks, but there are also, as has been mentioned, bodies of very similar pink granite closely associated with, and intrusive into, the porphyritic quartz syenite. The latter is regarded as the equivalent of the Pine Hill syenite, in which case it represents the final phase of the Morin series of intrusives. If, as the writer believes, the numerous bodies of pink granite cutting the porphyritic quartz syenite are to be correlated with the Guénette granite, this intrusive must represent an aplitic facies of the Morin series of intrusives.

Gabbro and Norite

There are several bodies of gabbro and related basic rock in the area. By far the largest of these, about eight miles long from east to west by three miles wide, lies at the junction of Kiamika, Boyer, and Montigny townships, the greater part of it in Montigny. This body is rather irregular in shape and adjacent to it are other small bodies of gabbro which doubtless stem from it. In the Sicotte map-area, a body, rudely circular in outcrop with a cross-section of about three miles, surrounds the northern half of Gónier lake, in Pope township, and a mass of about the same size lies between the Mont Laurier-Senneterre highway and Bois-Franc lake, in Robertson township. Smaller masses occur elsewhere in the area, chiefly in Sicotte and Lytton townships. The presence of erratics in places remote from known outcrops, notably west of lac des Ecorces in Campbell township and at the north end of range VIII of Aumond, indicates the existence of other bodies of gabbro, hidden by vegetation and overburden.

The rock in the several bodies, and indeed in different parts of any one body, is not all of uniform composition or appearance. The grain size is very variable, as is the relative proportion of dark and light minerals. Schistosity is strongly developed in some of the rock, totally lacking elsewhere. In general, however, the gabbro is a dark grey rock of fine to medium grain; rarely it is coarse and even pegmatitic. The texture is always granular, never ophitic. In addition to labradorite and augite, some of which is titaniferous, the rock

usually contains biotite, apatite, and magnetite; garnet is of rare occurrence. The pyroxene is often uralitized, but hornblende occurs also as a primary mineral. None of the gabbros examined contained olivine; on the other hand, a little quartz was present in some of them. In some facies, the pyroxene is in part or entirely hypersthene, and the rock becomes a norite. The rock outcropping a little north of Lacordaire lake, near the pond known as Modeste lake (Boyer township), is of this type. At this locality, also, there are erratics which are so coarsely crystalline that the rock is a true gabbro pegmatite. In some facies of the rock, biotite is so abundant as to be a main constituent. Examples of such highly micaceous gabbro are found in outcrops at Génier lake, Pope township, and in range I, Lytton, along the Senneterre highway.

Gradations are found from normal gabbro to types in which plagioclase greatly predominates over pyroxene, and very rarely, and then only locally to anorthosite, containing little or no pyroxene or other ferromagnesian mineral. The rock outcropping at François creek, on lot 4, range VIII of Montigny, along the road leading from Bédard to d'Amours lake, is a typical anorthosite, very light coloured and composed almost solely of broken and crushed plagioclase crystals. Similarly, the gabbro exposed in 'bluffs' three-quarters of a mile north of Dumouchel lake, in Pope township, shows differentiation, in places to rock composed almost exclusively of plagioclase.

In some occurrences, the gabbro exhibits no trace of schistosity and does not seem to have undergone any deformation. The rock outcropping along the Canadian Pacific railway at Campeau station, Campbell township, is of this type. In other places, the rock shows no obvious schistosity in outcrop or hand specimen, but when examined in thin section under the microscope is seen to be much crushed. The minerals are bent or broken and exhibit undulose extinction to a marked degree. Much of the gabbro is of this type. In still other occurrences, the rock is definitely gneissic. One of the most strongly foliated of these rocks observed by the writer is a micaceous gabbro, high in magnetite, which forms a hill on range VIII of Robertson township, between Paradis lake and lac des Vases.

The position of the gabbro in the sequence of igneous intrusion in the area is doubtful. In the table of formations, on an earlier page, it is indicated as one of the youngest of the intrusive rocks, but this is an arbitrary assumption, not based on any conclusive evidence. Actually, it is very possible that the several bodies of gabbro occurring in the area are not all contemporaneous. Only more detailed studies in the field in this and neighbouring areas will permit solution of this problem. As a general rule, in the Laurentian country, gabbro accompanies anorthosite, and the one rock grades into the other. Such gabbro is thus a member of the Morin (anorthosite) series, older than the granites and syenites of the series. There being no intrusive body of anorthosite in the present area, however, there is no sound basis for correlating the gabbro masses - although locally they have anorthositic differentiates -

with the Morin series, or even with one another.

Small dykes of aplite, and more rarely of pegmatite, cut the gabbro here and there, but in general they do not aid in determining the age of the latter relative to the other main intrusive rocks of the area. Along with stringers of aplite, irregular dykes of granite with bluish quartz cut the gneissic micaceous gabbro half a mile north of Dumouchel lake, in Pope township. Such bluish and slightly opalescent quartz grains are characteristic of some of the granites which the writer has grouped with the acidic phase of the Morin series. It is therefore possible that the dykes cutting the micaceous gabbro are to be similarly correlated, in which case the gabbro would be pre-Morin-series. Elsewhere, in the Nominungue map-area, there are indications, in a number of poor exposures, that the gabbro cuts porphyritic quartz syenite, which would make the gabbro post-Morin-series; and again, in the north of Robertson township, on ranges XI and XII, where gabbro and porphyritic quartz syenite are in proximity, it would appear that there is a gradation from one to the other.

Mention may be made here of some basic rocks of doubtful origin. These are gneissic rocks having the composition of gabbro, but it is possible they are of metamorphic origin and represent a very basic variety of the paragneiss or pyroxenitic amphibolite. Such material occurs as very large inclusions in the granite east of the south end of baie au Sable, in Pope township. The main outcrops are in range II of Lytton township, chiefly between lots 10 and 15. These have been mapped with the Grenville.

Alkaline Syenite

In mapping the Labelle-L'Annonciation area, which adjoins the present map-area on the east, Osborne (5, pp.28-31) discovered some outcrops of alkaline syenite just north of Tibériade lake, in the extreme northwest corner of his map-area. On tracing these northward, beyond the limit of the map-area proper, he found, and outlined in a sketch-map, a large body of such rock. This mass, it has now been found, extends westward into Turgeon township to occupy the northeast corner of the present map-area for a north-south length of nearly six miles and a width of three to four miles.

This alkaline syenite, which is almost entirely lacking in quartz, differs considerably in appearance from the porphyritic quartz syenite, described on an earlier page. In particular, it has no vestige of schistosity. It is also easily distinguished from non-gneissic pink syenite of Aumond township.

The rock is coarsely crystalline and often exhibits a miarolitic texture. It is composed of large crystals of microcline and albite, and biotite, which locally is abundant. Nepheline was not seen in any of the hand specimens or thin sections examined. The rock usually has a pale grey colour; rarely, it is pinkish-grey. It disintegrates rapidly into a feldspathic sand, in which large, unaltered fragments of microcline persist. Outcrops

of any sort are so rare in this part of the map-area, which is heavily wooded and where there are widespread morainal and fluvial deposits, that the western boundary of this alkaline syenite body could be determined only approximately.

Cutting the syenite in many places are dykes, some of pink aplitic granite, others of an almost black rock of quite unusual type. It is composed of pyroxene, biotite, abundant magnetite, and a little apatite and pyrite, and is doubtless a pyroxenite of igneous origin.

In the course of a reconnaissance carried beyond the limits of the map-area, as far as the southwest shore of Kiamika lake, the writer noted an outcrop of syenite similar to that of Turgeon township, which would indicate that this body extends for a considerable distance toward the northwest.

Far distant from the Turgeon township occurrence, outcrops of somewhat similar alkaline syenite were found by the writer on either side of Lièvre river, in Kiamika and Bouthillier townships. In Kiamika, the rock outcrops in several places between Ferme Rouge and Crozat lake and all within less than a mile of the east bank of the Lièvre. The main outcrop forms a long, narrow hill-ock which extends along range-line IV-V from lot 10 to lot 15. In all these outcrops, the rock is very fresh, but it disintegrates rapidly. West of the Lièvre, in range II of Bouthillier township, outcrops of the syenite extend, north-south, for a distance of more than a mile, and over a width of about half a mile immediately west of Rouge lake.

