N.F.B. Photo

Figure 1 | *Sun Life Assurance Building, Montreal, Que. Stanstead light grey granite. An outstanding example of the use of Canadian granite for building purposes.*

CANADA

The GRANITE INDUSTRY OF CANADA

by

G. F. CARR

INDUSTRIAL MINERALS DIVISION

CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
MINES BRANCH

No. 846

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PREFACE

Between 1912 and 1917 the Mines Branch, Ottawa, issued a series of reports in 5 volumes, **Building and Ornamental Stones of Canada,** by W. A. Parks. These reports dealt with all kinds of building and ornamental stone in the different provinces and each included sections on granite and associated rocks. They were:

Volume No.	*Title*	*Report No.*	*Date Issued*
I	Ontario	100	1912
II	Maritime Provinces	203	1914
III	Quebec	279	1914
IV	Manitoba, Saskatchewan and Alberta	388	1916
V	British Columbia	452	1917

Nearly 40 years have passed since the last of these reports was issued and some of them have long been out of print and unavailable for public distribution. Many changes have taken place in the intervening years, many of the quarries described therein have been closed and other new ones opened, and the building stone industry in Canada has made great advances. To place on record these changes and bring the information up to date is one of the purposes of this report.

Its main purpose, however is to acquaint architects, building contractors, monument dealers and the public at large with the merits of the various types of granites available in Canada. This, it is felt would result in a greatly increased demand for local granites, besides benefitting the industry as a whole and providing incentive for the development of promising but as yet undeveloped deposits.

Managers of the numerous granite quarries and plants throughout the country have, without exception, been most cooperative in furnishing information concerning their respective deposits and the granite industry as a whole; without their cooperation the compilation of this report would have been an impossible task. In particular the author wishes to thank Mr. C. Sperling, President of the Scotstown Granite Company Limited, for his assistance in preparing the polished granite specimens used for making the colour plates. It was at Mr. Sperling's suggestion that the sand-blasted strip half an inch wide was added to each stone to demonstrate the contrast between polished and sand-blasted surfaces.

JOHN CONVEY,
Director, Mines Branch.

CONTENTS

CONTENTS

ILLUSTRATIONS

COLOUR PLATES

ILLUSTRATIONS

MAPS

FIGURES

ILLUSTRATIONS

INTRODUCTION

Granite has been produced in Canada for many years and from the time statistics were first recorded in 1886 to the end of 1952 the value of production amounted to $90,272,184, over half of which was produced since 1936. Production in 1952 showed a 28 per cent increase in tonnage and a 22 per cent advance in value compared with that of 1951, the previous record year. This production includes all kinds of igneous rocks, whether used for building stone, monumental stone, curb-stone, paving blocks, rip-rap, crushed granite, etc.

The Canadian granite industry has gone through several periods of prosperity and depression, and although production is now at an all-time high, and the industry ranks eighth in value of production among the country's industrial minerals, it still lags considerably behind the building industry with which it is closely associated. In 1950 the latter industry showed a 666 per cent increase over 1939, whereas the granite industry showed only a 135 per cent gain in the same period.

The industry is dependent upon large building contracts and the monument trade for its prosperity. Granite is, without question, one of the finest materials that can be used for construction. Granite buildings are characterized by pleasing appearance, often attractive colours, and a general aspect of strength and durability. Monuments in granite are pleasing to the eye, have attractive polished surfaces, sharp clear-cut lettering and extreme durability.

Production of Canadian granites for building purposes is fairly well established and the many splendid granite buildings already erected across Canada bear witness to the excellent class of material available. The granites quarried in many parts of Canada compare favourably with those produced elsewhere, and no difficulty should be encountered by an architect or building contractor in obtaining suitable material in Canada of almost any colour desired. Canada also produces a wide variety of monumental stone fully the equal of many of the imported stones, and this branch of the industry is increasing steadily in spite of competition from the better known, lower-priced imports.

Imports and exports of granite have never been large. Most of the imports have been in the rough, sawn only or partly finished for use in the monument trade, and although the amount on the whole is not large compared with the consumption of granite for all purposes, it is an important

item from the viewpoint of those in Canada producing granite for this purpose. In some years imports of monument grade stone have been as much as one-third of the granite used for monumental purposes.

As Cole* remarked, the granite industry in Canada comprises two main divisions, the granite quarrying industry, including quarries and dressing works operated in conjunction with the quarries, and the monumental and ornamental stone industry, comprising firms having no quarries but operating dressing plants where stone for building and monumental purposes is cut, polished or otherwise finished. The latter division is not necessarily confined to granite, as the companies operating such plants may work a variety of stones such as limestone, sandstone or marble. Many of them are small and produce only monuments for local consumption, whereas others are of large size, capable of dressing and polishing stone for contracts of any size. Dressing plants are situated in every province of Canada and draw their supplies from a great number of sources.

This report deals with the first of these divisions, and only such statistics relating to the second division as are necessary to give a complete picture of the industry have been included. Similarly, it is not concerned with those granite quarries operated solely for the production of crushed stone.

Colour plates of a number of the better known and representative granites are included in order to assist architects, building contractors, monument dealers and others in visualizing the possibilities of various types of stone where used singly or in combination with one another. Considerable care has been taken in the preparation of these plates and they are considered to be true and accurate reproductions.

Quebec is the granite province of Canada because of the proximity of the granite areas to population centres and transportation facilities. In view of the growing importance of the industry and with the object of promoting its further expansion, the Quebec Department (then Bureau) of Mines issued 3 reports in the early thirties. These reports, which covered all quarries and plants and gave detailed information on all known deposits of commercial granite in the province, are as follows:

1. Commercial Granites of Quebec; Part I, South of the St. Lawrence River, by F. R. Burton.
   Que. Bur. Mines, Ann. Rept. 1931, pt E.
2. Commercial Granites of Quebec; Part II, Rivière-à-Pierre, Guenette, Brownsburg and other districts, by F. F. Osborne.
   Que. Bur. Mines, Ann. Rept. 1932, pt E.
3. Commercial Granites of Quebec; Part III, North of St. Lawrence River (Second Section), by F. F. Osborne.
   Que. Bur. Mines, Ann. Rept. 1933, pt E.

* Cole, L. H., The Granite Industry of Canada. Dept. Mines and Res., Canada. Mines and Geol. Br., unpub. report, 1938.

Several of the other provincial governments have issued reports on granites in their respective provinces. These include:

NOVA SCOTIA

1. Granite in Nova Scotia, by J. P. Messervey. Dept. Public Works and Mines, Monograph Pamphlet No. 12, 1925.
2. Black Granite at Shelburne, by G. V. Douglas. Dept. Mines, Ann. Rept. 1942, pp. 87-91.
3. The Shelburne Granite Area, by E. J. Longard. Dept. Mines, Ann. Rept. 1947, pp. 148-154.

NEW BRUNSWICK

Preliminary Report of the Granite Industry of St. George, Charlotte County, N.B., by W. J. Wright. Dept. Lands and Mines, Mining Section Report (1934).

CHAPTER 1

PROPERTIES AND STATISTICS

Granite is a granular, igneous rock composed essentially of quartz and orthoclase feldspar associated with smaller amounts of mica, either biotite or muscovite or both; plagioclase feldspar is often present in addition to orthoclase, and hornblende may accompany or replace the mica. Other minor constituents may also be present in varying amounts.

In this report the term 'granite' is used in its broadest commercial sense. The stones from the deposits described are in each case given their true mineralogical names, but they also may be referred to under the general term 'granite' later in the text. In the stone industry the term covers all compact igneous rocks as well as metamorphic rocks of igneous origin adaptable to commercial use; thus, syenites, diorites, andesites, gneisses and other related rocks are known to the trade under the general name 'granite'. 'Black granite' is purely a trade name employed to distinguish darker coloured commercial stones of igneous origin. These rocks are rarely true granites in the mineralogical sense. Stone so designated is not necessarily black but may be of varying shades of dark grey or dark green.

Granite has a number of qualities that make it highly suitable for monumental and building purposes. It is durable owing to its hardness and density, has a low porosity, can be found in a wide range of colours which are mostly non-fading, and generally takes a high polish with a usually good contrast in shade between hammered and polished surfaces. According to Daly (1) who determined the specific gravity of a number of types of igneous rocks used commercially, the average specific gravity of true granite is 2·667.

Dr. W. A. Parks conducted an extensive series of tests on Canadian granites. The following table on their crushing strengths is compiled from his reports.

Although the figures in Table 1 show that all standard Canadian granites have sufficient strength for ordinary building construction, it must not be assumed that they all have sufficient crushing strength for all applications. For such architectural purposes as pillars, and in bridge piers where great weights have to be sustained at one point over a comparatively small area, and where jars and shocks cause further stresses, it is absolutely necessary to know the crushing strength of the stone used.

The properties of granite are mentioned at greater length in the chapter entitled Uses and Specifications.

99246—2

TABLE 1

CRUSHING STRENGTHS
OF CANADIAN GRANITES

Province	Number of Tests	Crushing Strength in pounds per sq. in.		
		Minimum	Maximum	Average
MARITIME PROVINCES	12	25,893	48,984	32,023
QUEBEC	12	23,770	39,000	30,324
ONTARIO	4	23,152	33,453	28,309
MANITOBA	2	29,526	46,518	38,022
BRITISH COLUMBIA	16	23,291	36,608	30,565
CANADA	46	23,152	48,984	31,011
"BLACK GRANITES" (CANADA)	9	29,420	50,246	39,700

Table 2 gives the granite production as a percentage of total stone production for the period 1921-1952, while Table 3 shows the granite production by provinces for the same period. Table 4 shows the granite production by uses for the period 1925-1952, and Table 5 shows Canadian imports and exports of granite for the period 1930-1952.

TABLE 2

GRANITE PRODUCTION
AS A PERCENTAGE OF
TOTAL STONE PRODUCTION 1921-1952

Year	Total Stone Production Short Tons (1) (2)	Granite Production Short Tons (1)	Granite Per Cent of Total	Total Stone Production Value $ (1) (2)	Granite Production Value $ (1)	Granite Per Cent of Total
1921	3,671,498	319,398	8.7	6,343,696	937,894	14.8
1922	3,639,081	457,925	12.6	5,989,864	1,486,250	24.8
1923	4,113,170	398,432	9.7	5,920,578	1,159,303	19.6
1924	4,768,014	419,971	8.8	6,407,757	1,013,345	15.8
1925	5,706,119	971,718	17.0	7,464,777	2,014,535	27.0
1926	6,397,590	1,064,423	16.6	7,865,874	1,574,627	20.0
1927	7,306,396	730,009	10.0	9,265,304	1,383,557	14.9
1928	8,253,934	1,195,810	14.5	10,272,301	2,366,946	23.0
1929	9,622,424	1,728,165	18.0	12,066,532	3,080,815	25.5
1930	9,994,656	1,851,132	18.5	13,037,209	3,379,951	25.9
1931	8,398,110	1,190,887	14.2	11,075,184	2,763,050	24.9
1932	4,691,172	490,822	10.5	4,942,211	1,110,582	22.5
1933	2,939,824	256,723	8.7	2,996,576	679,585	22.7
1934	4,077,754	200,285	4.9	4,152,329	781,739	18.8
1935	4,317,947	326,354	7.6	5,303,234	1,126,287	21.2
1936	4,982,912	941,743	18.9	5,134,153	1,319,313	25.7
1937	6,935,612	1,135,099	16.4	6,939,360	1,827,433	26.3
1938	5,116,022	705,307	13.8	5,556,026	1,379,417	24.8
1939	5,443,522	1,102,395	20.2	6,475,696	2,119,501	32.7
1940	7,447,665	1,147,747	15.4	7,398,959	1,884,410	25.5
1941	7,940,801	600,922	7.6	8,000,684	1,498,786	18.7
1942	7,978,066	1,366,425	17.1	8,746,594	1,946,249	22.2
1943	7,222,950	780,422	10.8	7,964,179	1,522,072	19.1
1944	5,994,992	269,964	4.5	7,159,177	1,303,790	18.2
1945	6,205,555	221,630	3.6	8,166,700	1,284,748	15.7
1946	8,056,260	319,354	4.0	11,185,711	2,006,297	17.9
1947	10,889,388	551,527	5.1	16,464,749	3,175,364	19.3
1948	11,696,643	1,042,928	8.9	17,948,553	3,779,436	21.1
1949	13,928,039	2,321,017	16.7	20,528,073	5,110,024	24.9
1950	18,087,064	2,071,052	11.5	25,895,357	4,971,144	19.2
1951	18,676,706	1,950,564	10.4	28,649,768	6,014,121	21.0
1952	18,726,196	2,490,086	13.3	30,835,356	7,327,022	23.8

(1) *DOMINION BUREAU OF STATISTICS.*
(2) *EXCLUSIVE OF LIMESTONE USED IN MAKING CEMENT AND LIME.*

99246— 2½

TABLE 3

PRODUCTION OF GRANITE BY PROVINCES
1921-1952[2]

Year	Newfoundland		Nova Scotia		New Brunswick		Que
	Short Tons	Value $	Short Tons	Value $	Short Tons	Value $	Short Tons
1921	[1]	[1]	11,822	47,101	14,325	92,790	19,608
1922	[1]	[1]	12,725	44,489	11,389	95,352	88,169
1923	[1]	[1]	17,296	54,892	11,509	143,473	29,240
1924	[1]	[1]	7,554	33,021	4,921	80,812	42,283
1925	[1]	[1]	14,961	54,524	9,027	89,731	491,986
1926	[1]	[1]	4,884	41,738	3,824	66,423	494,385
1927	[1]	[1]	611	36,770	1,634	53,695	162,180
1928	[1]	[1]	39,360	102,295	5,485	66,435	230,660
1929	[1]	[1]	76,742	98,357	5,142	91,610	508,471
1930	[1]	[1]	7,856	38,107	46,209	139,212	711,943
1931	[1]	[1]	24,895	72,009	2,583	148,881	727,354
1932	[1]	[1]	3,635	18,461	4,369	102,699	143,520
1933	[1]	[1]	8,145	36,675	1,792	82,771	131,837
1934	[1]	[1]	325	12,300	5,984	76,793	69,428
1935	[1]	[1]	525	23,800	31,091	103,275	131,096
1936	[1]	[1]	66,507	99,855	1,485	73,784	137,912
1937	[1]	[1]	16,430	50,966	936	74,961	218,743
1938	[1]	[1]	5,765	31,768	954	71,600	294,446
1939	[1]	[1]	885	20,809	1,492	72,005	503,011
1940	[1]	[1]	87,975	155,458	1,326	69,833	366,662
1941	[1]	[1]	410	30,537	1,529	63,184	316,372
1942	[1]	[1]	429	41,985	964	29,334	1,178,765
1943	[1]	[1]	703	28,407	1,522	15,856	634,920
1944	[1]	[1]	1,886	37,532	1,857	47,504	127,544
1945	[1]	[1]	379	25,695	4,669	41,983	77,145
1946	[1]	[1]	8,394	49,176	358	27,683	109,443
1947	[1]	[1]	438	53,486	364	4,675	213,898
1948	[1]	[1]	553	105,991	418	22,760	155,031
1949	20,040	40,080	56,232	253,792	2,314	51,568	578,098
1950	—	—	131,871	404,344	817	21,307	488,073
1951	3,546	13,135	143,039	436,116	7,298	12,647	576,230
1952	20,150	32,725	170,719	474,455	7,600	25,000	1,239,032

[1] *NOT AVAILABLE.* [2] *DOMINION BUREAU OF STATISTICS.*

bec	Ontario		Manitoba		British Columbia	
Value $	Short Tons	Value $	Short Tons	Value $	Short Tons	Value $
378,021	165,418	233,353	—	—	108,225	186,629
665,406	185,738	412,995	—	—	159,904	268,008
436,902	188,998	293,454	—	—	151,389	230,582
442,933	214,691	208,219	—	—	150,522	248,360
1,363,220	263,567	242,150	—	—	192,177	264,910
863,052	398,253	359,217	—	—	163,077	244,197
757,582	390,679	294,098	—	—	174,945	241,412
1,241,668	605,275	566,601	114,000	114,000	201,030	275,947
1,623,860	850,927	926,977	—	—	286,883	340,011
2,042,783	856,124	876,110	—	—	229,000	283,739
1,987,589	133,905	232,557	—	—	302,150	322,014
541,689	73,272	186,357	18	232	266,008	261,144
408,207	19,650	39,433	332	2,987	94,967	109,512
488,477	75,526	128,386	213	2,702	48,809	73,081
806,685	44,473	93,465	387	4,630	118,782	100,432
429,283	492,227	582,603	185	2,038	243,427	131,750
611,125	625,160	769,860	138	1,796	273,692	318,725
757,531	254,917	351,941	329	6,120	148,896	160,457
1,276,859	495,619	625,880	174	3,544	101,214	120,404
792,708	529,440	704,421	218	4,324	162,126	157,666
866,182	152,426	388,325	244	4,155	129,941	146,403
1,449,840	90,530	288,828	133	2,452	95,604	133,810
1,164,463	79,582	212,136	—	—	63,695	101,210
830,238	125,604	307,497	357	4,967	12,716	76,052
887,113	109,286	279,105	425	6,130	29,726	44,722
1,408,618	122,562	406,403	256	3,766	78,341	110,651
2,131,565	192,273	784,408	286	5,365	144,268	195,865
2,218,520	469,789	1,114,060	395	7,299	416,742	310,806
2,578,169	452,649	1,461,131	1,267	5,676	1,210,417	719,608
2,485,460	405,636	1,298,836	24,187	6,125	1,020,468	755,072
3,141,177	487,496	1,485,446	206	4,231	732,749	921,369
4,873,257	350,724	798,680	1,200	1,200	700,661	1,121,705

TABLE 4

PRODUCTION OF GRANITE BY USES
1925-1952[2]

Year		Building Stone		Monumental and Ornamental Stone		Crushed Stone[1]
		Rough	Dressed	Rough	Dressed	Concrete Aggregate
1925	S. tons	7,480	11,627	11,359	3,580	
	$	41,657	236,651	134,295	188,513	
1930	S. tons	13,402	24,909	7,378	2,045	512,688
	$	149,535	1,189,120	110,285	111,504	307,338
1935	S. tons	5,135	10,315	5,313	9,231	17,026
	$	52,925	403,951	48,859	277,568	10,138
1940	S. tons	54,214	10,908	5,230	2,623	288,703
	$	120,372	255,527	55,176	223,203	341,581
1945	S. tons	3,117	1,267	10,199	5,789	38,871
	$	14,198	97,098	140,959	636,787	61,977
1950	S. tons	11,706	13,068	6,741	5,755	321,748
	$	136,079	1,003,510	145,725	903,098	352,752
1951	S. tons	9,668	18,934	6,973	6,411	418,685
	$	124,156	1,458,910	164,963	898,439	701,430
1952	S. tons	12,394	19,305	5,888	5,098	1,185,750
	$	202,684	1,301,785	153,438	878,699	2,618,168

[1] *TOTAL OF CRUSHED STONE ONLY AVAILABLE FOR 1925.*
[2] *DOMINION BUREAU OF STATISTICS.*

Crushed Stone [1]			Rubble and Rip-Rap	Flagstone, Curbstone and Paving Blocks	Miscellaneous	Total
Road Metal	Railroad Ballast	Total				
		594,705	292,166	50,801	—	971,718
		580,434	542,377	290,608	—	2,014,535
271,393	674,504	1,458,585	302,626	42,185	2	1,851,132
352,570	684,004	1,343,912	209,490	266,040	65	3,379,951
113,712	13,600	144,338	139,648	8,693	3,681	326,354
127,390	9,134	146,662	89,235	77,590	29,497	1,126,287
160,819	435,202	884,724	168,274	9,364	12,410	1,147,747
186,714	448,097	976,392	126,302	21,617	105,821	1,884,410
77,669	—	116,540	40,231	501	43,986	221,630
166,418	—	228,395	31,530	3,794	131,987	1,284,748
254,617	10,000	586,365	1,392,948	3,344	51,125	2,071,052
548,463	20,000	921,215	1,551,675	35,038	274,804	4,971,144
368,881	38,026	825,592	1,022,908	1,922	58,156	1,950,564
892,850	95,065	1,689,345	1,367,964	18,385	291,959	6,014,121
424,302	10,575	1,620,627	708,983	2,132	115,659	2,490,086
978,017	26,437	3,622,622	916,712	31,642	219,440	7,327,022

TABLE 5

GRANITE IMPORTS AND EXPORTS
1930-1952[2]

Year	Imports				Exports [1]	
	Rough	Sawn	Manufactures	Total	Short Tons	Value $
	Value $	Value $	Value $	Value $		
1930	78,233	8,999	174,780	262,012	1,768	21,913
1931	48,805	3,815	114,654	167,274	2,938	52,058
1932	48,351	7,689	79,706	135,746	2,133	41,172
1933	48,928	5,366	37,411	91,705	964	12,997
1934	65,925	4,961	27,248	98,134	1,153	9,766
1935	65,185	8,336	25,615	99,136	1,255	10,301
1936	70,667	7,094	22,361	100,122	1,156	8,788
1937	80,273	11,022	23,640	114,935	1,234	11,408
1938	62,735	10,429	25,939	99,103	657	5,042
1939	67,273	10,156	17,309	94,738	925	10,235
1940	45,684	11,355	4,896	61,935	1,075	10,954
1941	54,724	14,060	4,672	73,456	2,751	27,079
1942	44,022	17,488	2,738	64,248	3,245	47,155
1943	47,291	16,450	5,828	69,569	3,762	47,258
1944	53,707	15,783	9,430	78,920	3,871	42,567
1945	42,942	22,964	9,877	75,783	3,835	48,606
1946	158,556	44,169	16,811	219,536	5,277	82,008
1947	179,813	32,306	22,537	234,656	4,500	65,447
1948	156,196	40,571	23,528	220,295	5,124	99,434
1949	156,893	44,104	30,683	231,680	5,568	125,144
1950	146,089	39,464	123,119	308,672	5,579	76,184
1951	146,562	41,799	176,083	364,434	3,715	89,001
1952	130,194	57,924	182,158	370,276	1,839	40,411

[1] *INCLUDES MARBLE, UNWROUGHT.*
[2] *DOMINION BUREAU OF STATISTICS.*

REFERENCES

(1) **Daly, R. A.:** "Igneous Rocks and the Depths of the Earth", McGraw-Hill Book Company Inc., New York, 1933, p. 48.

CHAPTER 2

USES AND SPECIFICATIONS

The granite industry is dependent on two major uses for its existence, in the building, and in the monumental trades. Most others can be considered as secondary as they employ the waste material from granite quarries after the extraction of building and monumental stone. Such applications include granite used as concrete aggregate, road metal, armour stone for breakwaters, poultry grit, stucco dash, and rubble retaining walls. In some cases granite quarries are opened for the sole purpose of supplying concrete aggregate or road metal. In this case the granite quarrying should not be considered as a part of the granite industry but as a sub-division of the aggregate industry which includes sand and gravel, crushed limestone, sandstone and granite.

Granite products may be classified according to the form in which they are marketed as follows:

1. Dimension Stone

Building Stone.
Monumental Stone.
Ornamental Stone.
Paving Blocks, Curbstone, and Flagging.
Bridge Construction.
Special Uses.
- Granite Press Rolls.
- Curling Stones.
- Surface Plates.
- Grinding Media.

2. Rough Stone

Rip-rap.
- Breakwater Construction.
- Railroad Embankments.

Rubble.
Crushed Stone.
- Road Metal.
- Railroad Ballast.
- Concrete Aggregate.
- Terrazzo.
- Stucco Dash and Artificial Stone Facing.
- Poultry Grit.

Uses and Specifications

1. DIMENSION STONE

BUILDING STONE

The most important use for granite as far as the quantity of material consumed annually is concerned, is in the building industry. It usually lags behind the monumental trade in dollar value, however.

The construction of modern buildings varies considerably from that of 50 or more years ago. With the greater use of structural steel and reinforced concrete and the increasing cost of producing building stone, there has been a considerable decrease in the quantity of stone used in most buildings. Formerly, buildings were constructed with solid stone walls, many of which were load bearing, whereas today practically every major building erected has a steel frame which takes the full load of the building, with exterior walls of concrete, brick or stone. Today the granite section is usually limited to a veneer of from 2 to 6 inches thick on the first or second storeys of the building. Building costs have risen so much that to complete a whole building in granite would be extremely costly. With the grime and smoke of the modern city the entire building becomes almost a uniform colour and whether the top of a building is made of concrete or sawn granite makes little difference to the passerby. Both materials are enduring and require no maintenance for many years. However, the lower part of the building comes under the scrutiny of all people passing in the streets and an attractive polished granite face adds much to its appearance.

The type of buildings erected on this principle are office buildings of main banks, insurance companies, public utilities, and in some cases, general office buildings. These compare with the older type buildings such as the Sun Life Assurance Building in Montreal in which the outer walls are entirely of granite. In large office building construction in the major cities, granite is used extensively as a polished veneer on the lower storeys and main entrances.

The second important use for building granite is in churches and institutions. Although most of these bulidings are erected with steel frames, in a great many cases the walls are made of solid granite blocks which may have a sawn or rough-hewn finish.

The next important type of construction is in public buildings erected by the Dominion, Provincial, or local governments. These include such buildings as post offices, federal office buildings in various centres, provincial buildings, city or town halls, etc. The general trend in such cases seems to be to use local materials as much as possible. Quite often attractive combinations of stone and brick, stone and concrete, etc., may be worked out. In this type of construction it is quite common to have a base course of granite, corner blocks of granite, main entrances and steps of granite, window lintels and sills of granite, with the rest of the building finished in

facing brick. There is usually some use made of granite in each building of this class, the quantity depending on the availability of permanent local building materials and the distance from operating granite quarries.

For building purposes the stone must have an even texture, be of uniform mixture, with colour both pleasing and durable. For polished granite in base courses and trim a stone of the same quality as for monumental dies is required, but when other finishes are employed the specifications need not be quite so rigid. For massive structures a coarse textured stone may be used with pleasing effect, although fine textured stones are also in demand. Iron is at all times an objectionable constituent, as it will sooner or later cause disfiguring stains.

Another important use for granite which has been developed in the last few years is in the construction of modern houses. Modern houses are usually constructed with wooden frames with different types of outside finishes. Many of them have the exterior walls faced with brick and to a smaller extent, with the more expensive stone. Lately, the price of bricks and brick laying has increased to such a degree that stone veneer is competitive in selected areas. The granite quarry operators, by going through old waste piles, have been able to supply rough ashlar at a price competitive with brick in localities close to granite quarrying areas. As a result, their waste piles are fast disappearing and in cities like Montreal and Quebec, the amount of granite veneered houses being constructed is increasing steadily. As the fashion spreads, more and more people are demanding such a finish for their houses.

Formerly, store fronts were commonly constructed in polished granite, but the increased cost of such material in recent years coupled with the steady rise in consumption of the much cheaper artificially coloured glass type front, has largely eliminated this business except in the bigger and more important stores.

MONUMENTAL STONE

The use of granite as a monumental stone is by far its most valuable application. Included under this heading are monuments or tombstones, statuary, vaults, mausoleums, sarcophagi, war memorials, memorials to famous persons, memorials to commemorate historical occasions, and to mark historical sites.

The specifications for monumental granite are more exacting than for any other use, and only stone of the highest quality is used for this purpose. The stone must be free from flaws such as cracks, knots, hair lines, iron spots and any other imperfections that mar its beauty. The texture and mixture must be uniform, the colour both uniform and pleasing. The stone must be able to take and maintain a high polish, must be free from easily weathered minerals, and there must be a good contrast between the different finishes such as polished and hammered surfaces. Many of these

factors may not be very important when considering a stone for building purposes. It is probably true to say that a good monumental stone will make a good building stone whereas good building stones do not always make good monumental stones.

The colour of monumental stone is extremely important and the popularity of certain colours varies from year to year and from province to province. Style is another factor which is continually changing. The style 40 to 50 years ago consisted of polished pillars set on square or rectangular bases, while today the fashion is for thin slabs, rectangular in shape, with a beveled top. Machinery has been developed which makes this type of monument easier and cheaper to prepare than other types.

The finish is also an important factor in monumental work, changing from time to time. At the present time, there is some indication that hammered surfaces with raised or indented lettering may become the most popular type. A monument manufacturer must therefore be prepared to follow the modern trend with respect to colours, styles and finishes, in order to maintain markets.

Monuments or Tombstones.—Ordinary monuments usually consist of two sections, the upper section known as the die, and the lower portion to which the die is dowel-pinned and grouted, called the base. The die is the part on which the carving and lettering are inscribed, and should be capable of taking a high polish, if polished faces are required, and should be fine enough in texture to give sharp edges to carving and lettering. The base may be of coarse texture, and unless lettering is required, usually has rough sides with hammered top and bottom, or the surfaces may be sawn. The base may or may not be of the same stone as that used for the die. Most bases are made of grey granite as this is the cheapest granite available.

Statuary.—For statuary the granite should be uniformly fine in texture so as to take sharp edges and should work easily under the tool without excessive chipping.

Vaults, Mausoleums and Sarcophagi.—Granite is utilized to a great extent in cemetery vaults, mausoleums and sarcophagi. These structures are extremely expensive to manufacture on account of the large amount of polished granite and ornamental stone or carving required. They can be purchased only by the wealthy and consequently this business is carried on by a few specialists, although it is a highly profitable method of utilizing finished monumental granite.

Granite is undoubtedly the best material for mausoleum construction. Eurich (4) remarks on this subject: "In no other material is it possible to obtain such large pieces as are often required for roofs, etc. This enables the designer to make use of large stones, particularly for the roof construction, thereby reducing the number of joints, which is a very important point gained for the durability of the structure."

War Memorials.—The design and erection of war memorials in granite has been an important source of business for some granite firms since World War 1. Many cities, towns and villages erected these memorials in the period 1920 to 1939. Following World War 2 there was not a similar trend but many communities added the dates of World War 2 to their existing memorials, while others simply increased their size so that new names could be added. This has nevertheless meant a considerable volume of business for granite companies in this period, as most of the 900-odd communities in Canada with populations of over 500, have erected a memorial of some type.

The most famous of these is Canada's National War Memorial, erected in 1938 on Confederation Square in Ottawa. It consists of a group of 22 bronze figures representing all arms of the service, presented as pressing eagerly forward between 2 granite columns. These columns are surmounted by an entablature bearing the heroic bronze figures of Peace and Freedom. The whole memorial is nearly 70 feet in height, and was designed by the British sculptor, the late Vernon March.

One hundred and fifty-three blocks, having a total weight of some 830 tons are used in the construction of this memorial. They consist of 2 blocks weighing upwards of 35 tons, 9 blocks between 20 and 30 tons, 31 blocks between 10 and 20 tons, 17 blocks from 3½ to 10 tons and 94 pieces comprising the paving and steps, with an average weight of about 600 pounds. The cap or entablature surmounting the pylons weighs 134 tons and includes the largest single blocks in the structure, the architrave weighing 38 tons and the frieze but a few hundred pounds less. The architrave measures approximately 21 feet 4 inches in length, 6 feet 7½ inches in width, and 3 feet 2 inches in thickness.

The base of the memorial, 52½ feet by 28 feet, is of steel and reinforced concrete extending to bedrock. The base is extended by a paved terrace 22 feet in width, approached by 3 steps. In erection of the stone work little mortar was used, the blocks being laid on lead strips and fastened to the base or to adjacent blocks by bronze dowels, the centre space being filled with cement; the vertical joints between the blocks were calked with lead wool. All exposed faces of granite are finished with a fine axed surface (8-cut work).

The stone used in the National Memorial is a coarse-grained rose-grey granite from the Rivière-à-Pierre area, about 60 miles northwest of Quebec. The specifications required that the stone be free from objectionable minerals, spots and blemishes and of uniform colour and texture. To comply with the exacting character of the inspection more than 7,000 tons of stone were quarried to obtain the 830 tons actually used in construction. After quarrying, the stone was shipped to a finishing plant at St. Samuel, Quebec, where it was cut to the proper size and shape.

Other Memorials.—Memorials have been erected in Canada to commemorate wars and battles fought prior to 1914, and many famous historical sites have also been marked by the erection of suitable memorials. Throughout Canada individual memorials have been erected on behalf of persons who have played important roles in the history of the country.

ORNAMENTAL STONE

Granite is quite often used for its decorative effect on the outside and inside of buildings, such as cornices and veneer on inside hallways. It is used as an ornamental and decorative stone inside churches and in parks for ornamental steps, flower pots and fountains. Granite used in this way is recorded as building stone but should be considered as a special application because the finished stone for such purposes is usually much more valuable than ordinary building stone. Only granite without flaws and with a pleasing appearance is satisfactory. It should take a high polish, be of even texture, and absolutely sound.

PAVING BLOCKS, CURBSTONE AND FLAGGING

At one time an important use for granite was in the production of paving blocks and curbing, but in recent years the amount used for this purpose has been very small. Many of our cities have the remnants of these old pavements and curbs but their replacement by asphalt and concrete is proceeding rapidly. As a result, this trade is practically non-existent today, and the cutting of curbstone and paving blocks is a vanishing art.

Paving Blocks.—Granite paving blocks, or setts, were formerly used in a number of Canadian cities such as Halifax, Saint John, Montreal, Quebec, Sherbrooke, St. Hyacinthe, Toronto, Hamilton, Niagara Falls, Windsor, Winnipeg, St. Boniface, and Vancouver. Their main use, according to Freeman (5), was in "paving the space between street-car tracks and a strip generally 18 inches in width on the outside of the rails on those streets which are subjected to severe traffic conditions". They were also used for paving the roadway on hills, to provide traction for horses, and in subways, or where extremely heavy and constant traffic required a pavement that would stand severe wear.

Nowadays there is practically no demand for granite paving blocks and only one quarry at Guenette, Quebec keeps a supply on hand to meet the occasional request. Montreal, Quebec, and Toronto, formerly large consumers of paving blocks, have dispensed with this type of pavement, although paving blocks from the Guenette area were used in the construction of the St. Remi Street Tunnel, in Montreal in 1950. The Toronto Transportation Commission* "last purchased granite blocks in 1938 and does not anticipate

* H. W. Tate, Assistant General Manager, personal communication of December 11, 1952.

making any additional purchases in the future." They relay the blocks in their "track allowance paving and have on hand sufficient blocks to take care of wastage for many years to come."

Blocks were made in various sizes, each city having its own specifications. Toronto used a block 7 to 10 inches long, 4 to 4½ inches wide and 4½ to 5 inches deep, in other words, 34 blocks to a square yard of pavement. Montreal used a somewhat heavier block—7 to 12 inches long, 3½ to 4½ inches wide and 4¾ to 5½ inches deep; a 4-inch cube has also been employed.

Granite for use in paving blocks should be durable, sound, and uniform, and have the splitting quality developed along the rift, grain, and hardway, as all blocks must have rectangular faces. A fine- to medium-grained granite of uniform texture, hardness, and colour, without laminations or brittleness, and free from an excess of mica or feldspar is preferred. As Tillson (9) remarked, the hardest granites do not necessarily give the best results. The hard blocks wear on the edges so that in a few years the pavement becomes rough, although the surface of the blocks is smooth. In comparison, the softer blocks being more tough do not break at the corners so much but wear down evenly over the entire surface, so that the pavement keeps moderately smooth.

According to the American Public Works Association specifications (1), which are intended to serve as guides for public works engineers, "The blocks shall be of granite of medium-size grain, showing an even distribution of constituent minerals. They shall be of uniform quality and texture throughout, and free from seams or disintegrated materials." For heavy traffic the Association recommends a stone having a French coefficient of wear of not less than 8 and a toughness of not less than 7; for extra heavy wear a French coefficient of not less than 11 and a toughness of not less than 9 are recommended.

Curbstone.—At the present time the production of granite curbstone in Canada is confined to the Rivière-à-Pierre district of Quebec. The output, amounting to approximately 8,000 linear feet (500-550 tons) annually, is purchased by the city of Quebec. The use of granite curbstone in Montreal is confined to stock in hand, which will not be renewed.

Specifications for size and surfacing vary with each city, thus for Montreal the curbing is narrow and deep, the dimensions of the rough blocks being 8 to 10 inches wide, 18 inches deep, and at least 3 feet long. Quebec uses a block 9 inches wide, 12 inches high, with a minimum length of 5 feet. The blocks are usually dressed to specified size and shape for the part above ground.

Granite curbstones require a stone that has high resistance to abrasion and must split easily on rift and grain in order to break readily into required sizes. Specifications sometimes require the granite to be of uniform grain,

texture and colour, free from seams, excess of mica and disintegrated materials. Usually, however, colour is of no account and material unsuitable for building or monumental stock may be used for curbing, provided it is sound. For Quebec City, a grey granite is specified.

Flagging.—Occasionally large granite blocks from some thin beds are dressed and used as flagging but for most of such use sawn slabs are now employed.

BRIDGE CONSTRUCTION

Until the close of the eighteenth century, the stone or brick arch was the only mode of constructing substantial and permanent bridges, and consequently much of the granite quarried previous to that time was used for this purpose. By the end of the nineteenth century, steel and concrete had almost entirely replaced stone in bridge superstructures, and the use of dimension stone in bridge construction was largely confined to the supporting piers and abutments.

For use in bridge piers, abutments, and like construction, colour and texture are unimportant, as are the knots and blind seams if the stone is otherwise sound. Strength and durability are the main requisites for such use. The principal factor governing the use of stone is the cost of extracting it in large blocks.

Bridges in which Canadian granite has been employed for piers and abutments are the Quebec bridge completed in 1917, and the Ile d'Orleans bridge, completed in 1934.

The Quebec steel bridge (6), with a main span 1,800 feet wide, is the largest cantilever bridge in the world. Rose-grey stone from Rivière-à-Pierre, about 60 miles northwest of the bridge site, was used as facing for the abutments and 5 piers upon which the bridge rests. The facing of the pier shafts was laid with alternate headers and stretchers and backed with concrete in which were embedded displacer stones having an approximate volume of about one cubic yard. Headers were required to have a length of at least two and a half times the breadth with a minimum length of 7 feet. Bed joints were one-half inch throughout and vertical joints three-eighths of an inch for a distance of 12 inches back from the face and not exceeding 4 inches at any point. The upper 18 feet of the 2 main piers were built entirely of granite. Rivière-à-Pierre rose-grey granite is highly suitable for heavy works and foundations such as this.

The Ile d'Orleans bridge (3) has a total length of 7,000 feet. The central span of 1,035 feet is of steel and is supported at each end by 3 piers. The approaches are of reinforced concrete, supported by 16 piers on the north side and 16 on the south side. The 38 piers are faced with grey granite from the St. Samuel area of Frontenac county, and 6,500 granite blocks were used in the piers of the approaches exclusive of those that supported the central arch. Blocks vary in thickness from 18 to 36 inches

(top to bottom), from 3 to 9 feet in length, and average 15 inches in depth. In construction, after each two courses of blocks were laid the space inside was filled with concrete. This grey granite is admirably adapted to such a use and the piers not only have a pleasing appearance but are calculated to last indefinitely.

Concrete has now replaced stone in the construction of piers and abutments. However, in some areas a stone veneer is being used to cover up the bare concrete and give a pleasing appearance to the bridge. In New Brunswick many of these bridges have been built in the last few years and the granite veneer has added considerably to their appearance. In referring to this type of bridge, Mr. R. A. Malloy,* Chief Bridge Engineer of the New Brunswick Department of Public Works, writes, "This makes a very beautiful structure, and is not to be compared in appearance with the exposed surface concrete. This stone facing is not too expensive; especially if constructed in an area or locality where the stone can be easily obtained. All side forms used in the construction of a concrete structure and the rubbing of the concrete are eliminated, and I may add that this stone mellows with the years; whereas concrete loses its appearance".

Figure 8 is a photograph of a 100-foot reinforced arch, located on the Saint John-St. Stephen highway, at New River Mills, Charlotte County, N.B. The stone facing on this arch consists of three colours, light gray, dark gray and red granite, obtained in the St. George area of New Brunswick.

SPECIAL USES

Several special uses for granite are worthy of notice, four of which are described hereunder.

Granite Press Rolls.—A special use for granite is in the manufacture of granite press rolls for pulp and paper machines. They are solid cylinders of polished granite up to 36 inches in diameter, and of varying lengths up to nearly 30 feet, with a 6-inch hole through the centre for a shaft. Granite for this purpose should be fine-grained, hard, of uniform, close texture, of high tensile strength, and free from soft spots and sulphides which might be acted upon by any residual chemicals remaining in the paper stock. Mica is undesirable as, besides being soft, it has an affinity for the paper. Colour is unimportant but the stone should be capable of taking a high polish.

So far, granite press rolls have been produced from only one quarry in Canada, that of Brodie's Limited, at Guenette, Quebec. Previous to 1923, all granite press rolls were imported from either United States or Europe. The Guenette stone is a fine-grained, light-red granite of uniform texture, and is known to the trade as 'Laurentian Rose'.

The blocks from the quarry are shipped to the company's finishing plant at Iberville, Quebec, where they are prepared into rolls of the desired length and diameter.

* Personal communication, December 2, 1952.

Uses and Specifications

Except for breakage, these rolls appear to be practically indestructible and are probably good for 30 to 40 years. Consequently, there is little demand for replacement and the production may vary from none to half a dozen a year. To produce these rolls considerable capital investment is necessary and at such a low rate of requirement no new operator would be justified in entering the market. During the past year about two dozen rolls have been produced as a result of recent expansion in the pulp and paper industry.

Curling Stones.—So far, no curling stones have been produced in Canada, most, if not all in use in this country being manufactured in Scotland. The rock from which these stones are made comes from Ailsa Craig, an island off the west coast of Scotland.

A fair amount of granite is used in this type of manufacture, usually a fine grained syenite with very tough qualities, and one that takes a high polish.

An attempt was made by Cole (2) several years ago to find a domestic stone equal in toughness to the imported variety, and although many samples were tested, the investigation proved inconclusive. He gave the following tentative data on the qualities required in curling stones: the toughness factor (Page impact machine (7)), should be 21·0 or higher; the rock should be of fine-grained, homogenous texture and as free from quartz as possible; the specific gravity should range from 2·60 to 2·75; the colour should be uniform.

The following table shows that imports of curling stones have increased steadily in the past 6 years, those in 1952 being over 200 per cent higher than in 1947.

CANADIAN IMPORTS OF
CURLING STONES AND HANDLES*

	From U.K.		From U.S.		Total	
	Pairs	$	Pairs	$	Pairs	$
1947	1,113	35,834	—	—	1,113	35,834
1948	1,705	57,742	24	241	1,729	57,983
1949	1,726	62,746	319	3,694	2,045	66,440
1950	1,887	67,621	2	46	1,889	67,667
1951	3,126	116,551	121	2,379	3,247	118,930
1952	3,550	120,375	38	598	3,588	120,973

* DOMINION BUREAU OF STATISTICS.

Surface Plates.—Granite surface plates are required for layout and tool room work and for inspecting and checking the production of precision parts. The use of these surface plates has become standard practice in many plants as they are extremely hard and durable, non-warping, rust proof and corrosion proof, and will outlast surface plates made from other materials such as limestone, sandstone, and iron. The plates are slabs of granite which have been polished to a very close tolerance all over; for example, one manufacturer of granite surface plates finishes his surfaces to an accuracy of 0·00005 inch on sizes ranging from 12 x 18 to 24 x 36 inches, and to an overall tolerance of 0·0002 inch on special sizes up to 4 x 6 feet if required.

For this purpose, granite of very high quality that is capable of taking and maintaining a high polish is required. The stone must be hard, close-textured, fine to medium-grained, and must be free from all imperfections such as iron and soft spots, seams, and hair-line cracks. While not yet a very large use for granite, as more of this type of work is carried on in Canada the demand for such plates will probably increase. Several of the Canadian granites now being produced are suitable for the purpose.

Grinding Media.—Although no Canadian granites appear to have been utilized for this purpose, grinding cubes and tube mill liners are being produced by at least one granite company in the United States (8). Production of grinding media commenced at this plant in 1941 to help meet the shortage caused by the sudden cutting off of imports of flint grinding pebbles from France and Denmark and silex liners from Belgium. By 1946 these products accounted for 20 per cent of sales of this producer and had been widely used in the United States, Mexico, Canada and South America, and found highly satisfactory.

At this plant the granite blocks are broken down into cubes of the desired size, placed in tube mills lined with granite blocks, and wet ground for several hours to remove the sharp corners and edges. The grinding cubes are manufactured in sizes ranging from 1½ to 5 inches. Liners are made in various sizes ranging from 8 to 12 inches in length, and from 2½ x 5 to 5 x 5 inches in section.

Grinding pebbles and tube mill liners are used in large amounts by those producers of non-metallics and other materials who must avoid iron contamination in grinding. Before the war, the imported varieties mentioned above were used almost exclusively in the United States for this purpose.

2. ROUGH STONE

Rough stone, i.e. stone as it is produced in the quarry without further treatment or simply crushed, is used for a number of purposes and (if we

99246—3½

include those granite quarries which have been opened for the sole purpose of supplying concrete aggregate and road metal) constitutes the largest tonnage but not the greatest value of granite produced in Canada.

RIP-RAP

Rip-rap consists of large irregular blocks as they are produced in the quarry by blasting or other means, limited in size only by the equipment available for handling and the intended use. It is used in loose form as railroad fills, crib fillings, breakwaters, and backings for walls.

Breakwater Construction.—With our long and rugged coastlines many breakwaters are required to protect harbours and inlets for use of all types of shipping. These breakwaters require protection from the erosion of the tides and waves and great blocks of granite as well as other materials are used to keep them in place. This breakwater construction usually helps quarries to get rid of considerable material which would otherwise be considered waste. However the majority of the granite quarries are located at considerable distances from the coastal areas and consequently freight rates prohibit the use of this stone in most coastal breakwaters. There is however some use in inland waterways for control dams, breakwaters, etc.

Railroad Embankments.—Railroads use a considerable amount of waste stone for embankment protection along fast flowing rivers and streams. This use does not bring much return to the granite quarries but may enable them to get rid of waste which would otherwise hamper the development of the quarry.

RUBBLE

Rubble consists of rough, unsquared blocks used in masonry walls and foundations. For this use blocks that have broken with some regularity are generally used. In stone for these purposes, colour is of no account and such defects as knots or seams are not detrimental. In fact almost all granites are suitable for these uses, availability to market being the controlling factor.

CRUSHED STONE

Road Metal.—Road metal is granite that has been crushed, and the product screened into various sizes ranging from ¾-inch to 3 inches. It is employed in decreasing sizes to form the foundation for permanent highways. The toughness of the stone and its ability to break into cubical fragments rather than splinters are its chief requirements for this purpose.

Railroad Ballast.—Railroad ballast is prepared in a similar manner to road metal and the resistance to abrasion is its chief requisite. A dense stone is preferable as it does not tend to lift from the road bed by the suction of the passing trains and is less likely to be dusty.

Concrete Aggregate.—Granite for concrete aggregate appears to add greatly to the strength of the concrete. It is crushed and sized, and its toughness and angular breaks make it ideal for the purpose. Proximity to market and cost of crushing are governing factors.

Terrazzo.—Terrazzo consists of crushed and graded pieces of stone, from ½- to ¾-inch in size, used with Portland or some other special form of cement to make mottled flooring. After the cement has hardened the whole floor is smoothed and polished. Colour is one of the special qualities required and usually several kinds of stone are used in the same flooring. The blue sodalite from near Bancroft, Ontario, has been employed in special cases, as it is one of the few blue rocks in which the colour is permanent. Resistance to abrasion and the ability to break into equidimensional pieces are essential qualities.

Stucco Dash and Artificial Stone Facing.—In granite used for stucco dash or artificial stone facing, brilliancy of colour is one of the main governing factors. The stone is crushed and screened into sizes ranging from $\frac{1}{16}$-inch to ⅜-inch. In the facing of artificial stone the granules are placed as compactly as possible on a flat casting surface on which the casting form is placed. The casting table is constantly agitated while the cement binder is being poured on the granules, which have been filled in to a thickness of from ½ inch to 1 inch. The agitation of the table allows the cement to coat each granule thoroughly and prevents the formation of air bubbles. The facing is allowed to set before the backing of concrete is poured. Some of the rock comes from the waste of granite quarries but the quantity sold for this purpose is small.

Poultry Grit.—A small amount of the light coloured granites are crushed to granules and screened to uniform sizes for use as poultry grit. About the only Canadian granites that can be used for this purpose are those of light grey colour, as poultry will not take to coloured grit and consequently red and black granites are not suitable.

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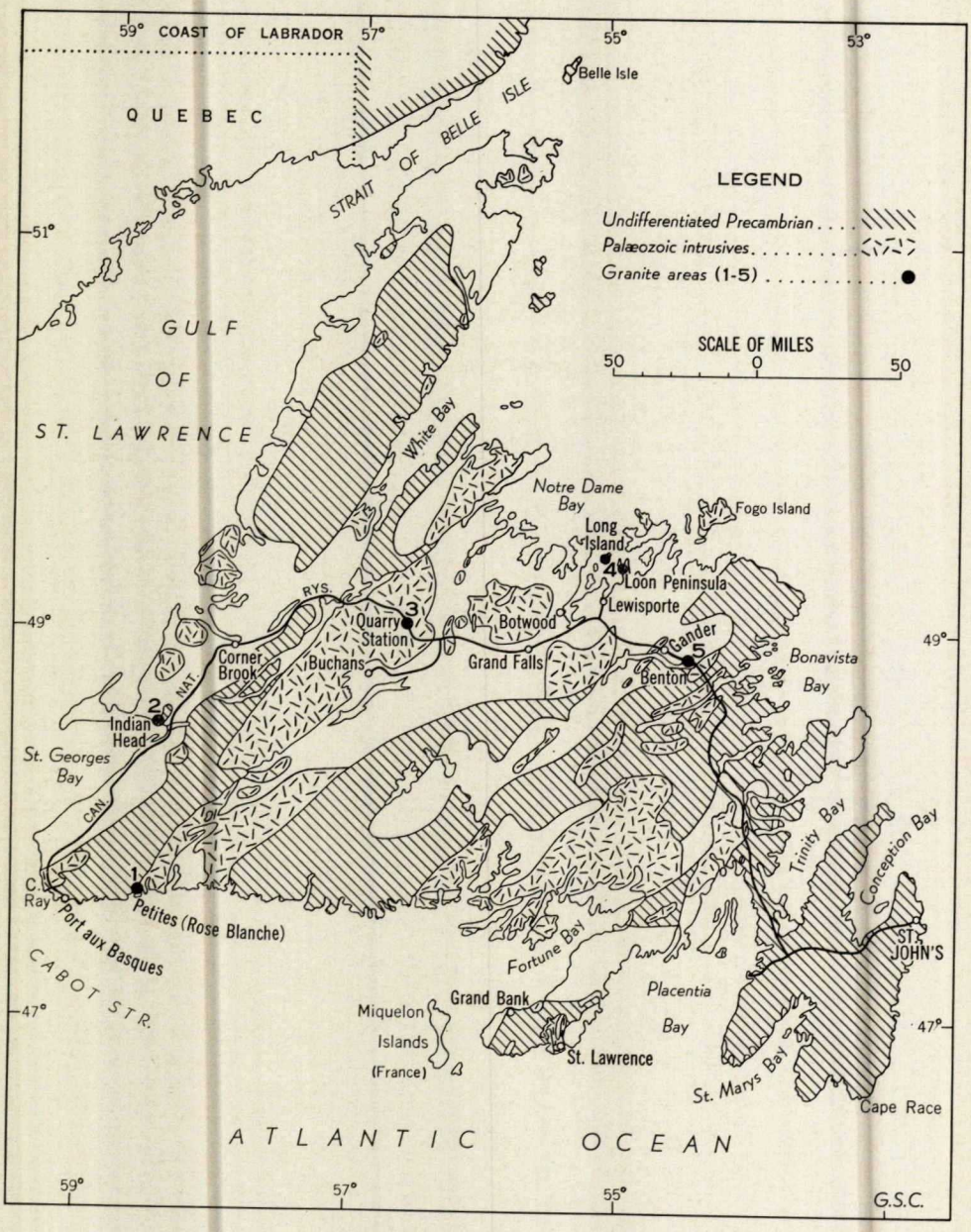


Sketch map of Newfoundland

CHAPTER 3

GRANITES OF NEWFOUNDLAND

Although granites suitable for dimension stone are of widespread occurrence in Newfoundland, they have, as Snelgrove (9) says, "been utilized on only a small scale for local buildings, bridge abutments, and paving". Quarrying has been mainly confined to the Petites (Rose Blanche) area of the southwest coast, to the south side of Conception bay, and to several points along the railroad which were opened during its construction in the 1890's to supply stone for bridge pier and abutment work. In this connection, quarries were also opened at Shoal Harbour, Trinity bay, near Benton, about 10 miles south of Gander, and near Quarry Station, 15 miles west of Millertown Junction. There has been very little, if any, production in recent years and at present the industry is at a standstill.