In these occurrences, the alkaline syenite is very similar to that in Turgeon township. It is very coarse grained, almost pegmatitic in places, has a somewhat microlitic texture, and is devoid of schistosity. The usual colour is pale grey. The chief constituent is albite, and other minerals usually present are hypersthene, biotite, magnetite, apatite, and sphene. Quartz is very rare, and nepheline was not observed. A peculiarity of this syenite is a notable content of calcite, whose origin is quite obscure. It may be secondary, due to circulation of calcium carbonate bearing waters after consolidation of the magma, or, alternatively, to alteration of the calcic minerals contained in the rock. It is more probable, however, that the calcite derives from the assimilation by the magma of blocks of Grenville limestone at the time the intrusion occurred. This hypothesis has been put forward by Adams and Barlow (18, pp. 232-234) to explain the presence of calcite in the syenites of the Haliburton and Bancroft areas, Ontario, rocks to which the alkaline syenites of Turgeon township, and of Bouthillier and Kiamika townships, bear certain similarities. However, neither nepheline nor corundum, which are abundant in the Haliburton-Bancroft syenites, have yet been found in those of the present map-area.

Minor Intrusions (Dykes and Sills)

In various parts of the area, the Grenville rocks and the main intrusive bodies are cut by dykes, which range in composition from acidic to basic and are evidently not all of the same age. In general, it is not possible to determine the time of intrusion of any of these dykes, beyond that they are later than, or more or less contemporaneous with, the rock they intrude. However, on lithological grounds, or because of intimate association, some of them may be correlated, at least tentatively, with one or other of the main intrusive bodies. This is the case with many of the acidic dykes - aplite, pegmatite, and granite - which are very numerous in certain parts of the area and which have been referred to on earlier pages in discussing the rocks they intrude, as, for example, the pink granite dykes cutting porphyritic quartz syenite in Lytton and Sicotte townships, which very closely resemble and are correlated with the Guénette granite.

Similarly, there are dykes of biotite microgabbro and dolerite cutting the large mass of gabbro, and also adjacent rocks, in Montigny and Boyer townships that are thought to derive from the same magma as the gabbro. Some of these dolerite dykes, the largest twelve feet wide, cut the gabbro just west of Modeste lake, near the northeast corner of the gabbro mass, in the southern part of range IV of Boyer township. They are black, dense, very fine grained rocks, and they have a well defined ophitic or 'diabase' texture. On the east side of the lake is a dyke of feldspathic andesite, dark in colour due to a high content of magnetite. About three miles northeast of here, in range II of Boyer township, on the hills above Lac Sagouay village, a dyke of dolerite cuts an outlier of the gabbro mass which is surrounded by Grenville rocks. About two miles due south of Modeste lake, and only a few hundred feet from the southern margin of the gabbro mass, the porphyritic quartz syenite along the north shore of Adams lake, in range IV of Montigny township, is cut by a group of biotite microgabbro dykes. The strike of all these dykes is between north and northeast.

A quartz-biotite microdiorite dyke, a foot and a half wide, was seen cutting crystalline limestone on the east side of the Lièvre, two miles south of Mont Laurier. It is stretched, broken, and offset, indicating clearly that it was deformed at the same time as the enclosing limestone. It may be noted that, just north of Mont Laurier, a body of diorite containing a little quartz is closely associated with, and grades into, porphyritic quartz syenite.

No basic dykes were observed in the Sicotte map-area west of Mont Laurier, but several fine grained, highly micaceous dykes or sills of lamprophyric type were seen in some places cutting the Grenville rocks. One of these, a minette, cuts the limestone in the quarry near the Mercier dam, in the southeast corner of Mitchell township, and a similar dyke, twenty or more feet wide, cutting paragneiss, is exposed along the Mont Laurier-Senneterre highway on lot 51, range XII of Robertson township. Not far north of here, on lot 56, a dyke of quartz microsyenite, several feet wide, cuts porphyritic

quartz syenite. It is a grey coloured, porphyritic rock, with phenocrysts of orthoclase and biotite in a matrix of feldspar, quartz, biotite, apatite, and magnetite.

Pleistocene and Recent Deposits

Superficial deposits of glacial, fluvial, or lacustrine origin are of great extent, and occupy all the low lying areas.

Glacial Deposits

The Pleistocene glaciers, which completely covered the region, have everywhere left clear evidence of their passage. Most of the rock outcrops, with the exception of the less resistant limestones, which suffered stream erosion after the retreat of the ice, show a 'roche moutonnée' form, and especially hard rocks such as the quartzite exhibit a remarkably high polish.

Glacial striae show that the general movement of the ice was in a south-southeast direction. Most of those observed strike between S.7°E. and S.20°E. Rarely, the striae have a somewhat different trend, indicating a local change in the general direction of ice movement.

The retreating ice left huge accumulations of morainal material on the surface of the region, and here, as elsewhere throughout the Canadian Shield, these deposits have greatly influenced the evolution of the stream system, changing the courses of rivers and forming innumerable lakes. Post-glacial erosion has resulted in the partial removal of the most easily transported morainal material, in places leaving in the valleys and on the hill-sides only unsorted accumulations of boulders. It is worth noting that, in general, the ice carried boulders only short distances, a feature that was emphasized by Osborne (5, pp.11-13) in his report on the Labelle-L'Annonciation map-area. When several large erratics of the same rock type are found at any place, it is almost a certainty that they come from a not far distant outcrop, most likely to be found no more than a few miles to the northwest. Thus examination of the moraines may greatly facilitate geological investigations.

In the two maps accompanying this report, morainal deposits have not been shown, but it must be understood that they are present almost everywhere, except where slopes are steep. Where the relief is slight, morainal material may completely blanket the bedrock over large areas. Moraines are particularly strongly developed northeast of Bédard (Boyer township), north of Boyd lake (Campbell township), east and south of Génier lake (Pope township), and along the Pope-Robertson boundary line north of Saint-Jean-sur-Lac.

Glacial effects are also made evident by numerous eskers, which are gravel deposits forming long, narrow ridges about fifty feet high. The longest eskers have a slightly sinuous outline, with short sections trending southwest, but in general their direction is south-southeast, according very well with the strike of the

striae. The best developed eskers are in Campbell, Robertson, Pope, Sicotte, and Lytton townships.

Some eskers can be traced for several miles. A typical one follows the east bank of Gatineau lake, on range X of Robertson township. Another extends southward for one and a half miles from the south end of this lake. Some of the islands in the numerous lakes of the area are remains of eskers, as is the case with those in Pope lake, which are the prolongation of a group of large eskers extending for two miles between this lake and baie au Sable.

The best example of an esker is that which follows the western arm of Philomène bay on its west side and which continues to the southwest end of Grier lake, in Sicotte township. From north to south, where it begins on lot 50, range IV, to its end on lot 6, range VI, it is seven and a half miles long.

Fluviatile and Lacustrine Deposits.

Fluviatile deposits of boulders, gravel, sand, clays, and muds are very thick in many places and form a succession of terraces along most of the larger valleys. From place to place, these terraces vary in number and in elevation above the neighbouring river. The village of Ferme Neuve is built on the lowest terrace of the Lièvre, between 20 and 25 feet above the river. Désert river has two well defined terraces at 60 and 120 feet, respectively, above river level. There are terraces, also, along valleys drained by insignificant streams, relics of rivers which, after the retreat of the ice, were of important size. Such terraces may be seen in Loranger township along the Sawga - a stream which is little more than a brook, and also along the valley extending from Saint-Jean-sur-Lac toward lac des Isles, Robertson township, in which must formerly have flowed a river coming from the northwest.

The long sand plain, in the middle of which is situated the village of Saint-Jean-sur-Lac, at an elevation of about 800 feet, is an ancient lake basin. Later stream erosion has cut into it considerably, but not enough to expose the bedrock. The exposed thickness of the unconsolidated material is about fifty feet and the actual thickness probably more. These deposits are composed, for the most part, of slightly ferruginous yellow quartzitic sand, as are all the river sands of the region, and accompanying them are boulder beds, gravels, and grey clay. Rare outcrops of Grenville rocks rise above the alluvial deposits and form small, rocky hillocks here and there.

The other alluvial deposits of the area, indicated on the maps by a distinctive colour, are similar to those of the Saint-Jean-sur-Lac plain. In some places, they are chiefly sand, in others, clay. Differences in vegetation betray differences in the nature of the deposits. Stands of jack pine are found in the sandy areas, while spruce and cedar are more common in the damp, clayey areas. Clay deposits usually exhibit a characteristic banding.

No indications of marine deposits of Champlain time were found, even in the lowest parts of the

area, around Montcerf and in the valley of the Gatineau, which are only about 600 feet above sea level.