The bedrocks of Newfoundland range in age from early Precambrian to Pennsylvania, or late Palæozoic. The Precambrian rocks are the most extensively developed, occupying from one-quarter to one-half of the total area of the province. They constitute the Long Range mountains of the west coast, parts of the interior of the island, and most of the east coast, including the Avalon peninsula. A wide variety of intrusive rocks are to be found in the Precambrian. In the west they are represented by wide belts of granites and gneisses, and by large masses of anorthosites and related rocks, while in the east they are represented by rock types ranging from aplites to gabbros, with the more acidic types predominating.

Intrusives of Palæozoic age are also well represented. They are widely distributed and consist mainly of granites and related rocks which reach their maximum development in the west-central part of the island where one such body is known to have a length of 100 miles and to cover an area of approximately 1,000 square miles. In comparison, the occurrences of basic and ultrabasic rocks of Palæozoic age are fewer and smaller in extent and are confined mainly to the western and northern portions of the island.

Very little of this vast area of Precambrian and Palæozoic intrusives has been mapped in detail and for this reason the Precambrian is shown on the accompanying map as undifferentiated. A large portion of the island, including the interior which is of a rugged and barren nature and almost uninhabited, is inaccessible except by air transportation at the present time, and for this reason those areas which have been mapped geologically are, generally speaking, confined to the coastal regions or within easy reach of road or rail communications. Work to date, however, has shown that a wide

variety of intrusive rocks are in many cases crossed by, or within easy reach of, existing lines of communication, and many would undoubtedly afford excellent quarrying sites for the prospective granite quarrying operator. Newfoundland has already produced several varieties of highly suitable building stone and there is every reason to believe that other equally good, or possibly better, sites may be disclosed where granite suitable for both building and monumental purposes may be produced.

Any granite quarrying operations in Newfoundland would be limited by lack of markets. The population of the island is small, totalling 316,000 and is spaced, for the most part, in small scattered communities on the coast. The province contains only 3 towns or cities with populations of over 5,000 and only 7 towns or villages with populations ranging from 1,000 to 5,000. In St. John's, the capital, with a population of 57,000, there has been an increasing tendency in recent years to erect buildings of reinforced concrete construction. This is probably due mainly to the cost of importing face brick and building stone, but may also be due to the failure of many of the imported bricks and marbles to stand up to the rigorous Newfoundland weather. Buildings faced with granite, however, (the court house and railway station at St. John's may be cited as examples) show no such deterioration.

For several years the writer has been engaged in making an investigation of the mineral resources of Newfoundland on behalf of the Mines Branch, Department of Mines and Technical Surveys. In this connection, visits were made to several of the once active quarrying areas, and to several other localities which have been described in various reports of the Newfoundland Geological Survey as suitable for the production of dimension stone. These areas, described briefly below, are:

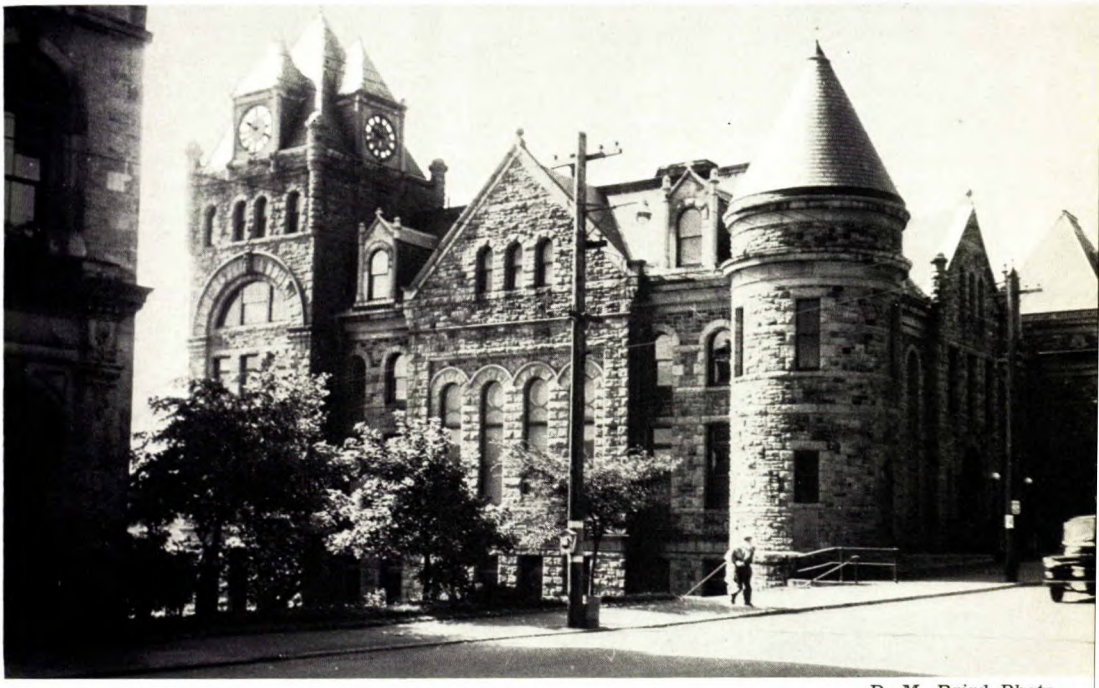
1. Petites (Rose Blanche) Area
2. Indian Head Area
3. Quarry Station Area
4. Long Island and Loon Peninsula Areas
5. Benton Area

Other deposits of granite suitable for the production of building stone are known to occur in Newfoundland, but due to their location no attempt has been made to exploit them to date. Such deposits occur at Pomley cove and North and East bays, Baie d'Espoir (7), on Fogo island (1), and on the eastern shore of Baie Verte between Devils cove and Pointe Rousse (10).

Good building stones are of widespread occurrence in Newfoundland Labrador but as Kranck (8) remarked, "the remoteness of the region from large cities robs them of value". Labrador has long been known as a source of the plagioclase feldspar labradorite, in fact, the mineral received its name from the region. According to Coleman (2), labradorite is the

essential mineral of the anorthosite which covers many square miles in the Paul Island-Nain region. In referring to the gem variety which occurs in a few places, he writes:—

"The gem variety of labradorite was first obtained from Paul Island, but according to Daly the best specimens have come from a quarry opened by R. G. Taber on Napotulagatsuk island between Paul island and the mainland. Apparently the quarry was not a commercial success, though this beautiful stone has been widely sold to museums, and fine specimens several inches square may still be obtained from dealers in minerals. If got out unfractured on a large scale, so as to be sawn into slabs, schillerized labradorite should make one of the most beautiful decorative stones imaginable."



D. M. Baird Photo

Figure 2 | *Court House, St. John's, Newfoundland. Constructed in part of Petites (Rose Blanche) pink granite.*

1. PETITES (ROSE BLANCHE) AREA

Petites is a small fishing village on the southwest coast of Newfoundland, about 4 miles east of Rose Blanche and 25 miles east of Port-aux-Basques, the western terminus of the railway. The area is reached by Canadian National coastal steamer from Port-aux-Basques to Rose Blanche and by motorboat from Rose Blanche to Petites.

The stone of the Petites area is a light-pink porphyritic syenite with a coarse grained texture. It is composed mainly of feldspar, a small amount of quartz, and smaller amounts of biotite; the feldspars range from white to pink in colour. A brief examination of the quarries and outcrops in the area did not disclose any marked variation in colour, composition, or texture of the syenite, neither were any blemishes or impurities noted in the stone. It appears to be highly suitable for use as a building stone and the court house at St. John's, which is faced with stone from the Petites area, has a very attractive appearance. An examination of the rough syenite blocks in the various quarries which were quarried approximately forty years ago, failed to disclose any trace of iron stains or weathering.

Five small quarries were viewed at Petites, 4 occurring on the mainland and one on Billards Island at the entrance to the harbour. The latter quarry was not visited due to heavy seas, but was seen only in the distance. All of these quarries are of the 'side-hill' type, having been opened on the hillsides bordering the ocean at elevations ranging up to 50 feet above sea-level. Of the four quarries examined, one was situated at the southeast entrance to Petites Harbour on the property of Mr. Newman, a local merchant, and the other three on the northwest side of the harbour not far from the entrance. All 5 quarries contained a fair amount of rough quarried stone left over from former quarrying operations.

The first quarry to be examined, that situated at the southeast entrance to the harbour, covers an area of approximately 1,500 square feet. It is within 50 feet of the shore-line, with the sill having an elevation of about 5 feet above sea-level. Two main sets of joints occur at this quarry, both of which are quite prominent: one set strikes east-west and dips uniformly at 65 degrees to the north, with the joints ranging from 6 inches to 4 feet apart; in the other set the joints are spaced 5 to 15 feet apart, are nearly vertical, and have strikes ranging from due north to N20°E. It was noted that a few vertical joints occurred cutting the two main sets at an angle of about 45 degrees. An examination of the quarry face, which ranges up to 15 feet in height, and of the outcrops in the immediate vicinity, failed to disclose any horizontal jointing or sheeting planes. The quarry contains a large pile of rough quarried blocks ranging in size from 6 x 6 x 6 inches to 3 x 3 x 4 feet.

The next quarry to be examined is on the northwest side of the harbour directly opposite the above quarry, about 15 feet above sea-level, and the face, which is an exposed joint plane, has a maximum height of 15 feet. Here again there are two main sets of joints, one set striking east-west and dipping at 80 degrees to the north, and the second set having a north-south strike and vertical dip; the east-west joints are spaced farther apart than the corresponding joints at the fist quarry described. The rough quarried blocks here range in size from 1 x 1 x ½ feet to 5 x 3 x 1½ feet, although one block was seen which measured 15 x 3 x 1½ feet.

At the third quarry, several hundred yards northwest of the second, only one well-defined set of joints was observed, namely, the east-west, vertical joints; the quarry face is an exposed joint plane belonging to this set. In addition, a minor set of vertical joints was seen cutting the major set at approximately 45 degrees. The largest block of quarried stone remaining at this locality measured 9 x 3 x 2 feet.

The fourth quarry is several hundred yards farther to the northwest. Two sets of joints were observed, the first striking north-south and dipping at 85 degrees to the east, the second striking approximately east-west and dipping at 75 degrees to the north. The joints are spaced farther apart at this quarry, the north-south joints ranging from 6 to 10 feet apart and the east-west joints are spaced even farther apart. As before, no horizontal joints were observed. Blocks measuring 6 feet long by 6 feet wide could easily be obtained at this locality.

2. INDIAN HEAD AREA

Indian Head is about 3 miles west of Stephenville Crossing, St. Georges Bay, west coast. It is connected with the Stephenville Crossing-Port au Port motor road by a trail about 2 miles in length. Indian Head presents a rugged topography, and elevations of more than 500 feet above sea-level are encountered in the area.

Snelgrove (9) referred to the quarrying possibilities of the area as follows:

"At Indian Head, on the north shore of Bay St. George, southwest coast, anorthosite (labradorite rock) is found in large quantities and presents excellent quarry sites. The stone is well jointed and takes a good polish. No quarrying has been done at this locality which appears to be equally as good as Labrador as a source of labradorite for dimension stone."

Several samples of anorthosite were obtained in the area by the writer. The stone is white to light grey, course grained and, in composition "is almost wholly labradorite with minor amounts of hypersthene, hornblende, and magnetite" (5). It has a pleasing appearance when polished, with a colour ranging from light grey to light green or bluish grey, depending upon the amount of hypersthene and hornblende present. One sample which contained more than the usual amount of hypersthene and hornblende presented a very attractive dark green appearance on polishing. All polished surfaces, however, were badly marred by fractures due, presumably, to frost action.

These samples, however, were obtained from outcrops situated between Indian Head and the motor road. Outcrops are numerous in this area but all appeared to be too badly cut up by joints and fractures to permit quarrying of dimension stone. In addition, these outcrops are usually surrounded by marshland, due to a poorly developed drainage system, and the cost of constructing a road into the area would be rather expensive, if not prohibitive. It would appear, therefore, that the logical place at which to attempt quarry-

ing operations would be along the shore at the foot of the sea cliff where, as Snelgrove stated, the stone is well jointed and takes a good polish. Transportation in this case would have to be by boat.

The rocks of this area have been classed as Precambrian in age (4).

3. QUARRY STATION AREA

Quarry Station is 14·9 miles west of Millertown Junction and 30·6 miles east of the Trans-Canada highway at Badger. The most convenient way to reach Quarry Station is to take the westbound morning train from Millertown Junction, the nearest settlement.

Reid Newfoundland Company Limited quarried granite in this area in the 1890's for railway construction. Several small bridges occurring between Quarry Station and Millertown Junction illustrate the way in which the granite was employed. The railway station at St. John's was faced with granite quarried at this locality, and Davies (3) reported that the stone was also used to pave Water Street. An examination of the railway station showed that, with the exception of an occasional black knot one inch in diameter, the granite is free from impurities and uniform as to colour, texture, and mixture. Water Street was recently repaved, and it is interesting to note that some of the discarded paving blocks have been used with great success as tube mill liners at the pyrophyllite mill near Manuels, Conception bay. The stone is a coarse grained, light grey hornblende granite of Devonian (?) age and is massive but well-jointed.

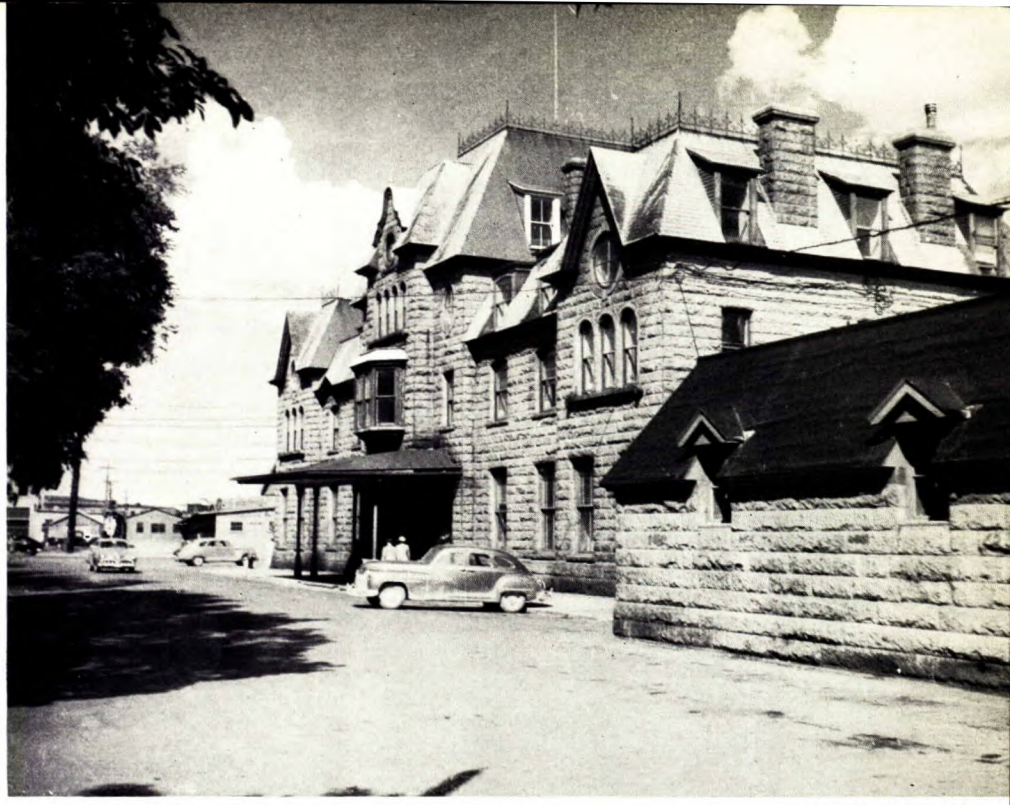
At Quarry Station the land is flat, overburden is absent, and quarrying in the past appears to have been confined to opening small pits where well-defined vertical joints are present; most of these pits are now flooded. Occasional plug holes show that in some cases only several blocks or possibly one block may have been quarried at these places, but it would appear that most of the blocks were quarried from pits that range up to 20 feet in diameter.

4. LONG ISLAND AND LOON PENINSULA AREAS

Long island is in the Bay of Exploits area, about 14 miles north of Lewisporte, the Notre Dame Bay terminus of the railway. The island is about 3 miles long and a mile wide. Loon peninsula, on the mainland, is about 8 miles southeast of Long island, and 12 miles northeast of Lewisporte. These localities may be reached by motorboat from Moreton's Harbour, New World island, situated about 20 miles to the north, or from Lewisporte.

Both of these granite areas occur in the Bay of Exploits and have been mentioned as a possible source of building stone by Heyl (6):

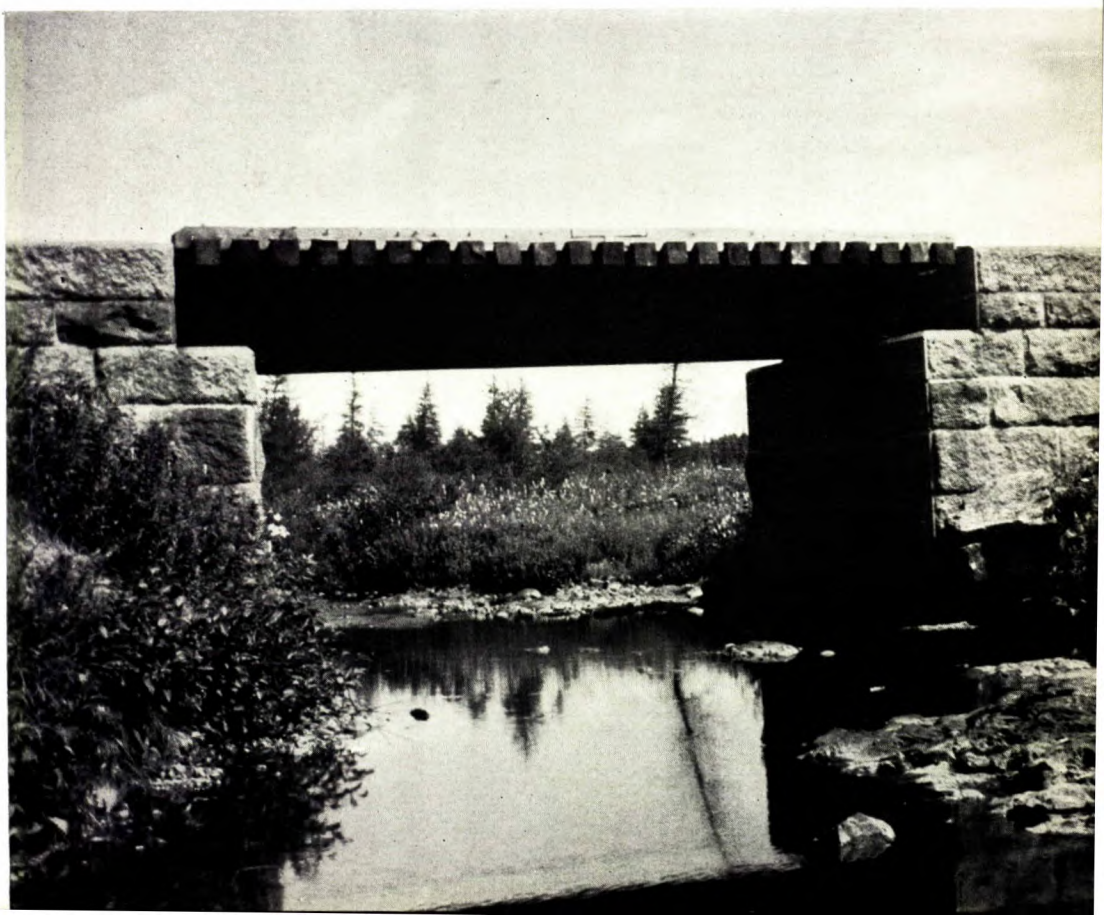
"The granodiorite of the Long Island and the Loon Bay batholiths is a stone suitable for building purposes; commercially this rock would be classified as a granite. There are both moderately coarse and medium grained



D. M. Baird Photo

Figure 3 *Railway station, St. John's, Newfoundland. Quarry Station grey granite.*

Figure 4 *Railway bridge near Millertown Junction, Newfoundland. Quarry Station grey granite.*



types, and these vary from pink to very light grey in colour. The constituent minerals are quartz, feldspar, and either mica or hornblende, or both. The rock is unaltered and has the strength and hardness suitable for structural work. Commonly, the jointing in the granodiorite is evenly spaced at fairly wide intervals, intersecting approximately at right angles—an important consideration in quarrying. This is particularly true on much of Long Island, on the eastern shore of Southern Head, and on parts of the Loon Peninsula. At all of these places quarrying could be carried on at tidewater".

Samples of fine grained and medium grained granite were obtained from the northwest corner and the southwest corner of Long island and from the east side of Loon peninsula about a mile north of Gull island. Due to their colours, which range from light pink to an offshade of grey, and to their location, it is very improbable that any granite quarries will be opened in the area in the near future. The northwest corner of Long island appeared to be the most likely place at which to open a quarry; the jointing here was well developed, overburden was negligible, and blocks ranging from 2 x 2 x 4 feet to $1\frac{1}{2}$ x $3\frac{1}{2}$ x 15 feet were seen. The most attractive stone, however, was seen on Loon peninsula.

5. BENTON AREA

The Benton quarry is at Mile 199 of the railway, 14 miles south of Gander. Benton, the nearest settlement, is 5·2 miles to the north.

Granite from this area was employed in the construction of railway bridges in the 1890's by the Reid Newfoundland Company Ltd. There has been no production since that time. Apparently the workings consisted of a series of small excavations along both sides of the railway. Several of these, all filled with water, were seen a short distance to the west of the railway line. Some quarried blocks were seen near the railway, and others near the flooded excavations. These blocks ranged in size up to 2 x 2 x 5 feet.

The Benton granite, a light pink, coarse grained stone, consists mainly of feldspar, smaller amounts of quartz, and only minor amounts of biotite. In some cases the feldspar crystals exceed one inch in length. The granite has an attractive appearance and would be suitable for building purposes, but due to its light colour and coarse grain, would be unsuitable for monuments.

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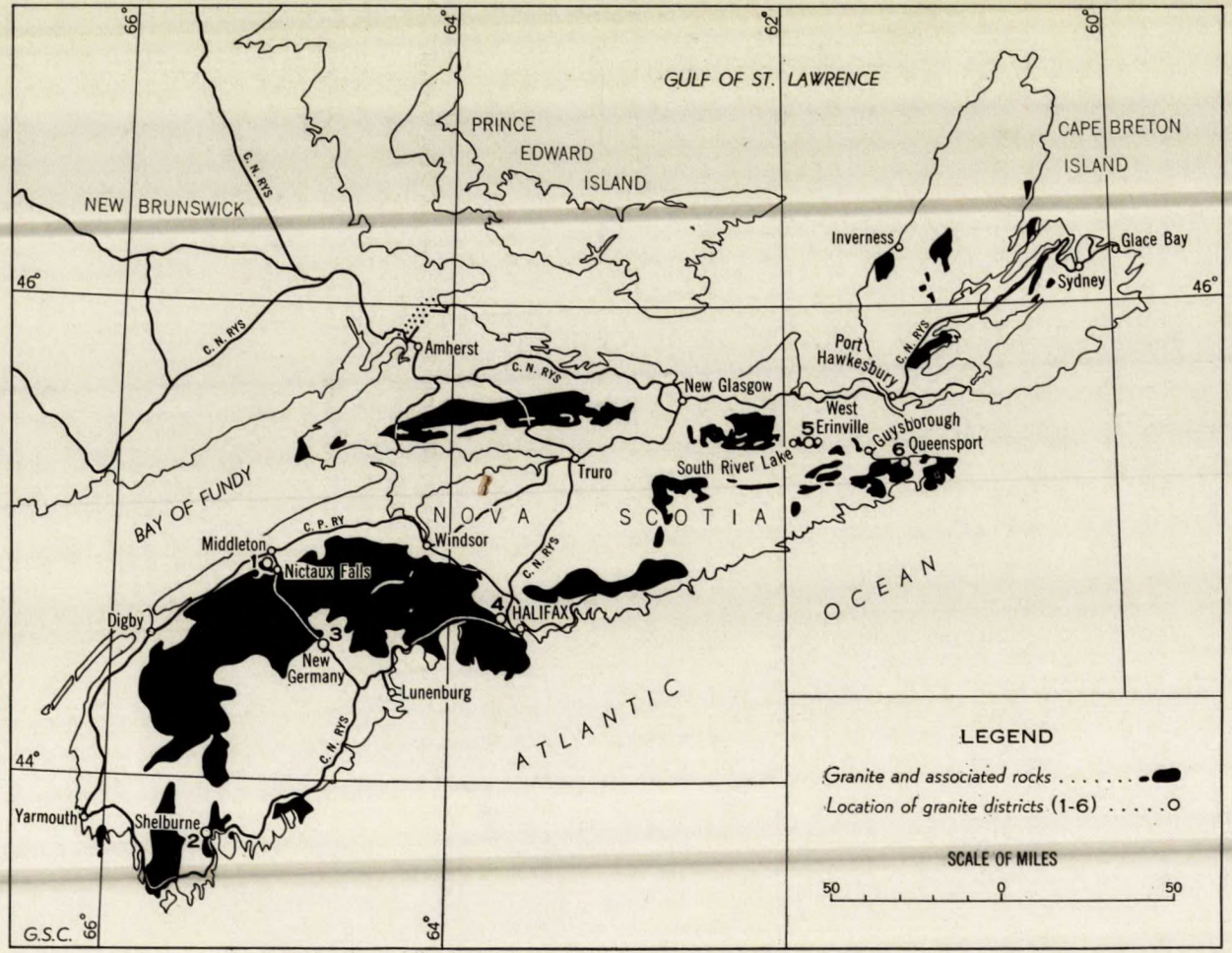

Sketch map of Nova Scotia

CHAPTER 4

GRANITES OF NOVA SCOTIA

Granites are widely distributed throughout the province, appearing in areas of various shapes and sizes (9). By far the largest granite mass is a crescent-shaped area approximately 120 miles in length and 35 miles wide, that extends in a general southwesterly direction from Halifax, occupying parts of Halifax, Hants, Kings, Lunenburg, Annapolis, Digby, Yarmouth, and Shelburne counties. Smaller bodies of granite, which are considered to be outliers from the southwestern tip of this main granite mass, occur in Shelburne and Yarmouth counties. Included in this southwestern portion of the province are the Shelburne and Middleton-Nictaux granite quarrying districts, together with the now inactive districts of Halifax and New Germany.

Eastward from Halifax the granite masses are more numerous but of smaller extent, and are largely confined to Halifax county and to the south-eastern part of the province in Guysborough county. The largest body, which is situated in Halifax county, extends easterly from a point north of Dartmouth almost to Sheet Harbour with a length of 50 miles and maximum width of 12 miles. There are no granite quarrying districts in this region at present. Two districts which have produced granite of some importance in the past are the Queensport and Guysborough districts, in Guysborough county.

Large masses of granite occur in Cape Breton Island but as far as is known no attempt has been made to exploit them for dimension stone.

Although granite quarrying has been carried on in Nova Scotia for many years, no extensive development has yet taken place, probably because of limited local markets and lack of variety and quality of the granite types. The granites are for the most part grey in colour and medium to coarse in texture, while the diorites, where present, are usually on the dark side.

The main transportation routes follow the settled portions of the province and practically no roads or railroads pass through the main areas underlain by granite. As a result, many large areas containing granites suitable for monumental and building work are not sufficiently close to transportation routes to make them of present economic importance. What development has taken place has been around the fringes of these large areas, where quarrying conditions are good and outcrops are close to towns and transportation routes.

By far the largest market at the present time for Nova Scotia granite is in the monumental trade of the province, with occasional shipments being made to adjacent provinces.

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The granite districts of the province are described below in the following order:

1. Middleton-Nictaux District
2. Shelburne District
3. New Germany District
4. Halifax District
5. Guysborough District
6. Queensport District

1. MIDDLETON-NICTAUX DISTRICT

Near the village of Nictaux West, 4 miles south of the town of Middleton, Annapolis county, a fine to medium-grained grey granite is being quarried, mainly for monumental purposes.

Both Middleton and Nictaux Falls are served by the Bridgewater to Bridgetown branch of the Canadian National Railways, while Middleton is also on the main line of the Dominion Atlantic Railway, 100-odd miles from Halifax. Situated on No. 1 highway at its junction with No. 10 highway, Middleton is the central point of the district, through which local stone can be delivered by truck.

In this district, more particularly in the area between Brickton on the west and Nictaux Falls on the east, a number of masses of Devonian granite occur, most of which are of relatively small extent. These masses are apparently outliers from the main granite mass that covers such a large area in the southwest part of the province. They rise as prominent features above the more gentle topography of the surrounding country which is underlain by sedimentary strata. Quarrying has been confined to the largest and most westerly of these bodies, which has a length (northeast-southwest) of 2 miles and a width of nearly a mile. The quarries are about a mile southwest of Nictaux West along the highway to Bridgetown.

The stone is medium to fine grained grey granite of fair mixture and even texture. The colour is slightly darker than some of the other grey granites of the province on account of the slightly larger amount of black mica and because the quartz has in some cases a brownish to slightly reddish cast. Both orthoclase and plagioclase are present, with the latter predominating, so that the rock is more correctly referred to as a granodiorite. The plagioclase crystals, for the most part, are in an excellent state of preservation, while the orthoclase occasionally shows slight decay.

The stone shows no pyrite or other iron-bearing minerals likely to cause rust spots on exposure to the weather. It is slightly harder than some other grey granites and consequently is very suitable for monumental use. The stone takes an excellent polish, fills well, and has good contrast between hammered and polished surfaces, but there is very little, if any, contrast between sandblasted and polished surfaces. At least one company in this district employs a Lithichrome process to improve the contrast between the

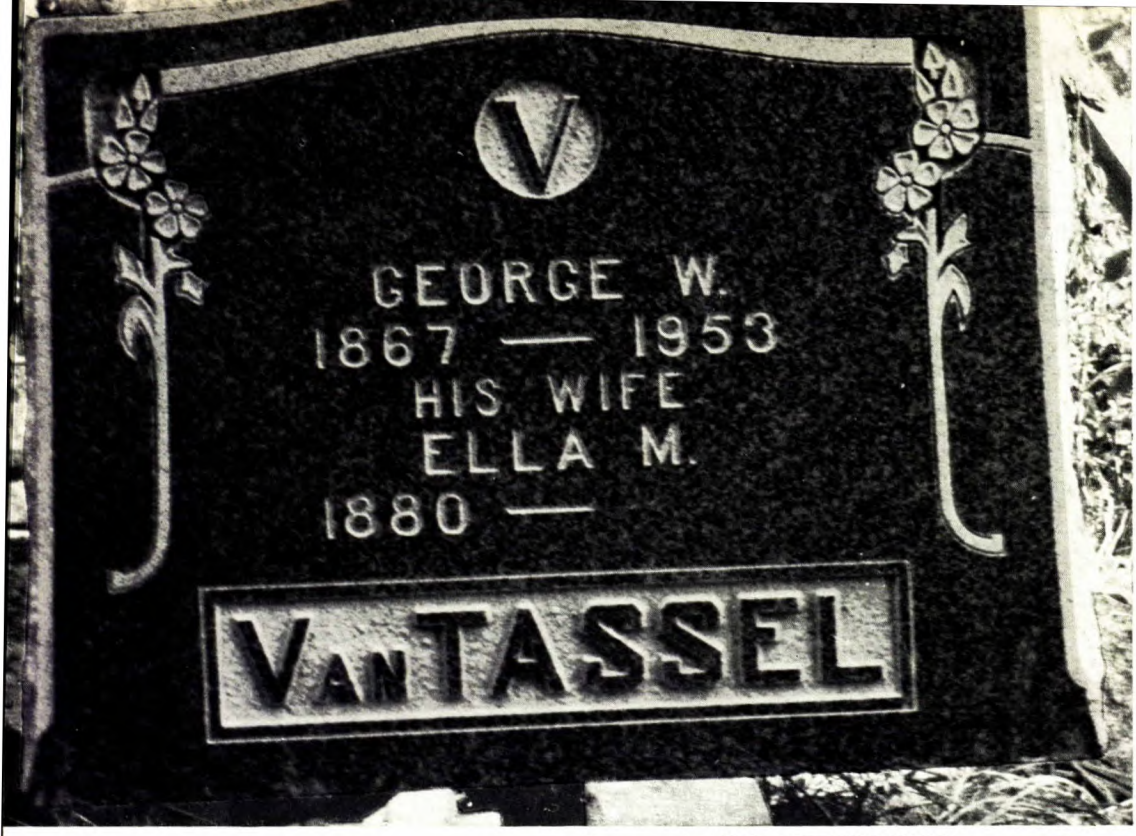

Figure 5

Monumental die of Nictaux grey granite with Hilite applied to sandblasted background to improve contrast. Nixon Granite Works, Nictaux Falls, N.S.

Figure 6

Post Office at Shelburne, N.S. Shelburne grey granite.

sandblasted and other finishes. The Lithichrome material, in this case Hilite, when applied to the sandblasted background, makes the monumental lettering and carving stand out particularly well. According to its manufacturers,* Hilite is designed to produce a transparent, natural white finish, as is obtained with steel shot. Figure 5, taken at the Nixon Granite Works plant, shows a polished die of Nictaux granite which has been treated by this process.

Quarrying was first started about 1889, when blocks were excavated for building culverts for the Nova Scotia Central railway, and subsequently the quarries were operated for the production of paving blocks, which found a ready market in the city of Halifax. Some large blocks were also sent to the dressing sheds at St. George, N.B., for finishing into monumental dies.

When Parks (8) visited the area in 1911 three firms were operating quarries near Nictaux West. Two of these operated mills, one at Middleton and the other at the quarry, while the third company shipped its output to Halifax in the rough. Annual production was in the neighbourhood of 600 or 700 tons with most of the output used for monumental work; a small amount was used for building.

When visited in September, 1953, two companies were operating in this district, Nixon Granite Works, and T. W. Scott and Company. A third company, Nictaux Granite (Canada) Limited, had not operated for several months. The former two companies operate on a very small scale while the Nictaux company operated on a fairly extensive scale, supplying well over half the total annual output of the district. It operated two quarries about 250 yards apart, the east quarry supplying chiefly building stone and the west quarry monumental stone; the stone was treated in a dressing plant situated between the two quarries. The Nixon Granite Works plant is at Nictaux Falls, while the T. W. Scott and Company plant is at Middleton, production of both companies being confined to monumental stone. The latter does not actually operate a quarry but obtains its supply of local stone from Elmer Rice who operates a small quarry solely for this purpose.

In this district approximately 1,500 cubic feet of local stone are processed annually in addition to a small amount of imported granite. This compares with the 1952 production of slightly over 3,000 cubic feet of local stone, when the Nictaux Granite (Canada) Limited plant was in operation.

The quarries are all of the 'side-hill' type, with faces up to 30 feet in height and lengths of anywhere from 50 to 150 feet. The main set of joints strike approximately northwest-southeast, are vertical and well-defined, and are spaced from 4 to 12 feet apart. Usually a second set of ill-defined joints cuts the major set at right angles, but fortunately these joints are more or less confined to zones, so that large blocks can be obtained by a careful selection of the place of operation. At one quarry, for example, where

* C. E. Cleveland Lithichrome Company, Fort Scott, Kansas, U.S.A.

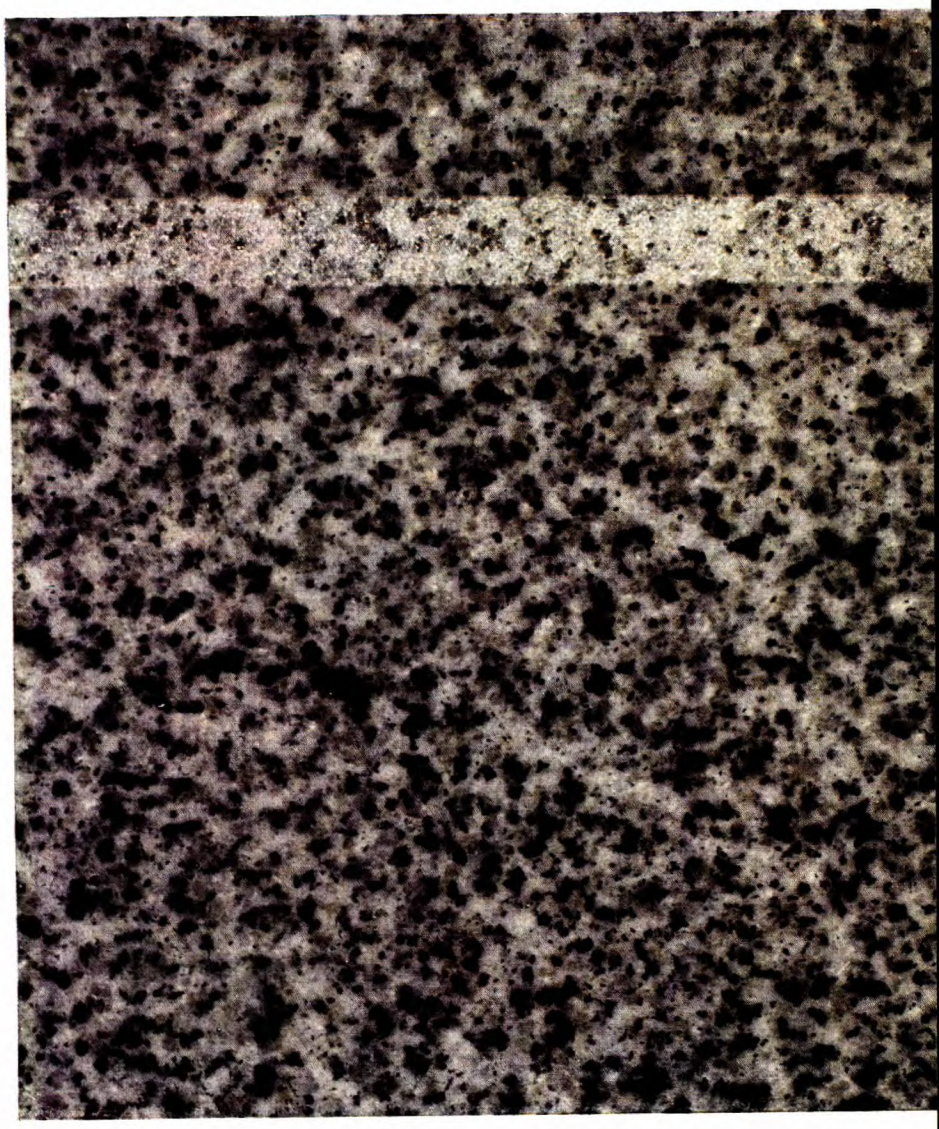

Plate 1

GREY GRANITE
Middleton-Nictaux District
Nova Scotia.

the stone appeared to be rather badly fractured on the whole, the writer noticed several quarried blocks measuring 9 x 2 x 2 feet. The rift is vertical and at right angles to the main joint planes. The grain is parallel to the sheeting which is horizontal or pitching slightly in a northerly direction. The sheeting is sometimes not well developed in the upper part of the quarry, but becomes more pronounced the deeper the quarry is excavated. The sheets dip at a small angle and are thick, several running over 6 feet.

All quarrying is done by drilling and blasting, followed by 'plug and feather' subdivision of the larger blocks into the sizes required for monumental purposes. The surface joints are very favourable for this method of quarrying, the rift and grain are strongly developed, and large blocks can be obtained with a minimum of drilling and blasting. It is stated that the main difficulty is to obtain blocks which are free from 'black knots' and that to obtain blocks which are entirely free from these 'knots', requires very careful selection and the elimination of much of the stone as waste. During an examination of several of the quarries in this district, however, very few of these black knots were seen. No primary saws have been installed at any of the dressing plants so that much additional waste results from trimming the blocks to size.

Hydro-electric power is available in the district and is used to operate the equipment in the dressing plants and the compressors situated at the quarries. The derricks have hand, gasoline, or compressed-air-operated hoists.

With operations at the Nictaux Granite (Canada) Limited plant suspended for the time being, the stone from this district is now used almost entirely for the production of monumental dies and bases. Dies with either polished or hammered finish are produced; at one plant nearly 90 per cent of the dies made from the local stone are given a polished finish, while at the other plant approximately 70 per cent are given a hammered finish. A relatively large amount of imported stone, mainly Swedish black granite, is used by both companies but the majority of the dies and practically all of the bases are manufactured from the local granite.

There are many outcrops in the district where quarries might be opened if demand for this type of granite was sufficiently great. However, grey granites, comparable in quality to the Nictaux stone, are widespread throughout Canada so that the demand for this stone will be confined to Nova Scotia, or at least to the Maritime Provinces. It will continue to be used locally as a stone suitable for monumental dies and bases, and will probably continue to be used occasionally for building purposes. It may be seen in the Methodist Church, at Annapolis; the Sir John Thompson Monument, at Halifax; and in the Bentley Buildings, at Middleton. At present its use for building purposes is confined to the production of an occasional step for a post-office, etc.

2. SHELBURNE DISTRICT

The Shelburne district in the southwestern part of the province, in Shelburne county, is conveniently situated for shipping either by rail, road or water transportation. It is served by the Canadian National Railway line from Halifax to Yarmouth, and by No. 3 paved highway from Halifax to Yarmouth via the south shore; while Shelburne Harbour offers ready means for shipment by water. By rail Shelburne is 164 miles from Halifax and 353 miles from Moncton, N.B.

It produces both black and grey granite, which is used mainly for monumental purposes. The district is chiefly important as a source of black granite, or diorite, which although still quarried on a small scale, has become quite popular as a monumental stone in the maritimes and, to a very limited extent, in Central Canada. The grey granite is somewhat similar to that of the Nictaux district, but is quarried on a somewhat smaller scale. Normally more black granite is used than the grey variety, but at present they are being used in about equal proportion.

Quarrying in this district to date has been confined to localities adjacent to main highways, the railway, or water transportation. Outcrops are relatively scarce and much of the stone quarried in the past has been supplied by large granite boulders which are found scattered throughout the district.

The Shelburne grey granite mass, an irregular shaped batholith of Devonian age, occupies both sides of Shelburne Harbour in its upper half and extends up the Roseway river for about 10 miles (6). It has an apparent maximum length of 16 miles, a width of 6 miles, and appears to be connected with a similar but larger mass to the west near Barrington and to a relatively small one to the east at Jordan bay. These masses are probably part of the main crescent-shaped granite mass to the north which occupies so much of the western part of the province.

The black granite occurs as a number of fairly small isolated masses in the Shelburne granite mass. The Birchtown mass, which lies about 4 miles west of Shelburne and immediately north of the main provincial highway from Halifax to Yarmouth, has been quarried to the greatest extent and is the only one being exploited for black granite at present. Exposures indicate the Birchtown mass to have an approximate length (north-south) of a mile and a width of half a mile. Other deposits occur at Morris Lake, Robert's Mountain, Little Rocky Mountain, and Moose Hill (6).

Longard (6) considered the Birchtown mass to represent an "intrusion of a dioritic magma which was later followed by a much larger intrusion of granite". He suggested that the other deposits might either be stocks or 'blows' in the course of the diabase dyke which runs from LaHave Island in a westerly direction to Shelburne. Douglas (3), on the other hand, was of the opinion that the "black granites of Shelburne represent a zone in which the early phases of the grey granite assimilated and metamorphosed

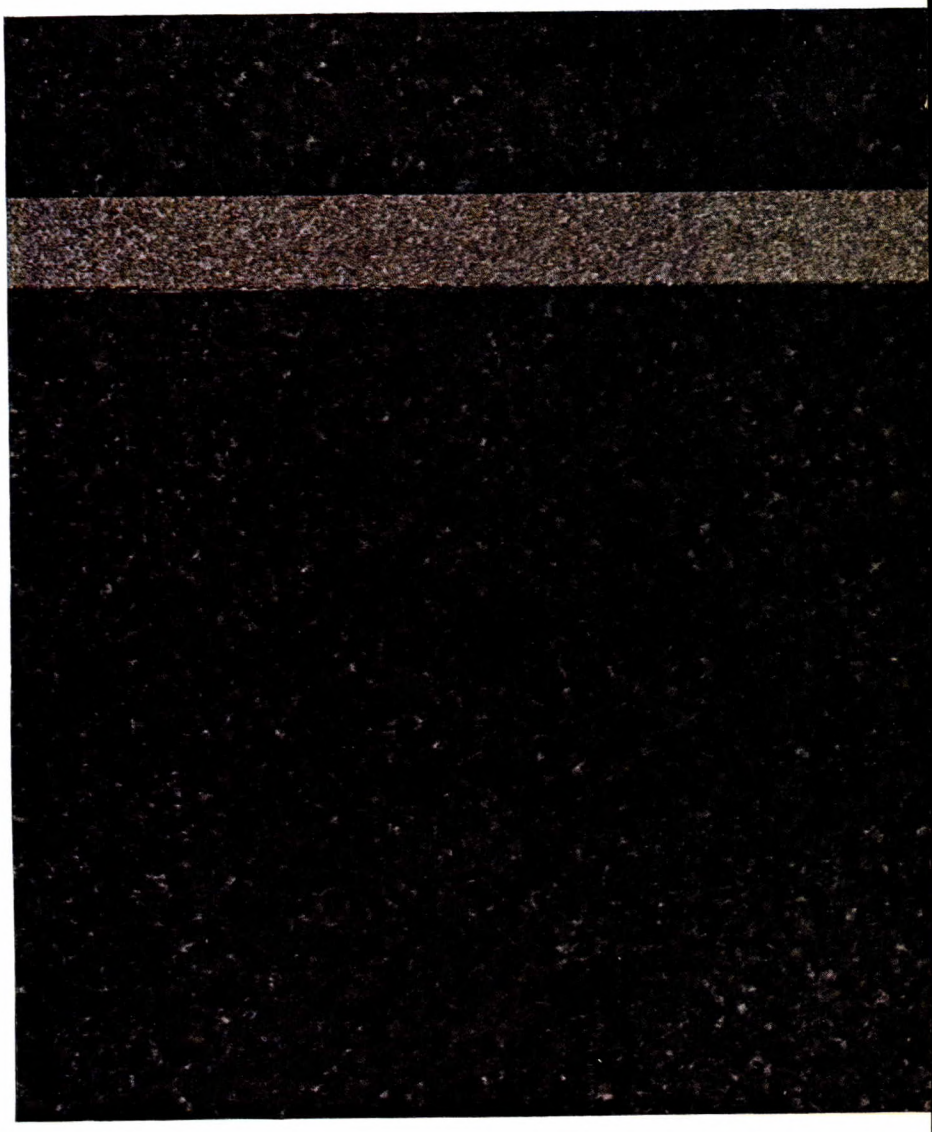

Plate 2

BLACK GRANITE
Scotia Granite Quarries Limited quarry
Shelburne District, Nova Scotia.

large xenolithic masses of quartzite and possibly slate of the gold bearing series". Diamond drilling has indicated that the black granite of the Birchtown mass may gradually merge into grey granite at depth.

Early literature contains little regarding the quarrying of granite in the Shelburne district, the first mention in the reports of the provincial Department of Mines being in 1885. The district was quite active shortly after the turn of the present century, in order to meet the large demand for building stone and paving blocks which then existed. Stone was supplied for the Herald Building in Halifax about this time.

When Parks (8) visited the area in 1911, granite quarrying was at a standstill, and had been for several years previous. In 1917, however, at the time of Faribault's visit (5) a few men were at work, quarrying grey granite for a church at St. Bernard, Digby county. The stone for this purpose was obtained from the west side of Shelburne Harbour, where quarries had been operated for many years. Faribault mentioned that a small amount of grey granite had also been quarried on the east side of the Roseway river about 2 miles north of Shelburne, and that two quarries had been opened in a large dark grey diabase dyke near Shelburne. He describes the diabase as taking "an excellent polish of a rich greenish-black colour" and mentioned that small shipments had been made to Moncton, N.B., and to other places.

In 1934 there were two operators in the district, C. G. Reid (Shelburne Granite Works) and W. T. Dauphinee (2). Both operated dressing plants in Shelburne, producing mainly monumental stock, both dies and bases, for local provincial trade, from grey and black granite. The stone was obtained from various localities and no extensive operations had been carried on at any one place.

At present there is one company quarrying granite in the district, namely, Scotia Granite Quarries Limited, a company incorporated (1) in 1950 to operate the quarries of W. T. Dauphinee. The company operates two quarries, one in the black granite at Birchtown, the other in the grey granite on Shepherd 'Island' on the west side of Shelburne Harbour. The stone is sawn and dressed in a modern dressing plant at Shelburne operated by the parent company, W. T. Dauphinee.