STRUCTURE

The somewhat irregular topography of the area does not seem to demonstrate any control attributable to geological structure, unless it be true that the nearly north-south direction of the main valleys accords, as it seems to, with several large faults.

The bodies of igneous rock which have intruded the Grenville or one another give rise to rather massive topographic forms of irregular outline. At first glance, the contours of these bodies, as mapped, show no particularly significant relationship to the structure as a whole. It must be remembered, however, that the mapped boundaries of most of them are only approximate. If vegetation and overburden were absent, making it possible to determine their precise outlines, it would doubtless be revealed that some of these igneous rock bodies have a shape quite different from that shown on the map. It is therefore, in the writer's opinion, inadvisable to draw, from the necessarily ill-defined shapes attributed to the intrusions, conclusions concerning the vastly complex structure of the Precambrian in this part of the Laurentians. With our present limited knowledge, it can be stated, only, that some of the intrusive masses have a somewhat elongated outline and that the direction of elongation is generally toward the north or northwest. The great body of porphyritic quartz syenite in Sicotte township is most significant in this respect; and it is observed that, near it, the schistosity of the Grenville rocks quite regularly is oriented parallel to the margin of the intrusion.

There must certainly be faults of important displacement in addition to the small faults which may be seen wherever the rocks have been subjected to even minor dynamic stresses, but it is difficult to obtain direct evidence of their existence. As mentioned above, the main valleys are probably developed along major faults with a general north-south strike (e.g., the Lièvre, the Kiamika below lac des Ecorces, and Désert river) or north-northwesterly strike (e.g., the Gatineau between the Mercier dam and Brûlé falls). This latter strike is also seen in the perfectly rectilinear depression in which lie baie au Sable, Pope lake, and Gatineau lake, and which, before being partially obstructed by fluvio-glacial deposits, must have been the channel of a large stream.

A study of aerial photographs of the region reveals the presence of a great number of linear structures, traceable in some instances for fairly long distances. Some are marked by straight-flowing sections of rivers; others by straight, rocky lake shores, which are often in marked contrast to curving opposite shores. These linear structures seem never to correspond to geological boundaries. If they are faults, they are no doubt faults along which there has been very slight movement. They may, on the other hand, be nothing more than simple fractures, tension cracks rather than true faults, which have been developed in rocks of low resistance and which are now accentuated by the effects of erosion.

The Grenville series has been tremendously deformed by successive orogenic movements, and its structure is most complex, the more so because of the great heterogeneity of its several members. The presence of a multiplicity of small, very close folds, as well as zones of shearing and fracturing, has in general obliterated all evidence of the direction of the regional movements which have affected the whole of this great geological unit. The intensity of this small-scale folding, and the wide variation in the strike of the folds, are both well shown by the great diversity in strike and dip of both bedding and schistosity over short distances. There are some places, of course, where, despite this complexity, the strike and dip of the schistosity may be locally regular. It is particularly noticeable that, where blocks of Grenville rock occur as inclusions in an intrusive rock, their schistosity is essentially parallel to that of the igneous rock. However, in every case where an area of appreciable size is considered, it is easy to demonstrate that there is no determinable system to the structure. It is impossible therefore, in the present state of our knowledge, to make use of observations of strike and dip to determine the attitude of the major folds.

Most of the intrusive rocks also have undergone more or less pronounced deformation. In some, this has taken place before their complete consolidation, as their microscopic structure shows; in others, or in addition, the deformation has followed consolidation. The common stretching and fracturing of stringers of aplite and pegmatite cutting these rocks is evidence of this. These, sometimes violent, deformations have produced zones of shearing and crushing in which the original structure of the rock has been completely obliterated; true tectonic breccias and mylonites are the result. These dynamic structures may be produced in very different sorts of rock. Thus, on lots 13 and 14, range II of Sicotte township, along the new Senne-terre highway, mylonitized granites and pegmatites intrude Grenville rocks. On range VI of Montigny township, east of Pie IX lake, a zone of mylonite lies well within the porphyritic quartz syenite mass. On lot 57, range I of Egan township, paragneisses intruded by aplite have been converted into tectonic breccia. The impure crystalline limestone that forms a small hill in Montcerf village has suffered a similar change. Among many other examples should be mentioned the limestone at chute du Chat, on Gatineau river (Lytton township), which has been crushed to mylonite.

ECONOMIC GEOLOGY

In many parts of the Canadian Shield, greatly deformed igneous and metamorphic rocks of Precambrian age similar to those underlying the present area have been found favourable for the occurrence of certain types of mineral deposits. Not far to the south, in Argenteuil, Gatineau, Papineau, Hull, and Pontiac counties, Grenville rocks which seem to be very similar to those in the Nomin-ningue-Sicotte area, contain deposits of magnetite, molybdenite, graphite, apatite, mica, magnesite, and feldspar which have been, and still are, successfully exploited.

The object and the duration of the writer's work did not permit of detailed prospecting in the area, but numerous localities were visited in which there are occur-

rences of interest of one or other of the above mentioned minerals. Some of them were already known, others were new. With few exceptions, the deposits seen do not appear very promising. In the pages that follow, however, all of them are briefly discussed, because such a discussion may furnish useful information for future prospecting, and make it possible to avoid undertaking useless work on occurrences of no economic interest.

Metallic Minerals

Copper

Copper mineralization was seen at various places, but only in negligible amount. A few veinlets of chalcopryrite were observed in outcrops of paragneiss near the church in the village of Nomingue, and also, with malachite staining, in closely folded pink gneissic granite which, with associated pegmatite, forms several irregularly oriented escarpments on the west shore of Nomingue lake, in lot 54, range IV of Loranger township.

Settlers informed the writer that some work had been done about ten years ago on a copper prospect on lot 23, range IV of Turgeon township. The country there is heavily wooded, and a search for the prospect met with no success. However, the rock outcropping in the vicinity, which is alkaline syenite, showed no trace of copper minerals.

Work on the new highway to Abitibi about one mile west of the village of Lac Saguay has exposed migmatite which in places contains specks of bornite.

Veinlets of chalcopryrite may be seen in large inclusions of amphibolite in pink Guénette granite at several places in the Brodie quarry on lot 4, range A of Campbell township.

Iron

On lot 13, in the centre of range II of Montigny, a number of ill defined outcrops of magnetite are distributed over a distance of about thirty feet. They are rusted on the surface and strongly affect the compass needle. Analysis of a composite sample taken from several of these blocks showed an iron content of 60.93 per cent, without a trace of titanium. The magnetite is closely associated with amphibolitic pyroxenite. The nearest outcrop of bedrock is of paragneiss and amphibolite. The magnetite thus is of metamorphic origin and is related to the Grenville rocks. The occurrence is in a wooded area, but is only one mile southwest of the Canadian Pacific Railway line. Further prospecting would, perhaps, be worth while to determine its possible importance.

Occurrences of magnetite with altogether different associations, consisting of segregations of the mineral in various types of acidic igneous rock, were observed at several localities. None of the segregations seen are more than three inches in diameter, but in some occurrences they are very numerous, as for example in the alkaline

syenite of Turgeon township, especially on lot 38, range VI; in pegmatite intruding gneiss exposed in road-cuts on the new highway one mile west of Lac Saguay; and in light-coloured and pegmatitic granites which cut the paragneiss on the old Gouin road on lot 13, range IV, Boyer township. Similar concentrations were seen in quartz veins traversing a small granite intrusion on lot 50, range IV of Kiamika township; and in pegmatite dykes cutting pink gneissic granite which is included in paragneiss outcropping near the top of a small hill on lot 16, range IV of Campbell township, not far from the west shore of lac des Ecorces. None of these occurrences are of any economic interest.

Ochre

The writer saw no deposits of ochre, but, according to villagers of Loranger, there is a 'paint mine' near the line between lots 58 and 59 in the east part of range VII of that township. This is probably a small deposit, such as are common in the Lake Nominuingue area, formed as the result of leaching, by circulating ground-water, of iron oxide from the fluvio-lacustrine quartz sands which cover the bedrock so widely.

The writer was informed that there is an ochre deposit also at Curtis lake (lac de la Montagne), which parallels, and is about half a mile east of Gatineau river, on lots 28 to 34, range I of Sicotte township.

Molybdenum

Molybdenite is of quite frequent occurrence as widely disseminated flakes in Grenville rocks, especially the rusty-weathering paragneiss and the metamorphic pyroxenite, and more rarely in granitic rocks.