The black granite in the Shelburne district varies greatly from place to place and ranges in colour from greyish-black to greenish-black. It can be classed as a diorite, consisting essentially of plagioclase feldspar, hornblende, and biotite, although occasional grains of quartz and some magnetite may be seen. Longard (6) recognized 4 varieties in the Birchtown mass, each of which had been quarried at one time or another. The principal quarries, and the only one operating at present, are located in the variety of 'low chlorite and medium feldspar content', a medium grained rock of darker colour than the other varieties.

The black granite is used chiefly for monumental purposes. It takes an excellent polish, and all polished surfaces appear to weather well; the polished surfaces are an attractive dark greenish-black, nearly jet black, in colour. There is excellent contrast between the various finishes, but the axed surfaces in time show a slight brownish tinge, and its use therefore would appear to be limited to where polished or other finishes are required. This stone should continue to be a highly popular monumental and building stone in the province, but it is doubtful if it is of high enough quality to complete with the imported black granite in Central Canada. It is known to the trade as 'Scotia Black'. It may be seen in the new Maritime Insurance Building, at Halifax, Nova Scotia.

The black granite quarry is about half a mile north of No. 3 highway. It has been worked more or less continuously for about 14 years and at present has a length of 75 feet, a width of 75 feet, and has been worked to a depth of 47 feet below the surface. Joints are spaced very irregularly and there appears to be a complete absence of sheeting. Consequently a system of channelling was adopted about 4 years ago to eliminate the large amount of waste which resulted when drilling and blasting alone were used. The usual practice is to quarry the blocks in sizes measuring 4 x 9 x 4 feet deep. These are then subdivided by 'plug and feather' into blocks measuring 4 x 4 x 4½ feet and trucked to the dressing plant at Shelburne. According to the quarry foreman the rift and grain are vertical, the rift striking approximately N12°W, and the hardway is horizontal. Quarrying is frequently hampered by pegmatite dykes and veinlets, changes in texture (rarely), an occasional blind seam, and the inclusion of grey granite; one 8-inch dyke and a few inclusions of grey granite 2 feet in diameter were noticed. It is reported that approximately 50 per cent of the stone quarried is suitable for building or monumental purposes.

The Shelburne grey granite is a true granite consisting of quartz, feldspar and biotite mica, and very little accessory minerals. It is fine grained, of a very even mixture, each mineral being in about equal quantity and uniformly distributed, so as to give a greyish cast to the whole stone. The quartz is translucent with a slightly smoky to brownish cast and the feldspar is white, translucent to opaque. The mica is fresh and very black, in fact none of the minerals show alteration. No metallics are visible so that the stone is unlikely to show rust spots on exposure.

On polishing the stone takes a high gloss with few, if any, incipient fractures, but there is occasional pitting of the mica grains. For monumental dies the stone shows a fair contrast between the polished and hammered surfaces so that lettering shows up very well. Most of the dies manufactured from this stone, however, are given a steeled finish, and to make it stand out well the lettering is sandblasted in extra deep. There are very few knots and large blocks free from such blemishes are readily obtained. There

are variations in the grey colour, some localities furnishing stone much darker than others, whereas in others a decided brownish cast to the stone is due to the prevalence of brownish quartz in the rock. The stone being quarried at present is a light grey in colour and is known to the trade as Scotia Grey.

Shelburne grey granite may be seen in the court house and post office at Shelburne. In this building the hammered work presents a very light colour, while the rock face ashlar is slightly bluish, but very uniform. This stone is being employed as a 4-inch veneer on the new public building being erected at Rockport, Nova Scotia.

The grey granite quarry is on the west side of Shelburne Harbour about half a mile south of the highway with which it is connected by road. It has been opened on a small outcrop which rises 15 to 20 feet above the general level of the peninsula on which it is located. Although it has been operated for 8 or 10 years and covers an area 75 by 45 feet, very little work appears to have been done. The rift is horizontal, while the grain is vertical, paralleling the main joints which strike approximately N80°W; these major joints are spaced from 10 to 12 feet apart. A few irregular joints were noticed cutting the major set at right angles. The sheets appear to be quite massive, and together with the wide spacing of the joints, easily permit the quarrying of blocks of regular gang-saw size; blocks measuring up to 9 x 3 x 4 feet have been quarried. No knots were seen here, but it was noticed that the stone was discoloured for several inches on each side of the jointing planes; this may disappear with depth, however. The recovery, which is now around 25 per cent, will undoubtedly improve with depth and with the introduction of channelling methods to the present method of quarrying by simple drilling and blasting.

Hydroelectric power is available in the district and is used to operate the equipment in the dressing plant and at the black granite quarry. At the grey granite quarry gasoline-powered equipment is used.

Approximately 85 per cent of the stone dressed in this plant is local granite, and depending upon the year, may be mainly grey or black. The 1952 production is given as 56 tons (about 700 cu.ft.) of grey and black granite used for building purposes and 334 tons (4,000 cu.ft.) of grey and black for monumental purposes.

3. NEW GERMANY DISTRICT

In the vicinity of New Germany, in Lunenburg county, is a large occurrence of grey granite which was exploited to a small extent many years ago. The granite is coarse and porphyritic and was employed chiefly in railroad construction. The stone from the principal quarry is described by Parks (8) as "not adapted to fine building, but it is an excellent material for bridges and other works of heavy construction; it may be seen in the Caledonian bridge, and in the LaHave bridge at Bridgewater."

New Germany is 16 miles northwest of Bridgewater on the Bridgewater-Bridgetown branch of the Canadian National Railways. No. 10 paved highway passes through the town.

4. HALIFAX DISTRICT

In this district, which lies to the south and west of Halifax Harbour, the quarrying of granite for dimension stone was carried on sporadically for many years. The district is on the eastern margin of a large granite mass of Devonian age. "The stone, which is all of the grey type", Parks (8) writes, "is comparatively fine grained near the outer margins of the mass, but, at a little distance from the edge, it becomes very coarse, showing crystals as large as 3 inches in length". In many places the jointing is well developed and suitable for quarrying, but in others the rock appears to be badly fractured and only suitable for rubble and rip-rap.

Quarrying of granite in this district began many years ago, stone being quarried for buildings in Halifax city in its early days. Granite was used in part of the foundations for the Halifax Citadel and many of the older public buildings are built on granite foundations. Granite curbstones and paving blocks were used in many of the Halifax streets, and in the older cemeteries the bases of many monuments are of granite from this district. It was also used in the construction of breakwaters and piers, the ease of quarrying large blocks making it especially adaptable for this purpose.

Writing in 1938, Cole (2) mentioned that no quarries had operated continuously in the district for a number of years, but that a number of openings were sufficiently equipped so that quarrying could be resumed at short notice should the occasion demand. During 1936 three quarries operated for several months each, with the stone being used in the construction of the new Federal building in Halifax and for monumental bases. This stone was all dressed at a single plant in Halifax. Little if any quarrying has taken place since that date.

The stone is a coarse-grained grey granite, or rather granodiorite, in which the feldspar crystals occasionally reach a length of one inch. The great mass of the stone, however, is considerably finer. The feldspar is milky white, the quartz is translucent to smoky, and the mica, which is very unevenly distributed through the rock, is dark brown to black. The feldspar crystals, according to Parks (8), are nearly all of the plagioclase variety and in an excellent state of preservation.

On polishing, there is a marked relief between the quartz and the softer mica, and the stone is therefore more suitable for hammered or rough finishes. The prevalence of black knots through much of the stone of the district is also detrimental to a polished finish.

Although quarries have been opened at a number of different points in this district, the industry may be regarded as having centered about one

mile to the southwest of the head of North West Arm. It is in this vicinity that most of the quarries, and the principal ones, are situated. The structural features of these quarries are very similar. In most cases 2 well-developed sets of vertical joints intersect each other at right angles. The spacing of these joints and the sheeting planes, which are approximately horizontal, permit the quarrying of rectangular blocks of large size with the production of very little waste. The rift is horizontal, paralleling the sheets, and the grain is vertical.

A series of openings were once made at Terence bay, about 20 miles by road south of Halifax. The stone, a grey granite very similar to that from the Halifax area, but considerably coarser, was obtained for the Bank of Commerce and several public buildings in Halifax. Although inactive for many years, the locality is of interest on account of the ease with which blocks of large size can be quarried and the fact that the granite shows fewer black knots than that in the Halifax area. According to Parks (8), excellent facilities for quarrying are presented at many places along the coast in the Terence bay area.

5. GUYSBOROUGH DISTRICT

In the area lying between Guysborough on the east and South River lake on the west and south of the Guysborough river are numerous small irregular masses of hornblende diorite, which in the 1930's attracted some attention as a source of 'black granite'. These exposures, of Palæozoic or Precambrian age, each rarely exceed a few square miles in extent. Serious prospecting has been confined to two exposures, near West Erinville, Guysborough county, and on the shore of South River lake, Antigonish county. Both are about 20 miles from rail or water communication, the greater part being over secondary gravel roads.

Quarrying began in 1933 and appears to have ended 4 or 5 years later. Work was confined mainly to exploration, and only a few monumental dies were shipped to various dressing sheds throughout the province. Both quarries were operating in November, 1936, when visited by Cole (2). He describes the South River lake quarry as a boulder quarry, and the one near West Erinville as a sheet quarry, the sheets being spaced so as to permit the quarrying of blocks over 2 feet thick. The stone appears to have been free of knots, blind seams, and white streaks, but was badly cut up by joints, resulting in a considerable amount of waste.

During 1953 M. R. Chappell, a building contractor of Sydney, Nova Scotia, investigated the possibilities of opening a quarry for building and monumental stone in the West Erinville area. The property, which was purchased from a Mr. Sullivan, is situated about three-quarters of a mile northwest of the West Erinville post office, on the Sullivan road. The outcrop investigated is dome-shaped with a diameter of around 200 feet and a maximum height of 20 feet. Chappell refers to the stone in a

recent letter to the writer as being of "an excellent quality from the standpoint of color, workability, texture and durability". However, there appeared "to be one detrimental feature, namely, pieces of appreciable sizes (could not) be secured without having dries or fractures in it." He succeeded in getting out a few pieces suitable for headstone work, but was unable to get blocks running from 5 to 10 tons such as are generally required when selling undressed stone to building and monumental producers. The deposit does seem to be badly fractured, but there appears to be a good possibility that a lot of the fractures will disappear with depth.

The stone of the Guysborough district is a greyish-black to black hornblende diorite of medium to fine grain and uniform mixture. The South River lake variety contains numerous minute granules of milky white quartz and calcite, with no definite or distinct boundaries, which give it a decidedly mottled greenish black appearance. Many metallics show in the polished surfaces of both varieties and the lustre is pearly rather than glossy, and there is much relief owing to the variation in hardness of the different mineral constituents. The weathering properties of the stone are not known.

6. QUEENSPORT DISTRICT

In the southern part of Guysborough county are many large masses of Devonian granite of a whitish-grey colour shading in places to a reddish or yellowish tint. The granite varies in composition and texture, according to its position, whether in the large masses or in more or less close proximity to the surrounding sedimentary rocks. It has been quarried at several localities in the past, more particularly at Queensport, Chedabucto bay, and at White Head and Whitehaven, about 8 miles south of Queensport, but all quarries are now idle. For convenience, this district includes that portion of Guysborough county which lies east of New Harbour river and south of Chedabucto bay.

The granite of this district occurs in two separate and distinct areas, with each area containing several large masses. The first, or Cape Canso area, extends from Cape Canso westward to Whitehaven, and the second, or Tor bay area, from Cole Harbour river westward to New Harbour river. The Queensport quarries are located in the northern part of the Tor bay area, in a granite mass having an east-west length of approximately 8 miles and a maximum width of 5 miles. White Head and Whitehaven are situated in the Cape Canso area near its southeastern boundary, in a granite mass some 15 miles in length and up to 6 miles in width.

Little information is available about the early history of the quarrying industry in this district. In 1836, Gesner, Messervey (7) writes, reported that millstones used for grinding grain were made from the granite cut at White Point, Canso. Faribault (4), in 1886, in describing the granite mass

east of Sherbrooke, mentioned that it had been quarried to a small extent and used in the construction of piers and abutments of the iron bridges of the district, and for other purposes.

The Queensport quarries were first opened in 1923, and operated more or less continuously for about 15 years before operations were suspended. They are situated about half a mile southeast of the village of Queensport. Queensport is situated on Chedabucto bay about 12 miles east of Guysborough on the road to Canso.

When Cole (2) visited the area in 1934, two quarries were operating and two types of granite were being produced. That from the northern quarry was an open-textured light-grey granite of medium coarse grain and fairly even mixture, while that from the southern (or boulder) quarry was closer grained and finer in texture and considerably darker in colour. Both types worked well under the hammer. The light coloured stone did not take a very good polish but made an excellent building stone and as such had been used extensively in the city of Halifax. The darker variety, however, took an excellent polish and was used principally for monumental dies. A small dressing shed, situated about half a mile south of Queensport on the road to Cole Harbour, was operated in conjunction with the quarries.

Cole described (2) the northern quarry as a typical sheet quarry in which the sheets dipped at an angle of about 10 degrees to the north; the rift was parallel to the sheeting and the grain vertical, and all three ways of parting were well developed. Four sheets were exposed, ranging in thickness from 2 to 3 feet, and the joints appeared to be well spaced, permitting the quarrying of large dimension stone.

Writing in 1914, Parks (8) mentions that granite from east of Tor bay, at White Head and Whitehaven had been used locally and a small quantity had been shipped to North Sydney, where it may be seen today in the Bertram block. The following description of the White Head property is taken from his report:

> "The rock forms a cliff of 12 feet above high water, and presents so steep a face that vessels can be loaded directly from the shore. The stone is horizontally sheeted, showing an upper 20 inch bed followed by a 16 inch and a 6 inch bed, with heavier material down to the water line. Vertical joints in one direction divide the formation at intervals of 4 or 5 feet; but at right angles to these joints fracturing is practically absent."
>
> "The material is a rather coarse, slightly porphyritic grey to white granite, which, by variations in the colour of the feldspar crystals becomes yellowish in part. There is no present production."

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Sketch map of New Brunswick

CHAPTER 5

GRANITES OF NEW BRUNSWICK

Extensive masses of granite, the greater part suitable for at least some form of construction, and in a number of places of monumental grade, occur in several areas in New Brunswick. These granites are greatly diversified, not only in texture, which varies from the finest grain to extremely coarse, but in colour, which ranges from dark red to the lightest pink, and various shades of grey, green, and black. Each type of stone has its special characteristics, and there is hardly a use for granite that cannot be satisfactorily supplied from one or other of the granite districts of this province.

There are five principal granite quarrying districts in the province. These districts, described individually in the following pages, are as follows:

1. St. George District
2. Bocabec District
3. Hampstead (Spoon Island) District
4. Bathurst District
5. Antinouri Lake District

In the past, quarrying operations have been carried on from time to time near McAdam, Woodstock, St. Stephen, Welsford, and Elm Tree, but as these localities have not produced any stone for many years they are mentioned only briefly or omitted altogether.

The industry has been quiet and comparatively small for many years, especially since the war, and has shown little if any sign of expansion, despite the abundance of excellent stone, cheap hydro power, excellent transportation facilities, and good labour supply. At present operations are confined to the Hampstead (Spoon Island) district where a pinkish-tinted grey granite is being quarried on a small scale mainly for monumental purposes; to the Bathurst district, where a reddish-grey granite is quarried intermittently for the local building trade; and to the Antinouri Lake district where a pink granite is being quarried for building purposes. This situation could be greatly improved if an attempt were made to sell more rough stone to the building and monumental trades. The increased production thus obtained would lead to the proper development of the quarries and the adoption of modern machinery. Better quarrying facilities would enable the companies to obtain stone more cheaply, thus allowing them to compete in a more extended market.

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Granites of New Brunswick

The granite industry of the province is one of the older industrial mineral industries, the earliest settlers having probably employed stone from nearby deposits or from granite field stones for houses and building foundations. The Hampstead (Spoon Island) district, on account of its ready access to water transportation, appears to have been among the first to come into production. The Bathurst stone, however, was probably the first to be quarried extensively, quarries having been opened up around 1869 to supply foundations for bridges, buildings, etc. The St. George red granite district came into production in 1872, while the Bocabec black granite was first quarried some forty years ago. The Antinouri Lake district came into production in 1951.

The most extensive deposits of granite (18) lie along one of three more or less distinct belts, or axes, which for the purpose of description are referred to below as the Central, Charlotte, and Southern axes. These belts have a general northeasterly-southwesterly strike, roughly paralleling the strike of the older intruded formations. Most of the plutonic masses were intruded in Devonian time, but in the Southern axis some are of Precambrian age.

The Central and most northerly axis comprises a chain of three large batholiths, several stocks, and numerous dykes, all of Devonian age, which extend northeasterly across the province from the International boundary in the vicinity of McAdam, to Chaleur bay. The largest batholith, which extends from the International boundary to and beyond the Saint John river, has been quarried to a limited extent on the north side of the Saint John river opposite the mouth of the Shogomac (5), and in the McAdam area (14), but for some years now all quarrying along this belt has been confined to a large stock near Bathurst and to a small stock on Antinouri lake. The other two batholiths lie in the central unsettled part of the province and have never been quarried. The stone encountered in the Central axis is generally a coarse grained granite, usually of a greyish colour, but varying locally to shades of red, pink, and brown. The structure is massive with well-spaced joints, yielding large blocks and boulders.

The Charlotte axis includes a belt of intrusive rocks of Devonian age that extend from the International boundary at St. Stephen, northeasterly across Charlotte county into Kings and Queens counties. The northeastern end narrows to a long tongue which finally gives way to several granite stocks west of the Saint John river near Hampstead. This is by far the most important series of outcrops in the province and includes the Hampstead quarrying district and the inactive St. George, Bocabec, and Welsford districts.

The intrusions of this belt consist mainly of large masses of light-coloured granite and allied rocks, and to a lesser extent of smaller bodies of dark, dioritic and gabbroic types (3) (4) (5) (11) (12). The granite is essentially a coarse grained biotite granite and its colour, on the whole, is

some shade of grey, although at St. George there is a relatively large area in which the prevailing colour is red. The dark, basic rocks also present a great variety of types, with textures ranging from fine to coarse and porphyritic, and colours ranging from light to dark green and black. These dark basic types are potential sources of black granite. They occur most extensively in the St. George-St. Stephen area, where they have been worked to a very limited extent in the past.

The Southern axis lies along the north shore of the Bay of Fundy between Mace Bay, Charlotte county, and the Petitcodiac river, Albert county. Granites and allied rocks are extensively exposed in this area, as well as some basic intrusives. In general the rocks are severely jointed and sheared, and no quarries have been opened in this area. The rocks of this belt are of Devonian or Precambrian age (2) (7) (11).

1. ST. GEORGE DISTRICT

The town of St. George, situated at tidewater at the mouth of the Magaguadavic river in Charlotte county, has a well sheltered harbour open to shipping the year round and is on the Saint John-Bonny River branch line of the Canadian Pacific Railway, 48 miles from Saint John. No. 1 paved highway passes through the town providing excellent connections with Saint John and United States. Approximate distances to the principal granite centres of Maine, Massachusetts and Vermont are 200, 380, and 380 miles respectively.

This district was for many years the center of the granite industry in New Brunswick. The stone, a medium to coarse grained red granite of high quality, was employed mainly for monumental purposes and, to a very limited extent, for building. Although there has been little activity in the area during the past decade, there is a possibility that operations may be resumed on a substantial scale as a result of the growing demand for good red granite both in this country and United States. For this reason the district is described at some length.

The St. George granite destrict lies along the southern side of a belt of igneous rocks of Devonian age (4) that extend from the International boundary at St. Stephen, northeasterly across Charlotte county into Kings and Queens counties. The stone of a pinkish tint is reported to extend over a total area of at least 50 square miles, but that having the strongest red colour (and as far as is known the best monumental stone) is confined to a small zone between Lake Utopia and the Digdequash river, an area of about 30 square miles. With a few exceptions all quarries have been opened within a mile of the southern contact of the granite; they are situated along the contact from Lake Utopia westward across the Magaguadavic river, a distance of about 7 miles. Most of the quarries, and the principal ones, lie about 3 miles north of St. George and half a mile north of the 'canal' or 'thoroughfare' connecting Lake Utopia with the Magaguadavic river.

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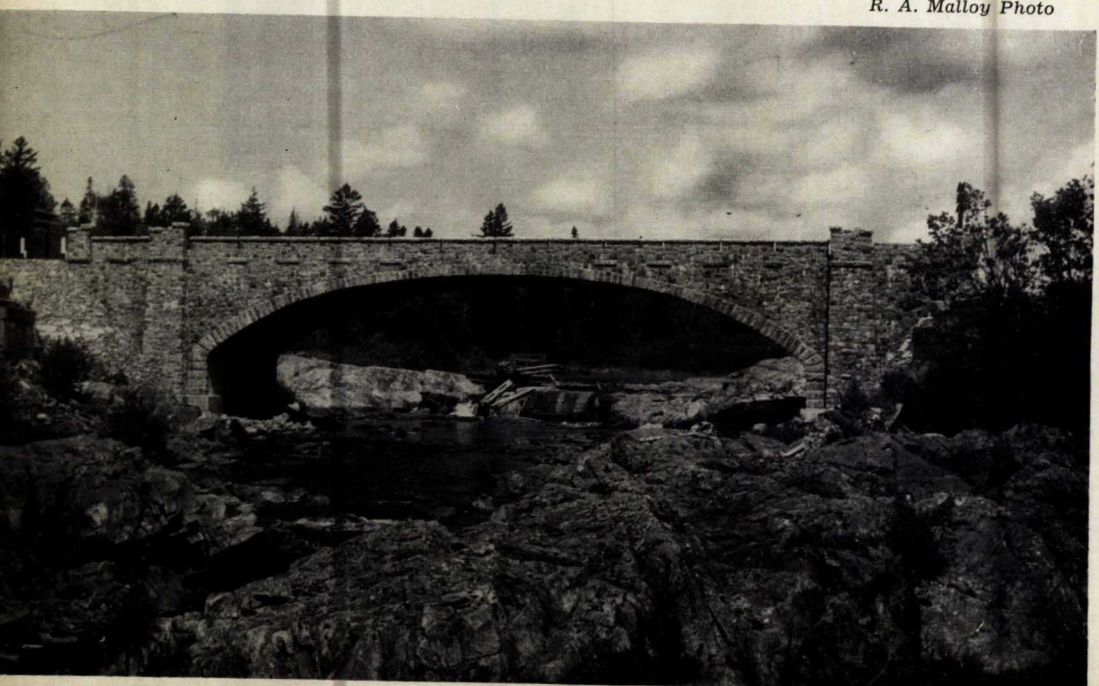
Figure 7 | *Post Office, St. George, N.B. St. George granite.*

Figure 8 | *Highway Bridge, New River Mills, N.B. St. George granite, light grey, dark grey, and red.*

R. A. Malloy Photo



The typical St. George granite is bright red in colour, but many different shades occur in the district. Parks (14) recognized and described three general types—the bright red, the pink, and the light. These types showed little difference in mineral composition, the red being due to the red colouring matter in the feldspars. The deepest reds are usually found along the southern edge of the granite, the colour becoming lighter farther north. The stone consists essentially of orthoclase, plagioclase, and quartz, with smaller amounts of biotite; tourmaline and molybdenite are the accessory minerals. Although commonly referred to as a biotite granite, it would be classified as a granodiorite owing to the relatively large amount of plagioclase present. Imperfections in the granite are quite rare. They comprise occasional grey knots up to 6 inches in diameter, quartz cavities, small lenses of pegmatitic texture, and the occasional aplite dyke. Occasional minute grains of metallics are present but none of sufficient size to cause trouble by rusting on exposure.

The stone, especially the dark and the medium red varieties, takes a high polish and fills extremely well. There is good contrast in the darker shades between the polished and hammered surfaces and this variety is an ideal material for monumental purposes. Whereas the extremely dark variety shows, under oblique light, only occasional pitting and incipient hair cracks, these cracks become more pronounced as the shade becomes lighter and in consequence the light varieties do not lend themselves so well to monumental uses. The lighter varieties, however, have given satisfaction as building stone, with either polished, hammered or rough finishes.

The existence of the St. George red granite and its suitability for monumental and ornamental purposes was first mentioned in the Geological Survey report of 1870-71, where it was compared favourably with the well-known red granite of Aberdeen, Scotland (6). The area came into production in 1872 with the opening of a quarry on the shore of Lake Utopia and the erection of a finishing plant at St. George (5) (13). When Bailey visited the area in 1897 four companies were operating the output was valued at between $80,000 and $90,000 per year; and about three hundred men were employed (5). At that time the companies were also finishing imported stone and had begun to develop the Bocabec black granites.

At the time of Parks' visit in 1911, five companies operated plants in St. George and consumed about 9,000 cubic feet of the local red stone annually (14). The output of finished red stone for the year 1910 was valued at approximately $45,000. To this must be added 1,400 cubic feet of Bocabec black, 3,000 cubic feet of Spoon Island grey, and some imported stone, bringing the total output to about $75,000.

Granites of New Brunswick

In his preliminary report on the granite industry of St. George, Wright (16) mentioned that four companies were operating in the district in 1932. The total output was valued at approximately $90,000. In describing the status of the industry in 1932, he wrote:

> "Four companies are operating but not one of them is fully equipped with modern machinery, and not one is working to capacity. There is strong competition among the individual companies. The quarries are partly filled with waste rock, the faces are in bad condition, steam plants have been abandoned, and there are no modern facilities for quarrying and dressing the product. The companies are not equipped to handle orders for building stone, and that trade is lost. The finishing mills have been kept up to their old standard, but the chief production is ornamental stone, made partly from local supplies or from foreign stone."

There has been little activity in the area since the war. Probably the last quarry to operate was that of Gilbert and Cottrelle which operated on a very small scale as recently as 1947-1948. Milne, Coutts and Company—for many years the principal operators—continued to operate their plant at St. George until 1950 or 1951. At present the industry is at a standstill.

As seen at the quarries, most of which are of the 'side-hill' type, the sheets have dips ranging from horizontal to 45 degrees, but average around 15 degrees; they range in thickness from a few inches up to several feet, with an average of between one and two feet. The joints may be regular and well-spaced but usually the opposite situation is the case with the result that large blocks can only be obtained at a few of the locations. The joints are usually steeply dipping, but occasionally dips as low as 20 degrees may be observed. Parks (14) mentions that a horizontal rift and vertical grain were feebly developed at one of the quarries whereas, "in most of the quarries, the stone (did) not present any preferential direction of parting."

Many quarries have been opened in the district over the years—Wright (16) describes some four dozen—but no very large development has ever taken place and most of the quarries are little better than prospects or 'motions'. As a result of the numerous fractures, much waste resulted from quarrying. After a quarry had been operated for several years the waste piles would accumulate to such a height that it could not be extended unless the piles were moved. Rather than do this with the limited facilities available, a new quarry would be opened.

All the quarrying was done by the same method, drilling and blasting. The use of channelling machines in conjunction with drilling and blasting at many of these quarries would have greatly decreased the waste resulting from irregular breaks and blasting damage. Mechanization was used in varying degree but most of the drilling was done by hand methods and much

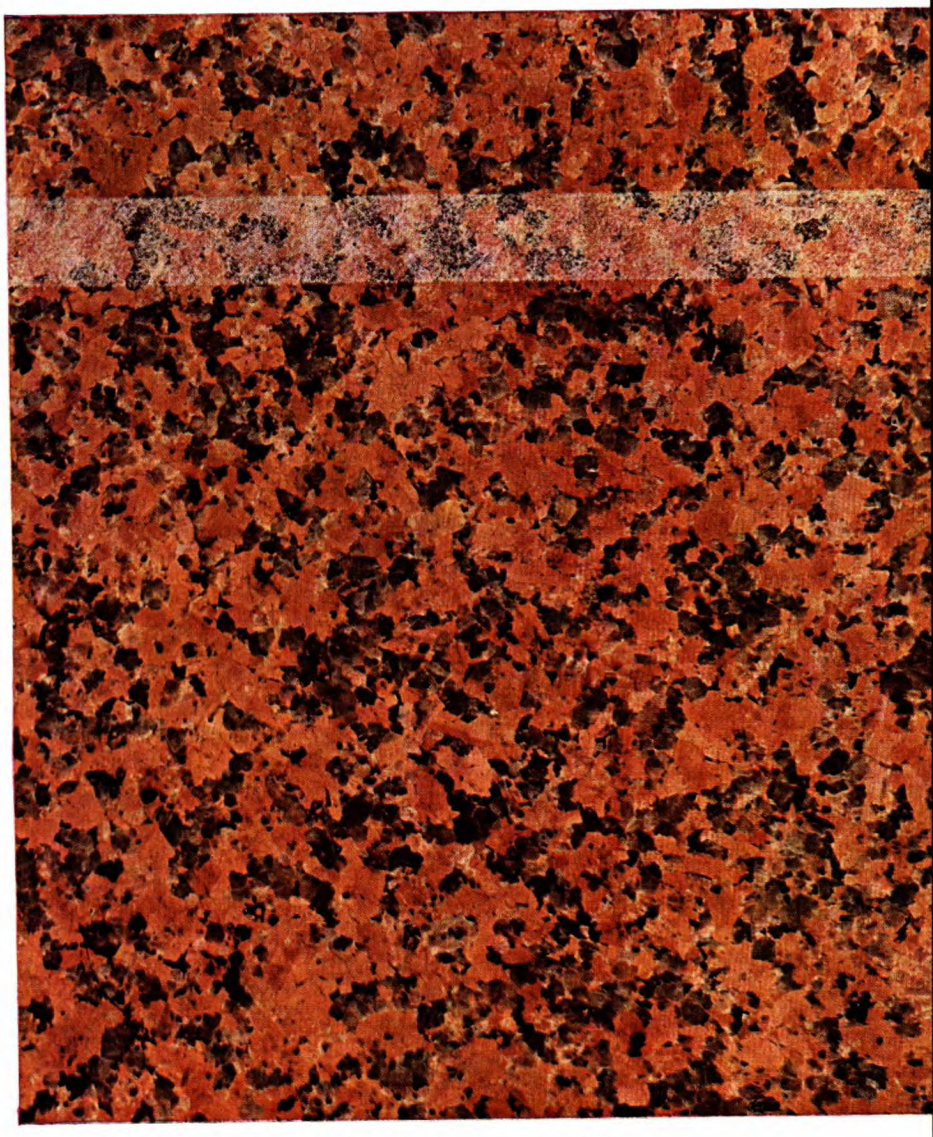


Plate 3

RED GRANITE
Milne, Coutts and Company quarry
St. George District, New Brunswick.

of the lifting was done by hand winches or derricks. Nearly all the output was used at St. George, and there was little or no attempt to extend the industry to the quarrying and shipping of rough stone.

The stone when polished is one of the most attractive red granites ever produced in Canada. The hammered surfaces do not weather as well as the polished surfaces and may in time turn whitish in colour. The polished surfaces, however, remain smooth and unweathered even after eighty years of exposure. The rough broken stone also weathers well.

St. George granite was used in the columns of the following structures:

Post Office, Saint John, N.B.
Post Office, Owen Sound, Ont.
Parliament Buildings, Ottawa, Ont.
John A. Macdonald Memorial, Montreal, Que.
Infant Jesus Church, Montreal, Que.
R.C. Cathedral, Boston, Mass.

and in the construction of the following:

Dry Docks, Saint John, N.B.
Railway Bridge, Saint John, N.B.
Banque des Peuples, Montreal, Que.
Montcalm Monument, Quebec, Que.
Museum of Natural History, New York, N.Y.
J. Pierpont Morgan Memorial, Hartford, Conn.

With the exception of the Saint John dry docks and railway bridge, in which a pinkish tinted grey granite from near Bonny River was employed, the stone used in the above structures was the typical St. George red granite.

The district has proven itself capable of producing a distinct type of granite highly suitable for monumental and building purposes.

The markets for such a stone are chiefly in Central Canada, where competition with other Canadian and imported reds would be rather keen, and in the United States where there is at present a large demand for a stone of this type. Present tariff on manufactured granite entering the United States is 15 per cent ad valorem, and on rough stone, ten cents per cubic foot.

The district was examined several years ago by Ralph Fletcher, of the H. E. Fletcher Company of West Chelmsford, Mass., on behalf of the New Brunswick Department of Industry and Reconstruction. As a result of this survey it was established (10) that "any possibility of operating the granite quarries on a small exploitation scale as in the past, even with some degree of mechanization, would not be sound in today's competitive market. Probably the best possibility for the reopening of the industry would be for it to be undertaken by a party now in the industry or familiar

with it and prepared to operate on a full scale continuing basis with the realization that considerable capital investment must be put into it before any return can be expected."

In referring to the numerous joints occurring in the granite the report states, "Granite is known by experience to improve with depth. The joints 'tighten' or close up and the beds as a rule are thicker. No quarrying at any depth was done in the St. George area with one or two exceptions . . ., but the above conditions, by local report, were the case."

2. BOCABEC DISTRICT

Described under this heading are those dark gabbros and diabases of Charlotte County which have been exploited to a limited extent in the past for monumental stone. They are generally referred to as the Bocabec 'black granites', taking their name from Bocabec, a small village about 10 miles west of St. George on the north side of Passamaquoddy bay, in Charlotte county. The paved highway from Saint John to St. Stephen passes through the village, and connections with either the St. Andrews or Saint John branch of the Canadian Pacific Railway can be made by travelling along this highway.

The granites occur in a band 1 to 3 miles wide from Bayside on the St. Croix river easterly along the southern side of the Charlotte axis to the Digdequash river, thence easterly across the granite to and beyond the Magaguadavic river, a distance of 17 miles. Other areas occurring in the vicinity of Oak Bay and St. Stephen have also been worked in the past. On the St. George (4) and St. Stephen (3) sheets these rocks are considered to be Devonian in age and to have been intruded at an earlier date than the St. George granites previously described.

The black granites consist essentially of plagioclase feldspar, pyroxene and hornblende, with varying amounts of biotite. Thin sections from a few localities show that the feldspar is chiefly labradorite, that most of the hornblende is secondary after pyroxene (augite), and that in some localities olivine is one of the constituent minerals. Magnetite is present and can be seen on polished surfaces, and Wright reports (16) the presence of chalcopyrite in the stone at one quarry. Parks (14) classes the rock as diabase because of the ophitic structure, but the coarse texture, and the schillar structure of the olivine, coupled with the fact that many typical gabbros show ophitic structure, seem to justify the terms gabbro and olivine gabbro.

The texture varies from fine to medium, and the colour from dark grey to dark green and shades of black. The darker phases were quarried at several points and marketed as black granite under such trade names as 'Irish Black' and 'Egyptian Black'. The rock is hard and tough and capable of taking an excellent polish. The polished surfaces are extremely attractive; when compared with samples of black granite being currently produced at Rouyn, Quebec, and Shelburne, Nova Scotia, a striking resemblance is seen.

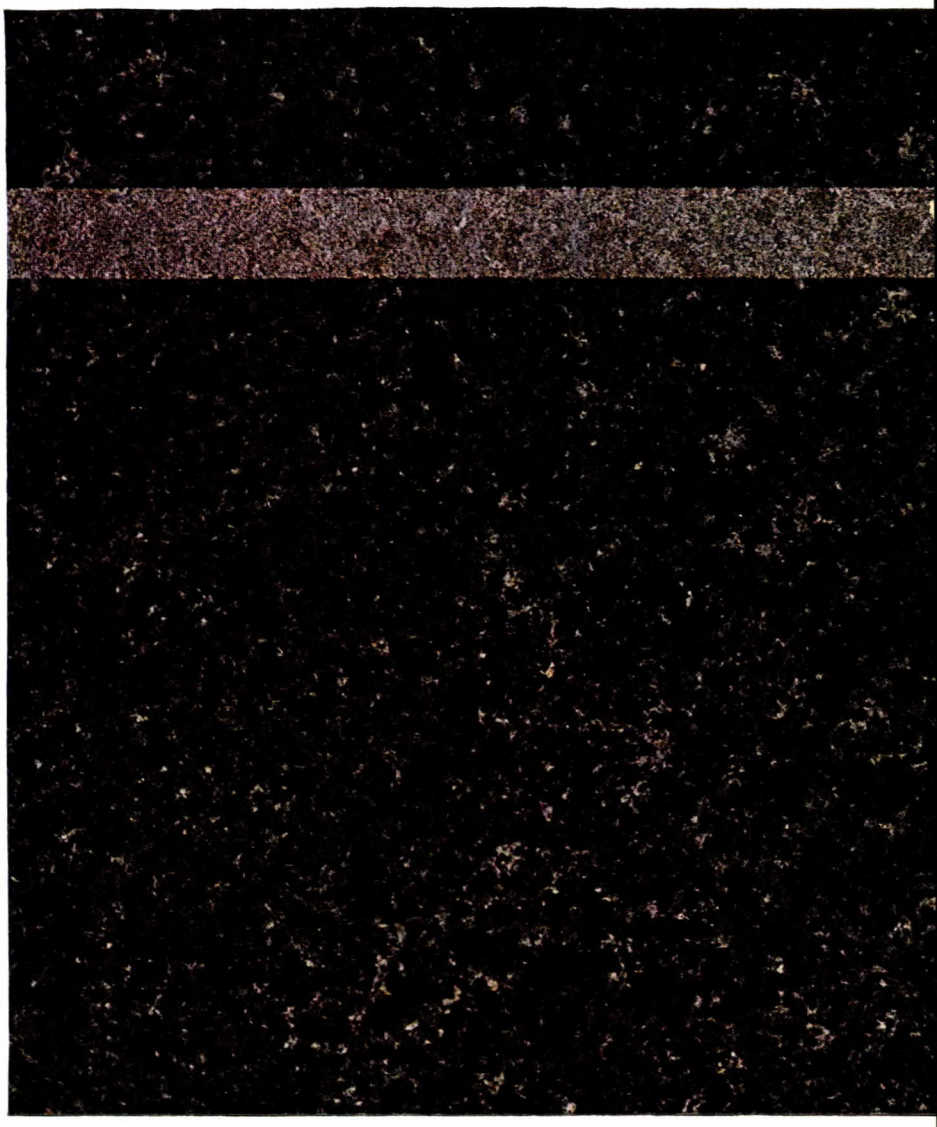


Plate 4

BLACK GRANITE
Spinney quarry, Digdequash Lake
Bocabec District, New Brunswick.

As revealed by quarrying to date, the stone as a rule is badly jointed, the sheeting poorly developed, and slight variations in colour may be noted in the stone at individual quarries. As Wright (16) remarked: "Imperfections are common, usually in the form of irregular zones of coarse-grained hornblende and feldspar, or thin irregular white lines of feldspar alone. The former are easily discarded in the quarries, but the latter are sometimes overlooked until the face is partly finished".

In referring to the black granites of the Bocabec district in 1898, Bailey (5) mentioned that some of them had been quarried to a limited extent. He described one quarry as having been opened near Bocabec and another near Limeburners lake, several miles to the west. When Parks (14) visited the area in 1911, two quarries were operating, but on a very small scale. About 1,400 cubic feet of the stone were cut in the St. George finishing plants during 1910. Four quarries were operating when Wright (16) visited the area in 1932, but on a very small scale. Of the twelve or more quarries examined by him, the majority had been opened during the previous 15 years.

Among those operating at the time of Wright's visit was the Spinney quarry, situated about 200 yards from the west side of Digdequash lake. Opened in 1932, it was probably the last to operate in the area, besides being one of the most extensive. It has a length of about 100 feet, a width of 50 feet, and a reported depth of 50 feet. The quarry was among those visited by Fletcher and is referred to in the report of the New Brunswick Department of Industry and Reconstruction (10). According to this report there is "a good road into the operation and it appears to be the best possible opportunity for further development in the entire area", and "at the depth reached, a floor was found being almost level and without cracks."

The Spinney quarry is flooded at present, but during the year 1953 a few pieces of black granite were obtained from a small outcrop situated to the northwest of this quarry. It is reported that this work was performed by Kenneth Fitzgerald, of St. Stephen, New Brunswick. The formation is largely concealed by overburden and insufficient work has been done to form any opinion as to the sheeting and jointing. However, the stone appears to be of uniform colour and texture.

Many small quarries have been opened in the black granite of this district but sufficient work was never carried out to prove continuity of stone both as to colour and freedom from flaws. Parks (14) mentioned that as a result of the "Rather excessive fracturing, together with the occasional presence of lighter coloured stringers and other blemishes", a large amount of waste resulted from quarrying operations. In referring to the Kennedy quarry at Limeburners lake he remarked that the "formation was found to be so badly broken that operations ceased without any stone having been shipped."

3. HAMPSTEAD (SPOON ISLAND) DISTRICT

This is a very old granite quarrying district and one of the most important grey granite areas in the province. The district is located on the west bank of the Saint John river about 2 miles southeast of the village of Hampstead, in Queens county. It is often referred to as the 'Spoon Island' district, a name derived from a small island in the Saint John river opposite the workings.

The area is served by the Saint John-Centreville branch line of the Canadian National Railways, with siding facilities available close to the quarries. Most of the stone is shipped by road but for more distant parts, rail transportation is used. Occasional shipments have been made by boat on the Saint John river. Road mileages to Fredericton, Saint John and St. Stephen are 53, 41 and 130 respectively.

Figure 9 | *C. E. Stults quarry, Hampstead (Spoon Island) District, N.B.*

The Hampstead granite stock is an eastern outlier of the belt of igneous rocks previously described as extending from the International boundary at St. Stephen, northeasterly across Charlotte county into Kings and Queens counties. This granite mass, of Devonian age, is roughly circular in outline

Plate 5

GREY GRANITE
Hampstead (Spoon Island) District
New Brunswick.

and covers an area of approximately 80 square miles (12). All quarrying has been confined to a small area, less than one mile square, located in the northern section of the granite near its contact.

The stone is a typical granite, consisting essentially of feldspar, quartz, biotite and hornblende. Feldspar is predominant, and its colour, which varies from a reddish pink to a bluish white, governs the general tint of the stone. Much of the feldspar and some of the mica show advanced stages of decomposition. The quartz is of the translucent to milky white variety.

Two main varieties of this stone have been quarried. One is a medium grained pinkish-tinted grey granite, known formerly as 'Gypsum Mountain Stone' and the other a finer grained bluish-grey variety, known formerly as 'Blue Monumental'. Some variation in texture of both varieties can be noted. At the present time only the bluish-grey variety is being quarried.

The black minerals frequently occur in large knots or segregations and in some cases mar the stone for high class monument work, making the blocks suitable only for building. Parts of the quarries are, however, free from these blemishes, and when care is taken to select clear blocks the stone makes an excellent material for monumental dies. The present operating quarry appears to be practically free of such knots, and only one 2-inch dyke was seen cutting the formation.

The stone takes a good polish and there is good contrast between the polished and hammered surfaces. In oblique light few incipient cracks are visible but numerous pit holes occur where the softer minute decayed particles have pulled out in polishing. It is interesting to note that sand-blasting equipment is not used at this plant; the men prefer automatic hand tools. It is stated that letters can be inscribed on monumental dies at the rate of approximately one hundred per day using this method.

The granite industry of this district dates back for over 100 years although references previous to the year 1871 are meagre. In that year Bailey and Matthew (6) mention the quarries as follows:

"At Hampstead in Queens county, quarries have been opened . . . and considerable quantities removed. The rock at this locality has been exposed to a depth of about fifty feet, and is of a uniform pale grey color, very homogeneous in texture, though occasionally containing darker hornblendic masses, and is easily obtained in blocks of any required magnitude."

When Parks (14) visited the area in 1911 one company was operating and the output was used for monumental dies and bases, building, and paving blocks. Both varieties of stone were being produced.

In 1936 there were two companies operating, each of which worked several openings and one of which operated a dressing shed near the quarries (8).

During 1953, and for several years previous, operations in the district were confined to one quarry and a dressing shed operated by C. E. Stults, a Saint John monument dealer. The dressing plant operates on a year round

Figure 10 | *McLean Memorial, Furnhill Cemetery, Saint John, N.B. Hampstead (Spoon Island) granite.*

basis while the quarry normally operates 7 months each year. The local granite is used chiefly for monumental purposes, mainly bases, with its use in building confined to an occasional step or window sill for public or semi-public buildings. A large proportion of the monumental dies are manufactured from imported Swedish black and, to a lesser extent, from the dark grey granite of Mount Johnson.

There are seven or eight main openings in this district. They are all of the 'side-hill' type, the largest having a length of 300 feet, a width of 200 feet, and a 30-foot face. The sheets are horizontal or dip at a low angle, and are usually well developed and sometimes quite massive, ranging up to 8 to 10 feet at some of the quarries. The rift is horizontal or nearly so, being in the main parallel to the sheeting, and the grain is vertical. Both rift and grain are well developed and the stone also splits fairly well along the hardway. Each quarry contains one set of major joints and one or two minor sets. The joints of both sets are vertical or steeply dipping, and the joints of the major set are spaced from 10 to 20 feet apart.

The present quarry, which has operated for 4 or 5 years, has a length of 50 feet, a width of 50 feet, and a face 15 feet in height. The rift more or less parallels the sheeting, which here slopes at an angle of approximately 25 degrees, and the grain is vertical. The sheeting is quite massive, making it necessary to develop artificial sheeting planes by drilling holes along the rift and blasting with black powder. The major jointing planes slope at approximately 70 degrees and are spaced over 15 feet apart. One or two joints were noticed cutting the main set at right angles.

Hydroelectric power is available in the area and is used to operate some of the equipment in the dressing shed, including the polishing machines. Compressed air is supplied by diesel-powered equipment, while the quarry derrick is equipped with a gasoline-operated hoist.

There are excellent opportunities for opening quarries in this district. By extending quarries to depth and instituting channelling methods, large blocks could be obtained and the amount of waste kept at a minimum. The present method of quarrying by drilling and blasting, together with the tightness of the joints, results in a large amount of waste. No difficulty is experienced in obtaining blocks as big as can be handled by the existing equipment, although the blocks are very irregular. As no saws are available, considerable additional waste (about 20 per cent) results from the cutting and trimming down of these irregular blocks. It was estimated that about 50 to 60 per cent of the material taken from the quarry at present finds its way into the finished product.

In the past Spoon Island granite has been used for monumental dies and bases, building stone, curbing, and paving blocks. Its use has largely

been confined to the Maritimes. At the present time the stone is used chiefly for monumental work, as the dressing shed is not equipped to supply large contracts of building stone; the company recently turned down several large building contracts for this reason. A considerable amount of the waste is used as breakwater material. If proper equipment were available, this district should be capable of supplying base material for all monuments manufactured in the province as well as excellent stone for monumental dies and building purposes.

The following are a few of many structures which have been constructed in whole or in part with granite from this district.

Public Library, Saint John, N.B.
Normal School, Fredericton, N.B.
Telephone Building, Saint John, N.B.
Bank of Nova Scotia, Halifax, N.S.
Capital Theatre, Halifax, N.S.
Post Office, Saint John, N.B.
Post Office, Fredericton, N.B.
Tilley Memorial, Saint John, N.B.
Champlain Memorial, Saint John, N.B.
Sir John A. Macdonald Memorial, Kingston, Ont.
Armories, Saint John, N.B.
Parliament Buildings, Fredericton, N.B.
Cotton Mill, Marysville, N.B.

The stone was also used in the piers of the highway bridge crossing the Saint John river at Fredericton, and in two reproductions of the McLean cross, one the McLean Memorial in Fernhill Cemetery, Saint John, the other the Guthrie Memorial in Forest Hill Cemetery, at Fredericton.

Black Stone.—In addition to the grey granite of this district, an area of black rock occurs on the side of the highway immediately south of Fallon brook and several hundred yards north of the quarries. No attempt has been made to work this deposit, first mentioned by Parks (14). The stone, an altered sedimentary rock belonging to the hornfels class, is fine grained and massive, and on fresh surfaces appears almost black (8).

4. BATHURST DISTRICT

The Bathurst district, an intermittent producer of reddish-grey granite, is situated in northeastern New Brunswick along the southern side of Chaleur bay. It occupies the northeastern end of a series of granite batholiths of Devonian age (18) which extend from the southwest corner of the province through to Nipisiguit bay.

Granite was first quarried in the Bathurst area around 1869, for the construction of bridges and approaches along the line of the Intercolonial railway in the Chaleur bay region (9). The stone was obtained from several quarries along the Nipisiguit river and drawn along a tramway to the head of the tide whence it was shipped by scow to the required point. Since the railway was finished, quarrying has been confined chiefly to a point near the head of the tide where several acres of stone are exposed. This stone has been used chiefly for building in the vicinity of Bathurst.

With one or two minor exceptions, granite quarrying in this district has been confined to the Bathurst stock, the largest of several such granite stocks which occur in the region south of Chaleur bay. These small stocks, writes Alcock (1), are of Devonian age and "are regarded as the upper parts of an underlying batholith of considerable size". The Bathurst stock lies on the west side of the Nipisiguit river immediately south of Bathurst, in Gloucester county. It is roughly elliptical in outline, with a length (north and south) of 10 miles, and a maximum width of about 4½ miles. Exposures are confined almost entirely to the banks of the larger streams, and the inter-stream areas are mantled with heavy glacial drift.

While the stone varies somewhat in colour and texture at different parts of the stock, it consists predominantly of the coarse semi-porphyritic pinkish-grey variety such as is seen at the principal quarry. It is a typical granite, consisting of orthoclase, albite, quartz, and biotite, with iron bearing minerals and apatite as the accessory minerals. Skinner and McAlary (15), who examined the southern part of the batholith, describe the granite as "commonly pink and coarsely granular to semiporphyritic, and . . . composed of about 35 per cent pink microperthite and orthoclase, 25 per cent albite, 30 per cent glassy quartz, and 10 per cent biotite". They observed small red garnets in exposures along Nipisiguit river. The stone is comparatively fresh, the orthoclase showing very little decomposition. Pyrite is rare so that there is slight danger of rust stains on exposure. The reddish colour of the stone is due to the presence of porphyritic crystals of red feldspar which lie in a medium grained mass of pale pink feldspar and glassy quartz and numerous flakes of mica (1).

The coarse grain and irregular texture does not make for an attractive monumental stone, but buildings made from it are very pleasing and have proven their durability in the many fine buildings in the town of Bathurst. The stone polishes and fills extremely well, and on large polished surfaces is very striking, and where used with other stone such as grey or blue limestone and sandstone it forms a very strong contrast. The polished surface, however, is only slightly darker than the hammered surface.