Its frequent occurrence in the pyroxenite is explained by the fact that this rock has relatively high porosity and as a consequence afforded easy passage for the emanations from the acidic magmas which furnished the molybdenum-bearing solutions. Several examples of this type of occurrence are to be found in the area, and, genetically, they are very closely comparable to the occurrences described by Eardley-Wilmot (19, pp.140-156) in the southeast part of Pontiac county.

There are scattered indications of molybdenite mineralization over a fair sized area just south of Mont Laurier on the hills overlooking the east bank of the Lièvre, on lots 19, 20, and 21, range I of Campbell township. These occurrences are covered by claims Q.24511-12 (lots 18 and 19) and Q.25481-82 (lots 20 and 21), held by H. Larmache, of Mont Laurier.

Molybdenite was first discovered on these claims in 1935, on lot 19. To date, the only work done on the showing consists of a few trenches, not more than a few feet deep. Most of this work was done in May and June, 1939.

The occurrence nearest Mont Laurier is on lots 20 and 21, on a bare, steep hill overlooking the Montreal

highway. This hill, and all the Lamarche claims, are underlain by Grenville rocks, chiefly paragneiss, with some intercalations of limestone and pyroxenite. The paragneiss is injected lit-par-lit by porphyritic granite, and is well banded. On the summit of the hill, the banding strikes east-west; on the east slope, it strikes S.60°E. and dips 50° toward the southwest. Much of the gneiss is rusty weathering, and is cut by numerous small pegmatite dykes containing biotite and some tourmaline. Some of the dykes parallel the banding, others are at right angles to it. The occurrences of molybdenite are most numerous on the southeast slope of the hill, where six trenches have been dug. The molybdenite, in flakes up to one inch in diameter, occurs principally in the rusty weathering gneiss, but there is some also in the pegmatite dykes. In places, it is accompanied by its oxidation product, molybdite. The mineralization is much scattered. The gneiss is only mineralized in part, and, even where mineralized, the flakes of molybdenite are widely disseminated.

At the original discovery, on lot 19, the molybdenite is chiefly associated with metamorphic pyroxenite which, here, is a fairly friable, green rock composed essentially of diopside and quartz with streaks of pyrrhotite, grains, and veined by phlogopite with a little green apatite. Beds of limestone are intercalated with the pyroxenite, and quartzites and garnetiferous gneisses outcrop nearby. The molybdenite occurs as isolated flakes and small, scaly aggregates which are very irregularly distributed through the pyroxenite over a length of 100 feet. Although a little more encouraging than that on lots 20 and 21, this showing is still very poor. It is possible that the solutions that were responsible for the mineralization were derived from the same magma that gave rise to a wide pegmatite dyke which outcrops a little to the west, on the same lot, at a place where feldspar has been produced.

The writer saw no other occurrences of molybdenite in the neighbourhood of Mont Laurier, but was informed by Mr. Lamarche that the mineral had been found in the garnetiferous gneiss along Lièvre river during the construction of the hydro-electric plant in the village.

Occasional flakes of molybdenite were observed by the writer in pale green pyroxenite on lot 44, range VI, Aumond township, near the west shore of Castor Blanc lake.

At several places in the area, molybdenite is associated with intrusive rocks. Some was seen in quartz and pegmatite veins which cut the gneiss and amphibolite on both sides of the church on top of the hill in the village of Nomingue. Mr. Provencher, of Guénette, showed the writer some occurrences of scattered flakes of molybdenite in quartz veins in grey orthogneiss on lot 3, range C of Campbell township. Not far east of there, at the Brodie quarry, the pink Guénette granite contains small inclusions of molybdenite in some places. The writer was also told of, but did not himself see, an occurrence of molybdenite a little south of Robillard lake, on lot 48, range III of Egan township.

Widely disseminated molybdenite is to be seen at several places in the numerous large outcrops of rock along

the right bank of the Gatineau at the foot of, and downstream from, Mercier dam, in the southeast corner of Mitchell township. The rocks here are predominantly highly granitized paragneisses, in which are numerous thin intercalations of slightly micaceous quartzite and limestone. The limestone is much stretched and deformed, the bands being at most a few feet thick, and in places they grade to pyroxenite. About 400 feet south of the dam, fractures within this assemblage of rocks, with general N.45°W. strike and two to four inches wide, are filled with quartz and calcite, together with some pyrite, pyrrhotite, and molybdenite. For the most part, the molybdenite is in close association with the sulphides. One such calcite vein, striking N.30°W. and dipping 62° southwest, contains massive pyrrhotite through which are distributed fairly numerous flakes of molybdenite.

There is no doubt that careful prospecting would disclose the presence of molybdenite at many other places in the area. All the occurrences mentioned in the foregoing paragraphs are small disseminations of no commercial interest. More encouraging is a prospect one mile north of Montcerf, on lot 69, range IV of Egan township, 500 feet east of the road from Montcerf to Lytton, where there are some old workings on which further development was done in 1938. The present owner of the property is Lorenzo Lafrance, and it is known locally as the 'Laurenzo Lafrance prospect'. The discovery dates from about 1900, and it was one of the first occurrences of molybdenite in the Maniwaki district on which any development work was done. It is mentioned in reports by Johnston (20, pp.8-9), Walker (21, p.30), and Eardley-Wilmot (19, pp.136-137).

The mineralized zone is on the northwest slope of a small, wooded hill, and the predominant rock is paragneiss, together with beds of crystalline limestone and lenses of pyroxenite. At the surface, the mineralization is chiefly in the gneiss, which is rich in highly oxidized pyrite and pyrrhotite. Flakes of molybdenite up to five inches in diameter may be seen in this decomposed zone. In places, they are oxidized in part to yellow molybdate.

The most important of the old workings is a trench 22 feet long, 10 feet deep, and about 10 feet wide, trending N.45°E. This excavation exposes greatly oxidized gneiss with zones of pyroxenite containing a few veins of phlogopite. Occasional aggregates of massive pyrite occur in the gneiss. The molybdenite is disseminated in the gneiss and pyroxenite, especially along fissures, some of which are essentially parallel to the gneissic banding, while others cut it more or less at right angles. An 80-foot adit, with trend S.35°E., was opened a little below and to the east of the trench, for the purpose of cutting the mineralization at depth. It is now caved-in, making entry impossible, but it would appear that it was not driven far enough to intersect the mineralization.

No further work was done at the property until 1938, when the present owner opened two shallow trenches extending northeastward from the original trench. One, trending N.45°E., is 34 feet long, 6 feet wide, and 1 to 2 feet deep; the other, with direction N.82°E., is 38 feet long, 3 feet wide, and 1 foot deep. These superficial

workings, naturally, gave no information on the possible depth of mineralization, but molybdenite in fair amount was exposed in the rock along both trenches and they served to show that the mineralization extends for about 100 feet on the surface. Molybdenite also occurs in small amount in the rock farther east on the same lot, near Désert river, and also to the north, on lots 72 and 73.

Nickel

Veins and aggregates of massive pyrrhotite are quite common in the rocks of the Grenville series, mostly in the metamorphic pyroxenites but also in the limestones and amphibolites, and they have caused some prospectors to believe there might be nickel in the district. To obtain some definite information on this point, samples of pyrrhotite were taken by the writer from several localities and were assayed in the Quebec laboratories of the Department of Mines. They were found to contain only traces of nickel, or none at all.

In the cutting on the Canadian Pacific railway just west of Boyd lake, on lot 8, range E of Campbell township, amphibolites associated with paragneisses contain a number of pyrrhotite veins three to four inches wide. An assay* of the pyrrhotite gave the following result:

<u>Gold, oz./ton</u>	<u>Silver, oz./ton</u>	<u>Nickel, ‰</u>	<u>Copper, ‰</u>
0.018	0.040	0.03	0.41

A sample taken from an old mica prospect on lot 56, range I of Aumond township, where the pyroxenite contains a high proportion of pyrrhotite, assayed 0.016 oz. gold per ton, with negative results for silver and nickel.

Gold Prospects

Up to the present, prospecting for gold in the Grenville sub-province of the Canadian shield has met with little success in Quebec. The parts of Labelle and Gatineau counties recently examined for the purposes of this report have proved no exception to this rule. Quartz veins are rare in this area, and most of those seen are completely barren. At the best, they contain only traces of pyrite mineralization. Many of these, as well as occurrences of pyrite in other rocks, have been examined by prospectors.

Some surface work was done a number of years ago at what is known as the 'Manceau mine', on lot 24, range V of Boyer township, about three miles northwest of the village of Lac Saguay. This prospect is in the bed of Sawga river, whose course has been changed for some distance.

*Unless otherwise stated, all assays given in this report were made in the Quebec laboratories of the Department of Mines on samples taken by the writer.

The rock thought to be auriferous is a coarse grained biotite paragneiss, high in quartz. It is accompanied by beds of quartzite. This highly granitized gneiss strongly resembles the rock outcropping east and west of Lac Saguay. In places, it has an almost pegmatitic texture and contains flakes of graphite as well as specks and veinlets of pyrrhotite. The weakly mineralized zone is about ten feet wide and outcrops over a length of fifty feet, with a north-northeast strike. Development work consists of a trench the length of this zone. Samples selected from material showing the highest pyrrhotite content gave only traces of gold upon assay.

The writer examined a few quartz veins containing a little pyrrhotite, and having a maximum width of two inches, which occur on lot 4, range B of Campbell township, on the south side of the ravine known as "La Coulée". These veins cut paragneiss a short distance from the south border of the Guénette granitic mass. Mr. Provencher, of Guénette, had samples from these veins assayed a few years ago and their gold content was only \$0.80 per ton.

H. Lamarche, of Mont Laurier, has had several assays for gold made on samples taken from slightly pyritiferous quartz veins on lot 21, range I of Campbell township. The highest assay obtained was \$0.52 per ton.

In 1934, some work was done by Donat Lamoureux on a gold prospect in the centre of lot 16, range Nord du Chemin Chapleau, Kiamika township. A pit, ten feet long and four feet deep, has exposed quartzite and paragneiss, pyritiferous and rich in graphite. Doubtless the presence of the pyrite caused the owner of the lot to undertake the work. Assays made at Ottawa showed no gold.

Prospecting for gold has been undertaken at two places in the Gatineau valley, but without success. One of these prospects is at Grand Remous, near the west bank of the river, on land belonging to Mr. Kelly (lot 10, range I, Lytton township). Here, a group of quartz veins, of which the widest is nine inches, cut pink aplite, which contains large inclusions of quartzite and gneiss. The veins are barren, but the granite enclosing them contains occasional specks of pyrite. Twenty-five years ago, a pit, four feet wide and five feet deep, was sunk on this showing. A composite sample, consisting of chips of quartz from the several veins and pieces of the wall-rock, assayed only 0.005 oz. gold (\$0.17) per ton and 'trace' of silver.

The other prospect referred to is on lot 44, range I of Aumont township, where Alex. Perron has done some surface work at two places, 180 feet apart, on the west flank of a hill that parallels the Grand Remous-Ste-Famille road. The rock here is slightly pyritiferous paragneiss and quartzite. A lens of white quartz, with crystalline cavities, occurs in the quartzite. Two samples were taken for assay, one (A) from the quartz lens, the other (B) from the pyritiferous gneiss. The results were as follows:

	Gold		Silver	
	Oz./ton	Value	Oz./ton	Value
A	0.003	\$0.10	0.042	\$0.02
B	0.005	\$0.17	0.025	\$0.02

P. Céré, of Bois Franc, has done a little work on lot 56, range B of Egan township, south of Sapin lake, where rusty weathering paragneiss is cut by a few veins of pyrite. An assay of the vein material gave 0.016 oz. gold per ton, equivalent to a value of \$0.56.

Non-metallics

Asbestos

Chrysotile asbestos of a golden-yellow colour is found in small, parallel veins of transverse fibres in the crystalline limestone near the south shore of lac des Ecorces, on lots 5 and 6, range IV of Campbell township. Very few of these veins are as much as half an inch wide. Narrow veins of asbestos are also seen occasionally in serpentine aggregates in the limestones, as, for example, in the east part of lot 32, range VI of Robertson township.

In 1938, Moise Meunier did a little surface work on an asbestos prospect on lot 38, range I of Aumont township, on the east side of the road from Grand Remous to Sainte-Famille. A pit, 10 feet by 5 feet by 8 feet deep, has exposed asbestos of very inferior quality, in veins not over one inch in width, along joints in pyroxenite. The asbestos occurs as brittle fibres, two to three inches long, lying longitudinally on the joint planes.

Apatite

Apatite is quite common in the crystalline limestones, occurring as very small crystals of pale blue or green colour. It is particularly abundant in outcrops on lot 22, range IV of Bouthillier township, and on lot 52, range V of Lytton. The amphibolite inclusions in the Guénette granite at the Brodie quarry also contain well developed, small, transparent, prismatic crystals of apatite, green in colour. Most commonly, however, the apatite occurs as an accessory mineral in the metamorphic pyroxenite, although it is nowhere as abundant in the present area as it is farther to the south, along the north bank of the Ottawa between Hull and Buckingham, where, in former years, there were many active 'phosphate' mines, from some of which there is still a small production.

Apatite, in generally small, broken crystals with dull lustre and having a bluish to greenish colour is associated with phlogopite in the deposits of the latter mineral described on a later page. In view of its minor importance, the several localities will not be listed here. Reference may be made, however, to an occurrence south of Mont Laurier, on lot 19, range I of Campbell township, where this mineral was mistaken for beryl. Here, the gneisses, limestones, and pyroxenites that form an escarpment overlooking the Lièvre contain broken crystals of blue apatite, one inch long, as well as smaller, green, translucent crystals. The crystals have a high, oily lustre, and their edges and corners are slightly rounded, as through incipient fusion.

Clay

Beds of grey clay, some of great thickness, form part of the river and lake deposits where these are widely developed, but, as a rule, they are buried beneath the overlying sandy deposits. However, trenches cut in road building and ditching operations have exposed the clays in many places. In almost every instance, they exhibit varving which clearly indicates the different cycles of their sedimentation.

As far as the writer knows, the only clay deposit to have been worked is that on the west bank of the Lièvre, immediately below Mont Laurier. Some twenty years ago, a brick kiln was operated here, making brick for local use.

Beryl

Although beryl has not as yet been found in the area, there was some prospecting for the mineral during the summer of 1940 in Robertson township, principally on lots 26 to 28 of ranges IV and V. At this locality there is a steep hill called 'La Montagne de Fer' (Iron mountain). The writer was unable to discover the origin of the name, which seems strangely applied, as the hill contains no trace of any iron deposit. It consists of quartzite, sillimanite gneiss and garnetiferous gneiss, which are cut by many pegmatite dykes.

Beryl occurs immediately south of the southern margin of the map-area, on the east part of lot 25, range IV of Robertson township at the north end of lac des Isles, and it was this occurrence that led H. Lamarche, of Mont Laurier, to seek the mineral farther to the north. The beryl on lot 25 is in large, faintly greenish-white crystals which are slightly translucent and have a dull lustre. It occurs with tourmaline and white mica in a wide pegmatite dyke which cuts garnetiferous gneiss. Some years ago, some development work was done on this dyke, first for muscovite, and later for feldspar. Recently, work has been resumed in an endeavour to find a greater concentration of beryl.

Limestone

Mention has already been made of the extensive development of crystalline limestone in the stretch of country between Kiamika and Désert rivers, and the principal bodies of this rock are indicated on the two maps accompanying this report. The general characteristics of the limestone have been discussed in the first part of this report, and, in particular, it has been emphasized that they are, in general, very impure, containing a variety of metamorphic minerals. Even where they seem to be relatively pure calcium limestones, they usually contain a high proportion of magnesium carbonate and, in many cases, the term 'dolomitic limestones' would best describe them. This will be evident from the following analyses, both of samples of pure white limestone, apparently free of foreign minerals. Sample A is from a cutting on the Canadian Paci-

fic railway between Val-Barrette and Brunet, on lot 7, range J of Campbell township; it is massive and has a marmoritized appearance. Sample B is from lot 57, range III of Egan township.

	<u>A</u>	<u>B</u>
SiO ₂	9.70	0.40
Al ₂ O ₃	0.57	0.01
Fe ₂ O ₃	1.67	0.11
CaO	28.89	40.08
MgO	22.78	12.31
CO ₂	32.88	n.d.
S	0.28	Nil
P ₂ O ₅	Trace	0.02
H ₂ O ⁺	4.07	0.71
H ₂ O ⁻	0.37	0.09
CaCO ₃		71.51
MgCO ₃		25.74
Ca ₃ (PO ₄) ₂		0.04

The limestone has been quarried at a number of places, but only as a source of lime for local use, for which purpose its degree of purity is of relatively little importance. Many of the lime kilns are now abandoned. Those that remain are operated intermittently, but since 1938 all have been idle. In 1938, two were in operation at Grand Remous, one on either side of the Gatineau, on lot 12, range I of Sicotte township, and on lot 2, range I of Lytton, respectively; and in that year, also, the kiln of J. Loisel, on lot 8, range Sud du Chemin Chapleau, in Montigny township, produced thirty tons of lime.