At present there is only one quarry, the Connolly quarry, operating in the district, and production is intermittent, the quarry being operated only on receipt of orders. According to J. E. Connolly, the quarry has not operated this year (1953), but in 1952 it operated from April to November; production was about 4,000 cubic feet, all of which was used in the abutments of the new highway bridge linking Halifax and Dartmouth, Nova Scotia.

The Connolly quarry is about a quarter of a mile north of the Canadian National Railways bridge over the Nipisiguit river and about 3 miles south of Bathurst. It has a length (east-west) of 200 feet, a width of 100 feet, and has been worked to a maximum depth of 20 to 25 feet below the surface. It is partially flooded at present and the following remarks will apply to the formation as exposed above the water line.

The sheeting is almost horizontal, sloping gently to the south paralleling the surface; it appears to be quite massive and well-defined in the northwestern section of the quarry where an 8-foot bed is exposed, but less massive and less well defined in the northeastern part of the quarry. Two major sets of well defined vertical joints cut the formation, one set striking N30°E with spacing ranging from 2 to 7 feet and averaging 5 feet, the other striking N75°W with joints spaced from 2 to 25 feet and averaging 12 feet. Two minor sets of vertical joints were seen in the eastern part of the quarry cutting the major joints at approximately 45 degrees; the average spacing appeared to be about 6 feet. The rift is horizontal and the grain and hardway, as revealed by 'plug and feather' marks, are vertical paralleling the major joints. The colour and texture appear to be very uniform and only one black knot (one inch in diameter) was seen. It was concluded that large blocks can be obtained with a minimum of drilling and very little waste at this quarry.

The granite from this area has been used almost exclusively for building stone. There are many fine examples of its use in Bathurst, such as the courthouse and the Roman Catholic church, convent, school, and presbytery. It is interesting to note that the original courthouse was built around 1890 and that the new addition of 1949 matches the old stone almost perfectly. The granite was also used in the Victoria bridge over the Nipisiguit river, and a small amount has been shipped to Chatham and Campbellton.

5. ANTINOURI LAKE DISTRICT

The Antinouri lake district, centred about 19 miles northwest of Bathurst in Restigouche county, is New Brunswick's newest granite producing area. The stone, a medium grained pink granite, is produced by P. E. Frenette of Jacquet River who has operated the quarry since 1951. It is reached from No. 11 paved highway and the Canadian National Railways station at Jacquet River by 11 miles of gravel road. Jacquet River is 30 miles north of Bathurst.

The Antinouri stock lies on the east side of Antinouri lake, and is roughly circular in outline with an area of about 4 square miles. It is another of those stock-like masses of Middle Devonian age which occur in the region south of Chaleur Bay. These small masses, as already mentioned when describing the Bathurst stock, are considered by Alcock (19) to represent the upper parts of a large, unroofed batholith which underlies the whole region.

The stone from this district may be described as a medium grained light rose granite of uniform colour, texture, and mixture. It consists essentially of "orthoclase, quartz, albite, and biotite similar to that exposed along the Nipisiguit" (19). It appears to be free of knots, dykes, and other blemishes.

The quarry is opened on the east side of the lake about 100 feet from the shore line. It has a length of 100 feet, a width of 100 feet, and an overall height of 20 feet. It is being worked in two benches, with the sill of the lower having an elevation of several feet above lake level. As seen in the quarry, the beds strike approximately east-west, dip towards the south at a low angle, and range in thickness from 2 to 7 feet. Joints are rather numerous, running through the granite at all angles, but in spite of this, blocks up to 15 feet in length can be obtained here and recovery is stated to be about 60 per cent at present. Figure 11 shows a block measuring 12 x 3 x 2 feet being dressed. As exposed in the upper bench, the most prominent joints strike approximately east-west, are nearly vertical, and are spaced from 3 to 8 feet apart. This set is cut by another fairly prominent set at approximately right angles; these joints dip around 60 degrees and are widely spaced, over 15 feet. Other joints occur.

Compressed air to operate the derrick, drills, hand tools, and surfacing machines, is supplied by two diesel-powered compressors.

According to Wright (17), the provincial Department of Industry and Development sampled the stone in 1950 with 163 feet of diamond drilling to test its suitability for structural purposes. As this is a relatively new granite quarrying district, the following information taken from a letter of December 13, 1950 from Mr. D. P. Connolly, of Bathurst, to the Honourable Sam Mooers, Minister of Labour, Fredericton, may be of interest. Mr. Connolly conducted the original exploratory work on the deposit.

"In quarrying (the granite) breaks freely on the natural bed rift, but as it is not quite as hard as the grey granite, I have found grain cleavage requires greater care and experience to get good results. . . Some one hundred and fifty running feet of ashlar was cut by us. It was enough to show that the stone can be readily dressed with hand tools."

Mr. Connolly was of the opinion that any difficulty experienced in surface head grain breaking, would be considerably lessened at reasonable depth. He concluded that there was a large deposit of good stone in the area and that "if care is exercised, particularly in the earlier stages of

Figure 11

Hand dressing granite blocks. P. E. Frenette quarry, Antinouri Lake District, N.B.

Figure 12

Old Roman Catholic Church, Bathurst, N.B., built in 1887-90 from pinkish-grey granite of the Bathurst District.

development as a quarry, there should be little difficulty in procuring anything in the nature of dimension stock within reason. The stone itself should fill most requirements and no matter how dressed, whether rock faced, tooled or polished, should give a very pleasing appearance".

At present the stone is used solely for building purposes, for which use it appears to be very well suited. Already it has been used in the construction of several important buildings in Eastern Canada and it is reported that at least one company in the United States is interested in employing the stone in an important building, to be erected at Chicago, Illinois. It has been used in the new $650,000 Church of Our Lady of the Seven Sorrows, at Edmundston, New Brunswick, and in St. George's Church, at Port Daniel, Quebec; in the former structure some 12,000 cubic feet of Antinouri lake granite were used.

The stone takes an excellent polish but appears to be rather light in colour and coarse in grain for the ordinary monumental dies and bases. However, it has been suggested by one dealer in the United States that this stone would make a nice all-polished mausoleum, while another suggested that it would make a highly suitable interior finish for a mausoleum.

OTHER DISTRICTS

Elm Tree—A small amount of diorite or hornblende granite has been quarried from a small intrusive mass about 1¾ miles west of the Elm Tree railway station in Gloucester county, about 11 miles north of Bathurst and 8 miles due east of Antinouri lake district. The quarry is situated on the south bank of the Elm Tree river along the road leading south from Madran. The intrusive is Middle Devonian in age (19).

The stone is greenish-grey, marred locally by light coloured and greenish streaks. It consists essentially of dull, greenish feldspar, black hornblende and quartz; apatite and pyrite are the common accessory minerals. Both the feldspar and hornblende are partly decomposed, and the surface of the waste rock in the quarry is marred by numerous small spots of iron oxide. The texture is medium grained except for the dense, chilled edges bordering the intruded sedimentary rocks (8).

Stone from the Elm Tree quarry was used in the railway bridge over the Elm Tree river, and in the construction of the Roman Catholic church at Petit-Rocher where it is blended with stone from the Connolly quarry at Bathurst.

Welsford—Quarrying was carried on at two localities in this district many years ago, in the vicinity of Welsford on the Canadian Pacific Railway and at Eagle Rock, or Eagle Cliff as it was formerly called, a prominent hill immediately west of the railway, about 2 miles south of Welsford. The district is on the Charlotte axis in Queens county, about 17 miles southwest of the Hampstead (Spoon Island) district.

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The following information on the deposit at Welsford is quoted from a report (5) by Bailey:—

> "During the summer of 1897, a company known as the Dominion Granite Company, of Bridgewater, N.S., . . . opened quarries and erected works at Welsford, . . . for the manufacture of so-called 'black granite'. The rock is in reality a mica-diorite, and is described as forming a mass about one mile long and half a mile wide. It is situated about a mile from the line of the Canadian Pacific Railway, and about twenty-two miles from the city of Saint John. It takes a good polish and is being worked for monumental purposes."

In 1871 Bailey and Matthew (6) mention the quarries at Eagle Cliff as follows:—

> "Here, two quarries have been opened in yellowish-grey syenite, and large quantities of the rock removed for building purposes along the line of the railway. It is well situated for transportation, splits readily into blocks of convenient size, and furnishes an excellent and durable building material."

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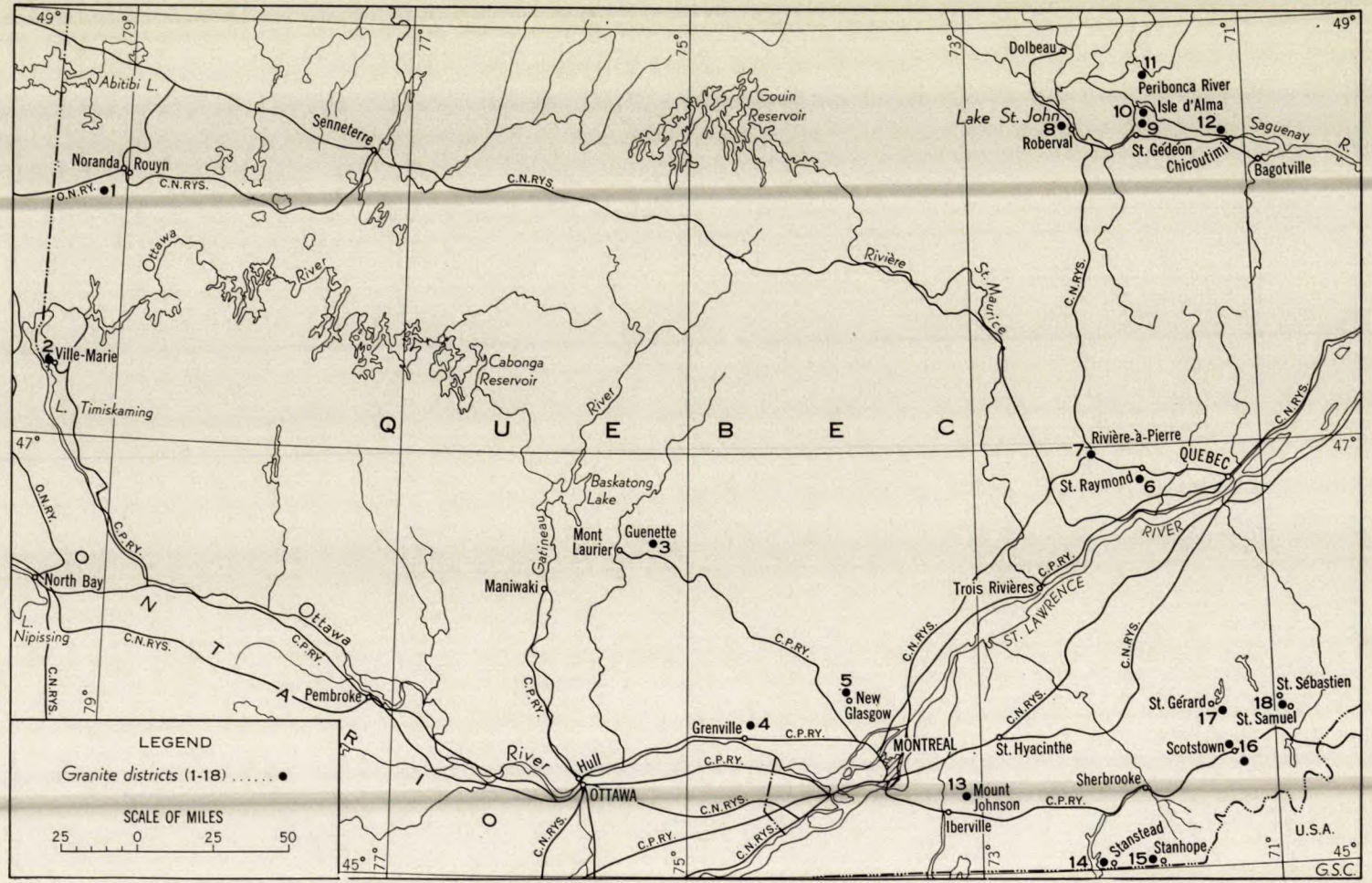


Sketch map of Quebec

CHAPTER 6

GRANITES OF QUEBEC

For many years Quebec has been the leading producer of granite in Canada and, in consequence, the industry has become well established especially in those districts in the Eastern Townships south of the St. Lawrence river. South of the St. Lawrence there is (12) "a well-known granite on which a highly developed industry is based, whereas north of the river the resources of granite are more varied in character and the industry is less developed." At present there are at least 10 important granite producing areas in the province.

A visit to these areas in the summer of 1952 disclosed approximately 30 quarries and 24 dressing sheds in operation, about half the quarries and two-thirds of the dressing sheds being located south of the St. Lawrence. Of a total of 571 individuals engaged in the granite industry of the province, 352 were employed south of the St. Lawrence and 219 north of the St. Lawrence. Included with the latter figure are the employees of the Scotstown Granite Company's large finishing plant at Cap St. Martin, several miles north of Montreal. With the resumption of operations at several of the larger quarries later on in the year, the total number of persons engaged in the granite industry was expected to reach a peak of 600 for the 1952 season.

The Precambrian Shield occupies most of the province of Quebec north of the St. Lawrence river, with the exception of the narrow band of Palæozoic rocks along the St. Lawrence and Ottawa rivers. These ancient rocks contain enormous masses of granite and allied rocks whose suitability for commercial use has been determined in only a comparatively few localities. Many of the areas underlain by granite are at present too remote from both adequate transportation and markets to make their operation commercially economic; in fact, while some of the areas where quarrying has already been carried on, have been geologically mapped in detail, there are still large stretches where little geological work has been done.

In the deposits already opened, the Precambrian rocks north of the St. Lawrence river provide a wide variety of colour, composition and texture, and it is believed that many new types will be found. Thus, there are the blacks, pinks, browns, and reds of the Lake St. John region; the

reds and greys of the Rivière-à-Pierre district; the pinks of Guenette; and the reds and greens of the Grenville area. All these stones are being or can be used for monumental dies and bases. Much of the area is badly banded and folded so that the rocks pass from true granite to gneisses. One banded gneiss, from the St. Raymond area, is becoming quite popular as 'facing' for private houses in Quebec city and Montreal.

Extensive masses of basic and ultrabasic rocks, mainly gabbro and anorthosite, occur north of the St. Lawrence. Large quantities of the anorthosite have escaped pronounced deformation and are suitable for commercial production. They present a remarkable variety of colours ranging from white to black.

South of the St. Lawrence the situation is somewhat different. Most of the areas are well settled, and traversed by numerous highways and railways so that there are few districts except those in the most easterly portion, which cannot be reached with comparative ease. In consequence the area has been more intensively prospected for deposits of stone suitable for building construction, and considerable development has taken place, although there are still isolated sections in which good deposits of granite are likely to be found whenever transportation is provided.

South of the St. Lawrence the granites are considerably younger than those of the Precambrian Shield and occur as a large number of comparatively small isolated areas. Although the stone from the various areas may vary considerably both in composition and texture, there is very little variety in colour and, with one or two exceptions, all may be considered as grey granites. As a rule the stone shows similar general characteristics such as well defined sheeting, good rift and grain and freedom from heavy jointing, so that large blocks can be obtained. In most of these areas the stone is a true granite and this constitutes the great bulk of the production.

The Monteregian hills, which form a distinct topographic and petrographic division in the province, are a series of isolated ancient volcanic hills with Mount Royal as the most westerly and Brome and Shefford mountains the eastern limit. Quarrying has been attempted on practically all of them but the only one on which quarries are now operating is Mount Johnson, where a dark mottled grey 'granite', of medium texture, is being produced. At Mount Megantic, which might be said to represent an eastern extension of the Monteregian hills, a medium grained dark green rock is being produced.

In the following pages, for convenience in description, the various granite deposits and quarries are arbitrarily grouped into districts as follows:

North of St. Lawrence River

District No.	*Name*
1.	Rouyn-Noranda
2.	Ville-Marie
3.	Guenette
4.	Grenville
5.	New Glasgow
6.	St. Raymond
7.	Rivière-à-Pierre

Lake St. John Region

8.	Roberval
9.	St. Gédéon
10.	Ile d'Alma
11.	Peribonca River
12.	Chicoutimi

South of St. Lawrence River

13.	Monteregian Hills
14.	Stanstead
15.	Stanhope
16.	Scotstown
17.	St. Gérard
18.	St. Samuel-St. Sébastien

NORTH OF ST. LAWRENCE RIVER

1. ROUYN-NORANDA DISTRICT

In this area, a large northeasterly-southwesterly trending diabase dyke has been exploited for 'black granite' on a small scale during the past few years.

The dyke (18) is one of a series of such late Precambrian dykes which intrude the early Precambrian sediments in this area of Rouyn-Noranda county south and west of Rouyn. It averages approximately 500 feet in width and has been traced from Beauchastel (Kekeko) lake, in Beauchastel township, southwest for a distance of 6½ miles to within half a mile of the east shore of Opasatika lake, in Montbeillard township. On the east side of Beauchastel lake the dyke crops out (8) intermittently and has been traced northeastward from the lake shore for about 3 miles, into Rouyn township.

The rock (16) consists essentially of labradorite, augite, and magnetite, with a little olivine, and may be described as a fine to medium grained, even textured, very dark grey gabbro. It takes a high polish and the black, bluish-grey and light-grey minerals combine to give the polished surface a very attractive appearance, highly suitable for monuments. The stone splits well in all directions, and there is a good contrast between dressed and undressed surfaces.

However, the dyke is badly fractured (3) at the surface from major joints running parallel with the dyke walls, and from many surface cracks, resulting from weathering action, which radiate in all directions. As a result, it was found quite difficult at the original quarrying site to quarry many blocks of the size required by the larger finishing plants. It is possible, however, that this situation may have improved with depth.

Operations were commenced in the area in 1946 when Canada Black Granite Company Limited opened a small quarry in this dyke near the southwest corner of lot 47, range I, Beauchastel township, about a mile west of Lake Beauchastel. Because there were too many joints at this quarry it was abandoned in 1950 in favour of another to the west on lot 43, where the joints are not as numerous. Blocks of the larger size can be obtained fairly easily at this quarry. Mr. J. E. Gilbert, Resident Geologist for the district reports* that on a recent visit to the quarry he measured 6 blocks having a volume of over 100 cubic feet, 10 of over 75 cubic feet, 19 of over 50 cubic feet and 23 of over 25 cubic feet. One block measured 10 x 4½ x 4½ feet, another 6½ x 5 x 4½ feet, and a third 8 x 4 x 4 feet.

When visited in June, 1952, this quarry was not operating and work was confined to a small dressing shed on the outskirts of Rouyn where two men are regularly employed in manufacturing memorials for the local trade. A wire saw has, however, been installed on the property since the visit and is at the moment in operation.

At the quarry, compressed air to operate the drills and the derrick air-hoist is supplied by one diesel-driven compressor. The wire saw is operated independently by an 8-horsepower gasoline motor.

The quarry is about 10 miles southwest of Rouyn on the Abbeville road about 500 feet west of the road. Noranda-Rouyn is served by branches of the Canadian National Railways from Taschereau and Senneterre, and by a branch of the Temiskaming and Northern Ontario Railway from Swastika, Ontario. Rouyn is on highway No. 59 about 390 miles northwest of Montreal.

This 'black granite' is highly suitable for monumental and building purposes, but due to the remoteness of the district, it is probable that its use for building purposes will be limited, and largely confined to the general Rouyn-Noranda area for the time being. Specimens of this stone, already sent to various monumental dealers in southern Ontario and Quebec, were

* Personal communication, November 14, 1952.

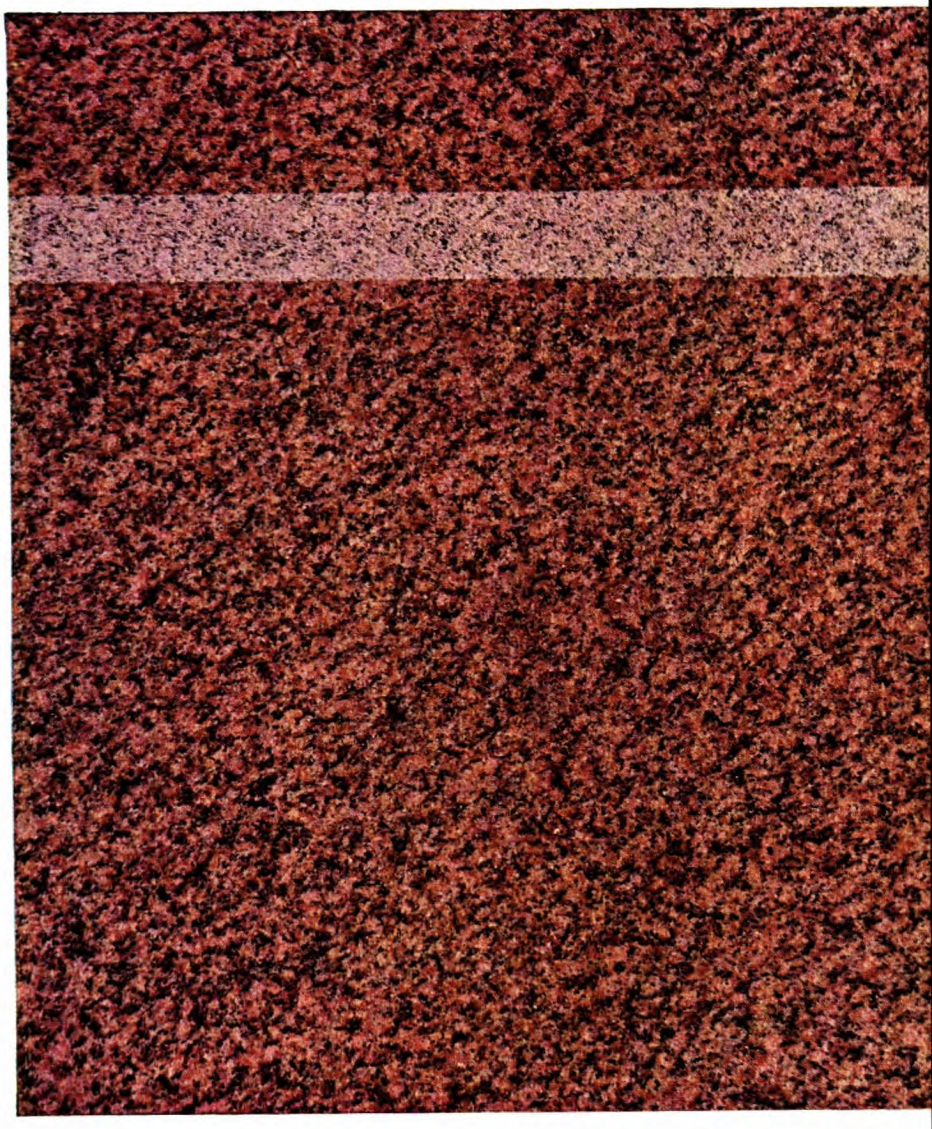


Plate 6

PINK GRANITE
Brodie's Limited quarry
Guenette District, Quebec.

considered to be of high quality and to have excellent stone-cutting characteristics. Transportation costs will be an important factor and may prevent competition with some of the more favourably located southern producers.

2. VILLE-MARIE DISTRICT

In the vicinity of Ville-Marie, on the east side of Lake Temiskaming in the extreme western part of the province, there are a variety of granite outcrops of Precambrian age, many of which have been tested and worked to some extent during the past. The area extends from Temiskaming on the south to near Rollet on the north.

At Ville-Marie there are outcrops of a pale rose coloured granite on Wine Point and Cedar Point, northwest and southwest respectively, of Des Pères bay on which the town of Ville-Marie is situated. Although of early Precambrian, these rocks do not exhibit any gneissic structures (13).

A small opening was made on Wine Point over 30 years ago. Stone from this quarry, a side-hill one located 100 feet up from the lake shore, was loaded on a scow and towed the mile and a half to Ville-Marie. At the quarry the main joint planes run N5°W and dip to the west at 68 degrees. There does not appear to be any definite sheeting and although the rift appeared to be vertical with a strike N5°W this can not be confirmed until fresh work has been done. A number of black knots show in the face now exposed and the jointing is excessive, but large sized blocks might be obtained elsewhere along the shore where the jointing is more suitably spaced.

The stone is described as a medium to coarse grained rose to dark red granite consisting of microcline feldspar, quartz and biotite, with smaller quantities of hornblende (13). Although it takes an excellent polish with good contrast, the colour is rather too pale to make attractive monumental stone. If sufficiently large blocks were obtainable the stone would be suitable for the building trade. According to Osborne (13), the Cedar Point granite is similar to that of Wine Point except that the grain is slightly finer and black knots do not appear to be quite as numerous.

East of Laverlochère, and several miles to the north of Ville-Marie, numerous small hills and ridges of a greenish granite occur, from which a few blocks have been quarried for monumental dies and bases. The stone is a hornblende granite in which some of the feldspar has been altered to an olivine greenish mass which, in contrast to the unaltered pink plagioclase, glassy quartz, and dark green hornblende, makes a stone of very pleasing colour. The distribution of the minerals is fairly uniform and the stone takes a high polish and fills well, but the contrast between polished surface and hammered face is not great. Black spots are frequently noticed in the exposures but there are large areas where a good quarry face could be developed free from such blemishes.

Near the village of Angliers, the northern terminal of the Canadian Pacific Railway branch from Mattawa, there is an outcrop of diabase which has been quarried as a black granite (13).

Farther to the north on the road to Rouyn and south of the village of Rollet are extensive outcrops of rose coloured granite. Several attempts have been made to quarry this stone, the most recent a few years ago when Super Service Inc., of Rouyn, obtained dimension stone from a small quarry half a mile south of the village of Roulier.