In and about Montcerf, in Egan township, there are several old lime kilns, said to have been abandoned for thirty years. These are on lot 73, range III; lots 62 and 69, range IV; lot 60, range V; lot 70, range B; and lot 47, range C. The ruins of a kiln are to be seen on lot 2, range VIII of Kiamika township, half a mile south of Val Barrette; and there was formerly a kiln near the west bank of the southwest arm of François lake, on range IX of the same township. South of Mont Laurier, in the valley of the Lièvre, three old kilns are grouped on lot 12, range I of Campbell township. Others are at Chute Rouge, on lot 6, range V of Lytton; on lot 54, range IX of Robertson; and a little northwest of Ferme Neuve, near Journalistes lake, on lot 7A, range II of Gravel. The last mentioned produced very good quality lime until about 1938 from limestone quarried on lots 6A and 7A.

Apart from its use as a source of lime, the limestone is quarried on a small scale at one place to produce monument stone. This is a white, crystalline, high-magnesia limestone. The quarry, operated by Mr. Provencher, is half a mile east of Guénette, on lot 23, range VII of Boyer township.

A band of marble is exposed for a length of 450 feet along the west bank of the Gatineau just below chute du Chat, on lot 43, range I of Lytton. It represents beds of limestone which have been subjected to intense dynamic stresses. It presents a variety of colour, including grey, yellow, white, pink, and red, with some layers of uniform

colour, others spotted or veined. The grain is usually very fine and the rock takes a high polish.

This zone of marble merits closer examination, to determine whether some of the stone might be suitable for use as ornamental stone. Some parts of the outcrop which are cut by granitic dykes doubtless contain too many silicate nodules to be advantageously worked, but other parts seem to be fairly homogeneous. In any future exploration of the zone, it would be important, first, to determine its extent to the west, away from the outcrops exposed by the action of the river. Being less than a mile from the colonization road on ranges I and II, the deposit is very easy of access.

A serpentine-bearing marble, which is quite decorative when polished, outcrops in the east part of lot 34, range VI of Robertson township. In this rock, grains of green serpentine, doubtless derived from diopside, are evenly distributed through crystalline limestone of greyish-white colour.

It can scarcely be doubted that, within the numerous bodies of limestone in the area, favourable zones could be found where the rock has chemical, physical, or other characteristics fitting it for some use in industry, but the finding of such zones would entail detailed mapping and careful research.

Feldspar

Pegmatite dykes, the main source of feldspar, are very numerous in the Grenville series, especially cutting the limestones and the highly granitized gneisses. These dykes are generally narrow, disrupted, and very irregular. Some, however, are of good size and can be traced for a fair distance.

Pegmatites also cut the intrusive rocks. They are especially numerous in the porphyritic quartz syenite. Some of the dykes cutting this rock are of very large size, as, for example, one with a width of 300 feet that outcrops on the western side of a small peninsula in the north part of lac des Ecorcés, on lot 21, range IV of Campbell township. It consists of pink potash feldspar and quartz, in part in graphic intergrowth, with rare tourmaline crystals; in general, the rock contains no mica. The same dyke outcrops again, with the same width, half a mile to the northwest, on lots 24 and 25 of the same range, in the cutting opened in 1939 during the construction of the Abitibi road.

In most of the pegmatite bodies examined, the feldspar is wholly or predominantly microcline, but is too closely associated with quartz to permit of its successful exploitation. To this disadvantage are added others, such as the small size of most of the dykes and their inaccessibility. Two occurrences, however, one in Robertson township and the other in Egan, appear to merit careful prospecting. In Egan, numerous dykes of pegmatite cut the gneiss exposed on the hill which parallels the left bank of Désert river between lots 47 and 51 of range IV; and in Robertson, prospecting for feldspar was being carried on in a locality southwest of Mont Laurier, on ranges IV, V, and VI, at the time of the writer's visit.

There has been a small production of feldspar from a dyke one mile south of Mont Laurier, on lots 18 and 19, range I of Campbell township. A small amount of work was done here in 1930 and succeeding years (Spence, 22, p.65), and again, on lot 18, in more recent years, by Phrasé Arbic, owner of the property. A shipment of six cars - about 240 tons - of feldspar was made to Montreal in 1932, and one car of the mineral was shipped in each of the years 1937 and 1938. The dyke has been traced for 1,500 feet across lots 18 and 19. The quarry from which the feldspar was extracted is 60 feet long, 15 feet wide, and 12 feet deep. The dyke, cutting paragneiss, strikes N.20°W. and dips at 75° toward the east. It consists chiefly of pale pinkish, microcline, but quartz is relatively abundant near the margins of the dyke. Prismatic greyish crystals of altered scapolite are in places associated with the microcline.

Fluorite

Violet coloured fluorite occurs very sparsely as an accessory mineral in some of the acidic intrusive rocks of the area, but no veins of fluorite that might be of economic interest were seen. It is most common in the aplites, but is also quite frequently present in the pink granites of Guénette type. On lot 49, range IV of Aumont township, the fluorite is disseminated as small crystals in an aplite which also carried grains of magnetite; and on lot 24, range I of Sicotte it occurs with epidote in the joints of a white, gneissic aplite.

Some of the pegmatites in the vicinity of Mont-Laurier also contain fluorite, as for example the dyke cutting the diorite body just west of Lièvre river, half a mile north of the town, and that on lot 19, range I of Campbell township, which contains small aggregates of very dark purple fluorite.

Graphite

Graphite is quite common throughout the area, but it is seldom present in the rocks other than as small, sparsely disseminated flakes. The host rock is usually some member of the Grenville series, and most often paragneisses or crystalline limestone, although some is occasionally encountered in certain intrusive rocks. Such is the case, for example, in the micaceous augite gabbro outcropping on lot 4, range VII of Montigny township, and also in some pegmatite dykes in several localities.

Graphite is present in most of the limestones in the area, in small, widely dispersed flakes, many of which have perfect hexagonal outline, but, even where the concentration is heaviest, it is not present in sufficient quantity to form an economically workable deposit. This type of occurrence, therefore, is only of mineralogical interest, and it would serve no useful purpose to list all the places where graphite-bearing limestones were seen. For the most part, the graphite flakes, which do not exceed one-third of an inch in diameter, are quite regularly distributed through the whole mass of the limestone. The outcrops in the western

part of Kiamika village, between Kiamika river and the road to Wabassee, may be cited as typical. Less commonly, the graphite is disposed along regular, parallel planes and thus gives the limestone a banded appearance. The outcrops on lots 20 to 22, range IV of Bouthillier township, just east of the Mont Laurier-Buckingham road, are an excellent example of this type of occurrence.

Where, as is so commonly the case, the limestone contains nodules of silicate minerals, as diopside, feldspar, or mica, the graphite flakes tend to be concentrated in these, and on weathered surfaces of the rock, they stand out, due to their greater resistance to weathering agents.

The paragneisses, and particularly the rusty weathering sillimanite gneiss, may contain much more interesting quantities of graphite than the limestones, and even workable concentrations. A deposit of this type was worked about fifteen years ago at a locality a mile and a half northeast of the Canadian Pacific railway station at Guénette and 500 feet northeast of the highway, on lot 28, range VII of Boyer township. The mine, which was operated by the Canada Graphite Corporation, of Montreal, was closed in 1930, not because the deposit was exhausted but because of the prevailing low price of graphite. Including shipments made from the stock-pile after closing of the mine, this operation produced between the years 1923 and 1935, 2,370,100 pounds of graphite valued at \$90,600. The workings consisted of a number of surface trenches spaced over a distance of 500 feet in a northwest direction, and a large semi-underground excavation ending at a shaft 130 feet deep, from the bottom of which there were lateral workings totalling 220 feet. As the underground workings are now flooded, they could not be examined. The main host rock of the deposit is a banded biotitic gneiss, in part highly pyritized, which is cut by dykes of fine grained grey granite, several feet wide, and also by dykes of tourmaline-bearing pegmatite. At the entrance to the large excavation there are, in addition, well developed beds of feldspathic quartzite, with strike N.80°E. and dip 32° to the south. The gneisses are irregularly mineralized with graphite and in places contain rich concentrations of the mineral. The associated quartzites are also graphitic. A road leads from the mine to a small mill, half a mile north of the deposit. The mill is now in ruins.

A graphite deposit which is fairly rich but apparently of small size may be seen in a cutting on the Canadian Pacific railway west of Boyd lake, in the east part of lot 8, range E of Campbell township. This cutting exposes a band of gneiss in contact (to the north) with amphibolite. The schistosity of the gneiss, which has intercalations of quartzite and limestone, strikes N.30°E. and dips vertically. The rock is pyritiferous and contains sillimanite as well as an appreciable quantity of graphite in small flakes.

There is a deposit of the same type in the centre of lot 16, range Nord du Chemin Chapleau, Kiamika township, where some preliminary prospecting work has been done for gold, as already mentioned. Here, again, the rusty weathering gneiss contains a fair quantity of graphite. Graphite also occurs in similar gneiss, with which bands of quartzite are intercalated, on the west slope of the valley of the Gatineau, on lots 56 and 57, range C of Egan township.

Graphite is rarer in the garnetiferous gneisses than in the pyritiferous sillimanite gneisses. However, in some places small amounts of graphite do occur in them, as, for example, south of Val Barrette, in the centre of lot 3, range VIII of Kiamika township, and along the Mont Laurier-Senneterre road on the Aumond-Robertson boundary line.

Garnet

Almandite garnet is a very common mineral in the gneisses and amphibolites, and occurs also, though much more rarely, in the quartzites.

Gneisses very high in garnet are widely developed in several parts of the area. Some of the amphibolites are even richer in garnet, but they generally occur as bodies of only small size, forming thin intercalations in the gneisses. There is a notable band of garnetiferous gneiss southeast of Mont Laurier. It cuts across the valley of the Kiamika, outcropping on the west side of the river on lots 45 and 46, range VI of Kiamika township, and on the east side on lot 45, range VII. The hills southeast of Boyd lake, on range-line D-E of Campbell township, are also underlain by garnetiferous gneisses, and huge erratics on lots 5 and 6 of range D contain beds composed almost solely of small, pink garnet crystals. In these localities, the rock may well be termed a 'garnetite'.

There is a zone with higher than average garnet content west of Mont Laurier, on ranges IV, V, and VI of Robertson township, between Saint-Jean-sur-Lac and lac des Isles. Still farther west, garnet is very abundant between Howard lake and Pope lake (Pope township), and on both sides of the Gatineau at chute du Brûlé. Many other places might be mentioned where the mineral occurs, but such a list would be of little interest.

The garnet crystals in the paragneisses are usually small and are very rarely as much as one inch in diameter. The largest seen by the writer were in amphibolite inclusions in a gneissic porphyritic granite at the top of a hill near the middle of lot 23, range IV of Bouthillier township. Some of these are as much as five inches in diameter, but they are very widely scattered. A few of very large size were seen in the granite itself. The garnet here is high in iron, if one may judge by its dark colour.

Though, in several localities, the garnet content of the rock is fairly high, only very small masses of the rock carry concentrations that might enable it to be worked profitably as a garnet ore.

Mica

The pegmatite dykes so widely distributed in the map-area contain, in general, very little mica, and, such as it is, it is more commonly biotite than muscovite. In no place was muscovite of possible economic interest seen in these dykes.

Phlogopite, or ferromagnesian mica, is the only

mica of common occurrence in the map-area, which may be considered as forming part of what some have termed the 'mica belt' - a belt extending across southwest Quebec and southeast Ontario. The Mont Laurier region is on the north margin of this belt. A considerable amount of development work was done about thirty years ago on phlogopite occurrences in, particularly, Aumond, Egan, and Lytton townships, and small shipments of mica were made from some of the deposits. The phlogopite occurs as an accessory mineral in the metamorphic pyroxenites, in which it is regularly distributed, filling pockets and vein-like fissures.

The mica sheets are usually from three to six inches, more rarely as much as twelve inches, in diameter. The quality varies from deposit to deposit. In some, the phlogopite is in flawless, highly flexible and elastic sheets of a quality entirely suitable for industrial use. In many, unfortunately, the crystals are interpenetrating, checked, or bent, or they break very easily along planes of secondary cleavage or parting more or less perpendicular to the perfect basal cleavage, features which render the material practically useless.

There are no mica prospects in the eastern half of the map-area, between Nominigüe and Mont Laurier, where pyroxenite is of very rare occurrence. A few small pockets of phlogopite were seen in the paragneiss a short distance south of Mont Laurier, on lot 19, range I of Campbell township, where, as already mentioned, molybdenite also occurs. Farther west, between Lièvre and Désert rivers, the writer visited fifteen places where work has been done on mica prospects. This work has been limited to trenching and the sinking of pits to various depths. The deeper workings are, in general, partially flooded.

In 1939, some mica was shipped from one of these pits, on the west part of lot 27, range X of Robertson township. The more important of the other workings are on lots 35 and 57, range I of Aumond; lot 40, range II, lots 55, 5, and 22, range IV, and lot 54, range V, of Lytton; and lots 66 and 75, range III, lot 51, range IV, and lot 16, range V, of Egan. The most extensive are those on lot 22 (near the border of lot 21), range IV of Lytton township. They date from 1898-1900 and consist of an excavation 45 feet long with a width varying from 15 to 40 feet and a depth of at least 30 feet. In the upper, unflooded portion of the pit, the principal vein of phlogopite, 3 feet wide, strikes east and dips vertically. In the past, an important amount of good quality mica, much of it with a somewhat silvery lustre, was mined here.

It is very possible that, in addition to the occurrences listed above, there are other prospects which the writer did not have the opportunity of visiting. There is a good chance too, considering the large number of pyroxenite lenses in the limestone, that further prospecting will lead to the discovery of new deposits of phlogopite.

Quartz

A mass of white, sugary quartz forms the bulk of a hill on lot 3, range VIII of Baskatong township. This hill, known locally as 'La Montagne Blanche' (White mount-

ain) overlooks the west bank of Philomène bay where it opens into Baskatong lake. It rises to a height of 120 feet above the lake level. The side of the hill, as seen from the lake, is steep, partly bare, and, in the sun, dazzlingly white. In places, the quartz has a high glacial polish.

This mass of quartz is an enormous lens having a length of 600 feet along its northeasterly trend and an apparent maximum width of at least 300 feet. It is closely associated with a pink, gneissic, aplitic granite, of very fine grain, which outcrops widely a few hundred feet to the north. This granite differs noticeably in appearance from the pink Guénette granite. It holds large inclusions of feldspathic, slightly pyritiferous, amphibolite, and is cut by many quartz veins, one inch to twelve inches wide. These veins increase in number toward the quartz body, from which they seem to be derived, and close to it the aplite is literally ribboned by them. They are frequently lenticular and interlaced, with general strike N.35°E., about the same as that of the ridge. Some of them contain a little feldspar. There is no clean-cut contact between the quartz body and the neighbouring pink aplite, but a gradual transition from one to the other. At least, such is the case at the north end of the hill. The quartz body is traversed by numerous joints, striking S.12°W.

It appears most probable that this mass of white quartz represents a band of quartzite that was trapped in the granitic magma and, as the result of thermal metamorphism and the action of magmatic solutions, was completely recrystallized, with elimination of practically all impurities. Osborne (5, pp.45-46) mentions the occurrence, near Belle Rive, in the eastern part of Labelle county, of a body of almost pure quartz derived from quartzite by such a process.

Analyses of samples taken every hundred feet along the length of the deposit showed a silica content between 99.67 per cent and 99.95 per cent. Iron oxide (Fe₂O₃) is very low, from 'trace' to a maximum of 0.07 per cent, and titanium is absent. Following are the results of the individual analyses:

	SiO ₂	Fe ₂ O ₃	TiO ₂
Sample No. 1	99.93%	trace	Nil
" " 2	99.93"	"	"
" " 3	99.95"	"	"
" " 4	99.88"	0.06%	"
" " 5	99.74"	0.06"	"
" " 6	99.67"	0.07"	"

The highest quality silica, needed particularly for the manufacture of window glass, should not contain more than 0.02 per cent of iron oxide (Fe₂O₃). Thus, according to this partial sampling of the surface, a part of the deposit could be used for such a purpose, since the samples from the south part of the body seem to be prac-

tically free of iron. However, a very careful sampling would be necessary to make quite sure of this. Even if the purity be proved, the distance of the deposit from the railway considerably diminishes its economic interest and makes it impossible to envisage its being worked at present. The Montagne Blanche is two miles from the nearest road to the west. From this road, it is about forty miles to Maniwaki, the terminus of a line of the Canadian Pacific railway.

A small body of white quartz, doubtless of the same origin as that at Philomène bay, but of much smaller size and less pure, is exposed three miles north of Bois Franc, on lot 64, range II of Egan township. This lens of slightly rusty white quartz is fifty feet wide and has a vertical banding, striking N.45°E.

Groups of white quartz veins without any sign of mineralization were seen at several localities. They are generally of small size and would seem to be of no economic interest, but for purposes of reference the chief occurrences will be mentioned. One group occurs in the granitized gneisses on the north side of the Bois Franc-Grand Remous road, on lot 58, range I of Egan township. On lot 55, range III of Sicotte, there are parallel and generally lenticular quartz veins, seldom more than four inches wide, which cut porphyritic syenite and the pink aplite which accompanies it. Other quartz veins have already been mentioned in discussing gold prospects.

Rose quartz, apparently pegmatitic in origin, occurs as veins, up to a few inches wide, cutting gneiss between Pope and Howard lakes, in Pope township. This is the only locality at which such veins were seen 'in place', but the fact that boulders up to two feet in diameter of similar rose quartz were encountered at several places in the northeast part of Pope township, and in the north part of Robertson township on ranges 9, 10, and 11, shows that larger veins occur in the area.

This rose quartz is similar to, though of less pleasing appearance than, that occurring in some of the Madagascar pegmatites, which is greatly valued as an ornamental and semi-precious stone. The samples taken by the writer are translucent, slightly opalescent, and have a greasy lustre. They contain impurities, chiefly opaque white quartz. It is possible, however, that diligent search might reveal occurrences of rose quartz of merchantable quality.

Talc

There was some prospecting for talc in 1938 near the left bank of the Gatineau, on lot 38, range I of Aumont township. At this locality, a small ridge parallel to the river is underlain in part by limestone which is cut by pegmatite dykes low in mica and is intruded at its south end, about 800 feet from the talc deposit, by a small body of pink aplitic granite. The talc prospect is on the east slope of the ridge. A trench 60 feet long by 15 feet deep, with northeasterly trend, has been opened in a greyish-white limestone containing flakes of graphite, grains of diopside and pyrite, and mica nodules. The talc occurs in a northeasterly striking shear zone. There are three main veins,

a few inches wide, whose strike varies from N.10°E. to N.30°E. They are cut by other, narrower veins.

The talc is compact or lamellar, translucent, and varies from greyish-white to pale green in colour. It is apparently very pure, but there is not enough of it to give the deposit any economic interest. The talc is doubtless an alteration product of the dolomitic limestone.

Various Minerals

Several other minerals of no economic interest, but of whose occurrence it is interesting to know, were also observed. Some of them have already been mentioned in this report.

Tourmaline, in well formed, black crystals, is a common mineral in some of the pegmatites, as on lot 6, range F of Campbell township, and in those which cut the garnet-bearing amphibolites on top of the hill in the village of Nominique, on lot 36, range V of Loranger township.

Actinolite occurs in the pyroxenite between the north shore of Gauvin lake and the main highway, on lot A, Southeast range of Campbell township. Tremolite, in fibrous, compact masses, pure white in colour, is quite abundant in the limestones south of lac des Ecorces, chiefly on lot 13, range J of Campbell township, where it accompanies, in some outcrops, aggregates of translucent serpentine of pale grey colour. The latter mineral is quite common in some of the limestones, but its colour is usually yellowish or pale green.

In several places, yellow scapolite occurs in the crystalline limestones, notably on lot 42, range III of Aumond township, and in those which outcrop near Clément station, on the Canadian Pacific railway (lot 19, range I, Campbell). In this last occurrence, it is in part altered to wilsonite, a massive amorphous mauve coloured mineral.

The limestone which is invaded by pegmatitic granite on lots 42 and 43, range VI of Kiamika township, contains some mauve spinel accompanied by small flakes of phlogopite and grains of chondrodite, an orange-brown mineral with very high lustre. Small blue crystals of spinel also occur in the limestone on lot 31, range III of Aumond township.

Sphene, which is common in the intrusive rocks of the area, particularly the augen gneisses, occurs also in the metamorphic rocks, and in some occurrences the crystals are of large size. The abundance of this mineral in the unusual feldspathic amphibolite so widely developed northeast of Castor Blanc lake has already been mentioned. Well formed, brown crystals, more than an inch long, were seen in a narrow band of very impure limestone north of the Mont Laurier-Senneterre highway, on lot 54, range V of Lytton township.

Building Materials

Granite, Syenite, Limestone

Granite quarries, and quarries in other rocks, have been opened at a number of places, but only two of them were being operated at the time the writer was in the area. There are four quarries in the pink aplitic granite body near Guénette, in Campbell township. Stone from these is sometimes marketed under the name 'Imperial pink'. The most important operation is that of Brodie's, Limited, of Montreal, on lot 4, range A. The quarry, which was first opened in 1910, is adjacent to the main highway and is served by a spur line of the Canadian Pacific railway from Guénette station, two miles to the southwest. The granite body here has three well defined sets of joints at approximately right angles to one another, and, in quarrying, the stone breaks readily into rectangular blocks. It is used chiefly as paving blocks, curbstone, building stone, and press rolls for paper mills. For a more detailed description, the reader is referred to the report by Osborne (4, pp.42-46).

The old Ledoux quarry is on lot 6, range B, and not far distant are two other quarries, on range A, a little north of Brady (Trout) lake, near the old road from Guénette to David lake. One of these, now abandoned, is on lot 1c, the other, the Beauregard quarry, on lot 2. The latter was opened in 1937 and in 1939 supplied the stone for the church at Ferme Neuve. The rock here is somewhat coarser grained than that at the Brodie quarry.

A mile northeast of Guénette, on lot 1, range C of Campbell township, is the old Provencher quarry. Here a pale grey orthogneiss, fine grained and well banded, was quarried to make curbstones, which were shipped to Montreal.

Just in front of Mont Laurier station, on lot 24, range I of Campbell township, is the Matte quarry, now abandoned, from which was obtained the stone for the Mont Laurier cathedral. It is a porphyritic, pink quartz syenite (augen gneiss) with two sets of joints. One set strikes N.40°E. and has a vertical dip, the other strikes N.45°E. and dips 10° to the northwest.

Apart from this quarry in Mont Laurier, there are only two quarries in the western map-area. Both are now abandoned: They were opened during the construction of the Baskatong reservoir dams in 1927.

The more important is in the southeast corner of Mitchell township, near Gatineau river and about 600 feet southeast of the Mercier dam. This is a double quarry. The east part is an excavation 180 feet long, 120 feet wide, and 30 feet deep; the west part, now flooded, is nearly circular, with diameter of about 130 feet. The two are separated by a very narrow, rocky wall. This quarry supplied stone for the Mercier and Lacroix dams. The rock is Grenville limestone and the quarry workings reveal well its complex structure, intense deformation, and high degree of contamination with silicate minerals. The foreign minerals are often arranged in bands, which probably bear no relation to the original stratification, but which bring out very clearly the highly distorted character of the limestone beds.

The other quarry is in granitized gneisses on lot 37, range IV of Sicotte township. From it was taken the stone for the construction of the dykes around Philomène bay.

Besides the quarries mentioned, there are, in various parts of the area, favourable localities from which excellent stone for building and other purposes could be obtained in case of need. Among the most decorative stones, and the most easily accessible, may be mentioned the augen gneisses (porphyritic granites and quartz syenites) that form large intrusive bodies in Campbell and Sicotte townships, the pink syenite of Aumont township, and some bodies of gabbro, in general a very resistant rock. Fine grained, pink granites very similar to those worked at Guénette occur in several places, notably in the townships of Lytton, Aumont, and Sicotte.

Sand and Gravel

Superficial sand, gravel, and boulder deposits are found in most of the low-lying parts of the area. In various places, they are worked from time to time to provide material for the building and maintenance of roads.

CONCLUSIONS

Although no large deposits of metallic or industrial minerals have been found in the map-area, there are, as has been noted, numerous interesting occurrences of a variety of such minerals, as, for example, magnetite, molybdenite, graphite, phlogopite, and feldspar, and in past years there has been a small production from deposits of some of these.

Of the several types of rock occurring in the area, those of the Grenville series are most widely developed, and it is these rocks that most merit the attention of the prospector. Most of the prospects and mineral occurrences described in the foregoing pages are in rocks of this series. It is to be noted that here, as in many other countries where they are found, the migmatites seem, in general, to be unfavourable for mineralization. Prospecting should be directed especially to the areas of crystalline limestone, preferably in the vicinity of the numerous intrusive bodies that have cut them, as well as to the pegmatite dykes.

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