Near Temiskaming in the south of the area some granite has been quarried from loose blocks. This stone is described as a granite-gneiss and has been used in the construction of the lower part of the Canadian Pacific Railway station at Temiskaming (13).

None of these granite occurrences is being worked at present. Distances to consuming markets at Montreal and Toronto are over 400 and 300 miles respectively.

3. GUENETTE DISTRICT

This district, in Labelle county about 125 miles north of Ottawa, is the source of one of the best 'red' granites produced in Canada to date. Granite quarrying has been carried on in the area since 1910, and in the last few years, as a result of the increased demand for this stone, production from the original quarry has increased and several new quarries have been opened. The area is of added interest as it is the only locality from which granite press-rolls for paper mills have so far been obtained in Canada.

The granite body extends across Campbell township into Rocher and Boyer townships, and is rather unusual in that it occurs as a massive dyke which has been traced at least 10 miles, with widths varying from half a mile to over a mile (12). The age of the granite is unknown, but the dyke apparently occurs along an old fault plane in the Grenville series of Precambrian rocks (12). The mapping of rock formations in this area is quite difficult due to the heavy overburden.

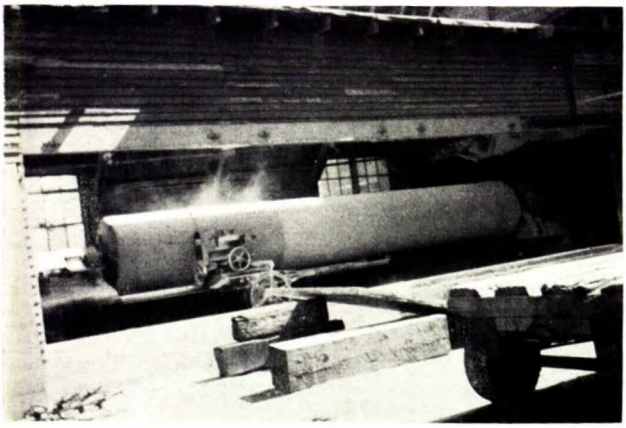
The rock is a fine to medium grained pink granite consisting of microcline, quartz, albite, biotite, and muscovite, with small amounts of magnetite and other minerals. Osborne (12) describes the rock as having the texture of an aplite dyke in that "it is fine-grained and the constituent minerals tend to be rounded and without rectangular boundaries". The quartz is water white and clear and gives great depth. The granite takes a high polish with good contrast between the several finishes.

At present, four quarries are operating in this district, all being 2 to 3 miles north of Guenette, which is 147 miles northwest of Montreal on the Mont Laurier branch of the Canadian Pacific Railway. The new No. 11 highway from Montreal to Mont Laurier passes within a few miles of the quarries, so that most of the production is shipped by road.

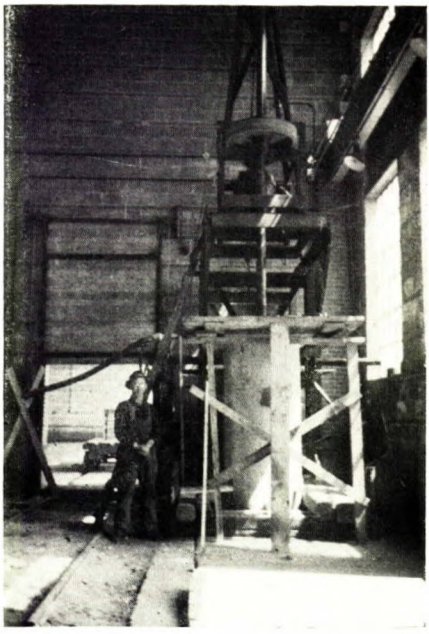
Figure 13

Preparing granite press rolls at Brodie's Limited dressing plant, Iberville, Que. This granite is quarried at the company's Guenette quarry.

(a) Rough blocks in plant yard at Iberville, Que., partly shaped by hand.



(b) Rough cylinder in lathe being trued to approximate size by means of steel discs.



(c) Cylindrical block, held vertically, being drilled by steel shot drill for reception of steel shaft.

(d) Finished blocks ready for mounting on steel shaft.

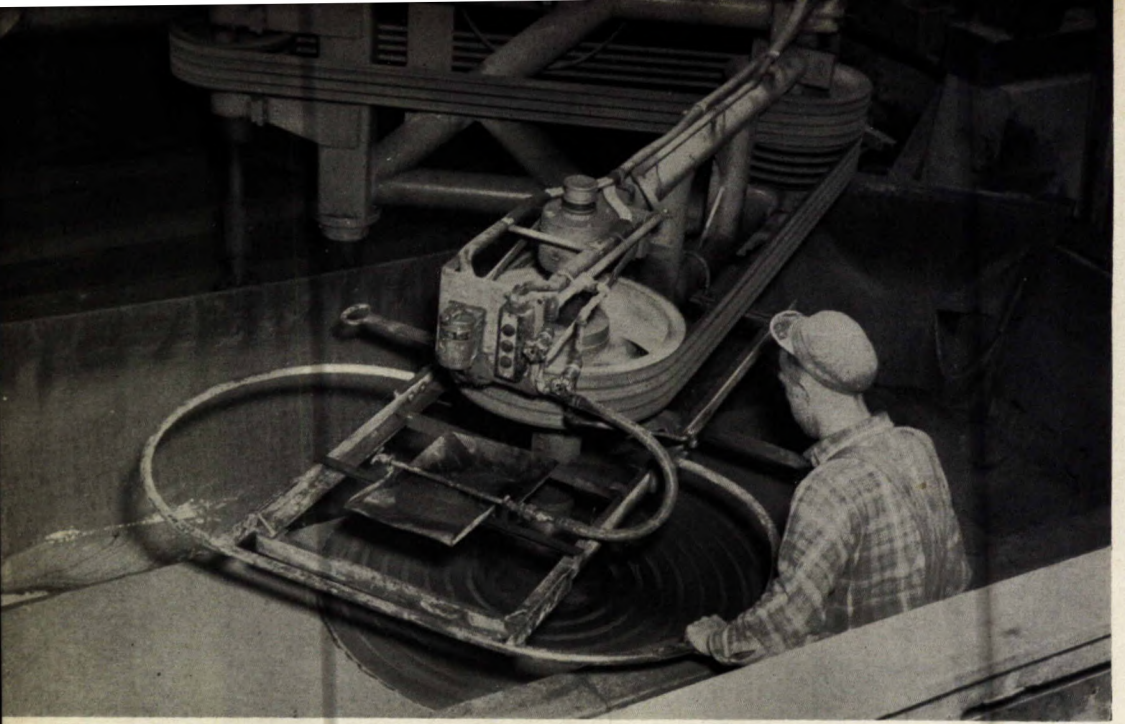


Figure 14 | *Modern polishing machine in operation. (Courtesy, Smith Whitcomb and Cook Co., Barre, Vt.)*

Figure 15 | *J. A. St. Pierre quarry, Guenette District, Que.*

Figure 16 | *Splitting granite by means of 'plug and feather' at Atlas Granite Company, Limited, quarry, Guenette District, Que.*

Figure 17 | *Brodie's Limited quarry, Guenette District, Que. Paving block cutter at work with pile of finished blocks.*

The oldest, and one which has brought the district into prominence as a producer of granite, is owned by Brodie's Limited of Montreal. This quarry, connected with the Canadian Pacific Railway at Guenette by a spur line 3 miles long, was first developed in 1910 and, except in 1913 and 1914, has been operated by the present owners since 1911. The product of this quarry is the finest grained stone in the district and the exact type has not been duplicated by any other quarry. It is from this quarry that granite press-rolls have been produced.

The Guenette stone became popular for monuments during and after World War 2, when it was difficult to obtain imported red granites, particularly from Finland. Monument dealers in many sections of the county obtained their first Guenette granite during this period; people have noted its attractive appearance in monuments and consequently there has been an ever increasing demand for it. Other quarries have been opened in the area, and the stone, although not quite as fine grained and even textured as the original Guenette, is an extremely attractive monumental stone. It is also becoming quite popular in the United States.

Brodie's quarry, at which the only large scale quarrying operation in the district is carried on, is a combination of the 'side-hill' and 'below-surface' types. It has a length north and south of over 350 feet, a width of nearly 300 feet, and the lowest operations have reached a depth of over 100 feet

below the highest point on the face. The other quarries are of the side-hill type, the largest of which is 200 feet long and over 100 feet wide, with a face of 50 feet.

Quarrying is fairly difficult as there are numerous knots and many streaks of colour. Also, as quarrying progresses, there is considerable rock pressure, and in the lowest benches of Brodie's quarry it is becoming increasingly difficult to produce large blocks suitable for granite press-rolls, due to the narrow sheeting and extra jointing resulting from pressure. The stone, however, has a distinct rift which parallels the sheeting, the joints are steeply-dipping and well spaced, and the sheets are gently-dipping and average from 3 to 10 feet in thickness, so that medium and large-sized blocks may be obtained with simple drilling and blasting. For special jobs, such as granite press-rolls where long rectangular blocks ranging up to 4′ x 4′ x 28′ to 30′ in size are required, channelling is resorted to.

Cheap power is not available in this district, and all plants have to generate their own supply. Steam plants were formerly used to a great extent but now diesel-powered and, to a lesser extent, gasoline-powered equipment is much more common.

The stone from this area finds its chief use as a monumental stone. Its fine grain and even texture, ability to take a high polish and delicate carving, and the pleasing contrast between the several finishes, admirably suit it for this purpose. As a result, the Guenette area is now generally considered as producing one of the best red monumental granites in the country.

Although it is somewhat more difficult to split into paving blocks and curbstones than some of the other granites found in the province, it has been in good demand for these uses on account of its excessive toughness and durability under heavy wear. As a result, very large quantities of paving blocks have been shipped to Montreal and to points outside the province. In June, 1952, there were approximately 200,000 finished blocks on hand at the quarry.

Its fine grain and even texture and its ability to take a high polish, together with its freedom from pitting and hair cracks, admirably adapt it for the manufacture of granite press-rolls, and several hundred rolls made from this granite have been placed in Canadian paper mills.

4. GRENVILLE DISTRICT

This district was formerly described (12) as the Brownsburg District, but as there is now little or no quarrying near the town of Brownsburg and several quarries are operating near the village of Grenville, it may be more correctly called the Grenville District.

It is about 50 miles northwest of Montreal and 3 to 5 miles north of the Ottawa river. There are good highways connecting it with Montreal and most of the stone is hauled by truck. The Canadian Pacific Railway

northshore line from Montreal to Ottawa passes within a few miles of the southern edge of the granite mass, and a privately owned railway from Kilmar to the Canadian Pacific Railway at Marelan Station actually passes within several hundred feet of two quarries.

In 1857, Sir William Logan, Director of the Geological Survey of Canada first drew attention to the possibilities of the igneous rocks of this district being used for building stone, but not until the early 1890's was any quarrying attempted.

This district lies within the Laurentian highlands near its southern edge, and is unusual for the variety and types of granite which are found within a relatively small area. The oldest rocks of the district belong to the Grenville series, and these have been intruded by numerous bodies of igneous rocks, such as true granites, syenites, diabases, anorthosites, and dykes of various descriptions, all of Precambrian age. The most important of these, as far as the granite industry is concerned, is the Chatham stock which extends 9 miles west of Brownsburg and 5 miles north and south. This stock consists essentially of large areas of granite and syenite, with associated syenite porphyry and quartz porphyry dykes.

For a more detailed description of the formations in this district, the reader is referred to Osborne's report (12).

Brownsburg Area.—The granite occupies about as large an area as the syenite, and occurs to the west and northwest of Brownsburg. This is the original quarrying area and many important quarries were opened in this granite mass. Quarrying was commenced in this area in 1890, and reached its peak somewhere between 1907 and 1917; the most important quarries, considering both the amount of stone sold and the duration of operations, were worked by Jos. Brunet (12). During recent years only one quarry has operated in a small way in this area, and at present all operations have ceased.

The Brownsburg granite may be described as a medium to coarse grained granite consisting of feldspar, quartz, and hornblende. Two distinct varieties of colour are found, one a reddish-pink and the other a greenish-grey. In the reddish-pink variety the colouring is imparted by the feldspars which are stained various shades of red and brown, and by the filling of the minute cracks in the feldspar and between them with red iron oxide. The feldspar shows some weathering as do the iron-bearing minerals, and it may be that the grey type will predominate at depth. In the greenish-grey type the feldspars are fresher and although the grains still show minute fracturing, the iron oxide colouring is absent and some of the feldspar grains have a light olive green tint, which together with the smoky colouring of the quartz gives a decided greenish-grey colour to large blocks of the stone. Both the varieties of granite show incipient fracturing viewed by oblique light but the stone takes a good polish and fills well. However,

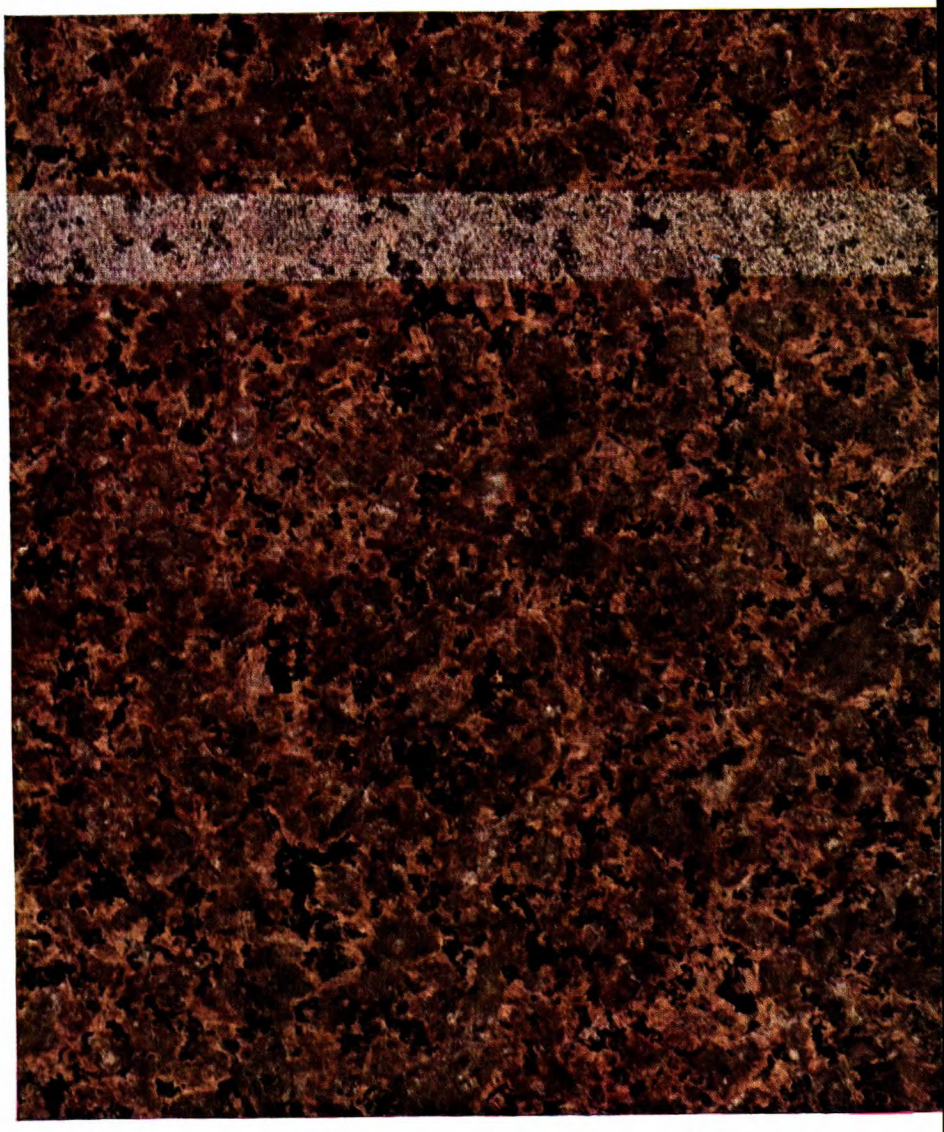


Plate 7

SIENNA RED GRANITE
Scotstown Granite Company Limited quarry
Grenville District, Quebec.

there is little contrast between the polished and other finishes, so that the stone is more suited for rock face and hammered finishes than for polished trim.

At the quarries, the rift is horizontal or nearly so, paralleling the sheets which range from 6 inches up to more than 5 feet in width; the joints are usually steeply-dipping and well spaced; and the rift and grain are well developed, facilitating the production of curbing and paving blocks.

Production was mainly confined to curbing and paving blocks, and large quantities of both were produced during the period this area was an active granite quarrying centre. The stone from the larger operations was also employed for building and monumental purposes, that from the Brunet quarries, in particular, being used extensively and with good satisfaction in many large buildings in Montreal and elsewhere and also for monumental dies. The Berube quarry, among the last to operate in the area, also supplied stone for building purposes and for monumental bases (12).

Grenville Area.—North and east of the village of Grenville there are two large areas of red syenite which have been extensively quarried in recent years. These areas lie respectively east and west of Rawcliffe and are separated by syenite breccia and older rocks. Operations began in 1938 and at present there are three quarries in operation, two of these being located immediately to the east of Rawcliffe, and the other, a little over a mile to the southwest.

Generally speaking, the rock from this area may be described as a medium to coarse grained syenite consisting of red and pink feldspar and black hornblende. It differs from the granite of the Brownsburg area in that it contains no quartz (12). The stone occurs in various pleasing shades of red, and depending upon its colour and the quarry from which it is produced, is marketed under such trade names as 'Grenville Red', 'Sienna Red', 'Scots Red', 'Mahogany', and 'Chestnut'. It takes a high polish, and has a very attractive appearance both on polished and unpolished surfaces. Depending upon the variety, the contrast between the polished and unpolished surfaces varies from fair to very good.

Quarrying conditions vary considerably with each quarry. At one quarry the joints are extremely close and irregular, at another they are well developed, and at still another they are rare. The sheets are nearly horizontal, and averge less than 4 feet in width at one quarry, compared with over 10 feet at another. The rift parallels the sheeting and is not very well developed. In some cases the stone shows concentrations and streaks of black minerals. Generally speaking, therefore, the quarrying of stone in this area can be considered an expensive operation.

Although hydro power is available in the area, at present the quarries depend upon their own power supplies. Compressed air is supplied by either diesel or gasoline-operated machinery, and most of the derricks have steam-operated hoists.

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The stone is used as a building and as a monumental stone, and for both uses it is very well suited. Examples of special monuments manufactured from this stone include the Baron DeHirsch memorial at Montreal and the war memorial at Lachute. In order to supply monumental dealers with sawn slabs of granite and promote its sales of granite for monumental purposes, one operator recently installed a wire saw at the quarry. The stone is well suited for building purposes, for both indoor and outdoor use, and there is a growing demand for the several varieties now being produced. It has been used to good effect in churches, schools, and numerous private homes. The new Citizen Building annex at the corner of O'Connor and Queen streets, Ottawa, has a base course of red granite from this area. Quantities of this stone have also been used as breakwater material in inland waterways.

The area produces one of the high quality red granites of Canada, and due to its location, amounts used for building and monumental purposes may be expected to increase substantially.

5. NEW GLASGOW DISTRICT

New Glasgow is 11 miles northeast of St. Jerome, with which it is connected by highway No. 41, and by the Joliette-St. Jerome branch of the Canadian National Railways. St. Jerome is 35 miles northwest of Montreal on highway No. 11; the Lac Remi branch of the Canadian National Railways from Montreal, and the Mont Laurier branch of the Canadian Pacific Railway from Montreal, both pass through St. Jerome.

Although the use of granite from this district has been confined almost entirely to the production of paving blocks prior to 1914 (13), a brief mention of the district is made to draw attention to the large deposits of anorthosite and gabbro of Precambrian age which intrude the Grenville sediments in the area north and west of New Glasgow.

In referring to the anorthosite of the area in 1894, Adams (1) mentioned that it may be obtained in unlimited amount, of any colour from deep violet to white, and might in many cases be employed with advantage for decorative construction. It is interesting to note (1) that two 6-inch polished cubes of anorthosite, one of the white variety from New Glasgow and the other of the violet variety from range II of Morin township (15 miles northwest of New Glasgow), were exhibited in the Colonial and Indian Exhibition at London in 1886; the white variety was stated to take a high polish, the polished surface bearing a striking resemblance to marble.

On account of its toughness, its ability to split well, and its favourable location, the anorthosite in the vicinity of New Glasgow was extensively used for paving blocks during the early part of the present century. As early as 1891 several quarries had been opened, and Adams reported (1) that by

August of that year, a total of 541,000 anorthosite paving blocks had been shipped to Montreal by rail. Osborne (13) examined about 10 of these quarries, the largest of which was about 40 feet by 40 feet, with a face of 20 feet. With the exception of one opened in the blue variety, all of these quarries were opened in green anorthosite, and where mentioned, the formations are described as having a northeasterly strike and steep dip to the west, the sheeting being poorly developed, and the horizontal joints irregular.

A few years ago Scotstown Granite Company Limited obtained several carlots of green anorthosite from two adjacent outcrops located half a mile north of New Glasgow. This stone is fine-grained and takes a high polish, the polished surface is a very pleasing shade of light green, and monuments manufactured from it have a very attractive appearance. It was noticed, however, that variations in colour occur, making it difficult to obtain polished surfaces free from light or dark coloured bands or streaks. In addition, it is stated that several monuments which have been exposed to the elements for a few years, already show signs of weathering.

In view of the foregoing, this stone does not appear suitable for monumental or building purposes where polished surfaces are required, but should a deposit be located free from local variations in colour, the stone would be suitable for inside or ornamental purposes. The stone breaks easily and is suitable for rock faced ashlar for small buildings. With regard to paving blocks, Osborne reports (13) that blocks manufactured from this stone "suffer from the disability that they are composed only of plagioclase feldspar, which, under the abrasion of traffic, tends to wear to a uniform slippery surface."

In describing one band of green gabbro which cuts the anorthosite north of New Glasgow, Osborne mentions (13) that some polished surfaces have a very pleasing appearance, and in places where the jointing is well-developed, it might be employed for decorative use. He was of the opinion that some paving blocks in use in the city of Montreal are probably from this band, but the site of the quarry was unknown to him.

6. ST. RAYMOND DISTRICT

This district is about 35 miles west of Quebec city, with which it has good highway connections. It is served by both the Canadian National and Canadian Pacific railways, but, so far, all shipments have been made by road.

For several years a formation of banded gneiss about 6 miles south of St. Raymond and 6 miles northwest of St. Basile, in Portneuf county, has been exploited by a local company on a small scale for building stone. The stone is marketed in the form of rock faced ashlar, of the "rough" or "undressed" variety, and is mainly used as wall facing for private houses in the Quebec city area. Buildings faced in this manner have a very attractive appearance, and there is a growing demand for the banded gneiss of the St. Raymond district for this purpose.

Marvel Granite Regd. commenced work in the area in 1946 and to date has opened two small quarries, both on range VIII, of Bourglouis township. When visited, operations were confined to the larger of the two quarries, which is approximately 100 feet long, and 50 feet wide, with a face of 15 feet. At both quarries the rift is nearly horizontal, paralleling the sheets which range up to 2 feet in thickness, and the joints are vertical and well developed, spacing ranging from 2 to 10 feet. The rock is a granitic gneiss, consisting mainly of quartz, feldspar, and hornblende. The colour varies from grey to light red at the quarries, while other varieties were noted in several outcrops occurring in the vicinity. The rocks of Bourglouis township have been classed as Precambrian in age (17).

7. RIVIÈRE-À-PIERRE DISTRICT

Rivière-à-Pierre is in Portneuf county about 60 miles northwest of Quebec city, at the junction of the Lake St. John line and the Montreal branch of the Canadian National Railways; by rail, it is 56 miles from Quebec and 147 miles from Montreal. Connection with the area is chiefly by railroad but a fairly good gravel road links Rivière-à-Pierre with St. Raymond, and from there a good paved highway exists to Quebec. This district has been an important granite producing centre for over 50 years, and takes its name from the village of Rivière-à-Pierre, around which the various quarries are situated. Two main types of granite have been quarried here, a medium grained blue-grey granite which is slightly gneissic in character and, a massive coarse grained rose-grey granite. These granites intrude formations of the Grenville series, some of which in the vicinity of Rivière-à-Pierre have been so intensely metamorphosed as to form new rock types.

The main body of the blue-grey granite lies west and south of the village of Rivière-à-Pierre. The same granite is noted along the C.N.R. line to Montreal at Summit Siding, Rousseau Mills, and as far west as Notre Dame des Anges; it is also exposed along the C.N.R. line to Quebec for over 4 miles. The stone is a medium grained blue-grey granite composed essentially of quartz, plagioclase (oligoclase), and hornblende (12). The amount of hornblende varies in different quarries and in consequence stone of various shades from light to dark grey is obtained. It shows a distinct foliation or parallel alignment of the mineral grains, especially the hornblende, and this has an important bearing in the quarrying as well as in the finishing of the stone.

The most extensive mass of granite in the district lies east and north of the village, and in it the larger quarries have been opened. This granite is noted as far as 19 miles north of Rivière-à-Pierre, 6 miles south, and 10 miles east. The stone is a coarse grained rose-grey or rose coloured granite varying in intensity of colour not only in different quarries, but also in the same quarry. It is composed (12) of microcline, albite, quartz, and biotite. The feldspar is rose-coloured to bluish-white in tint and gives

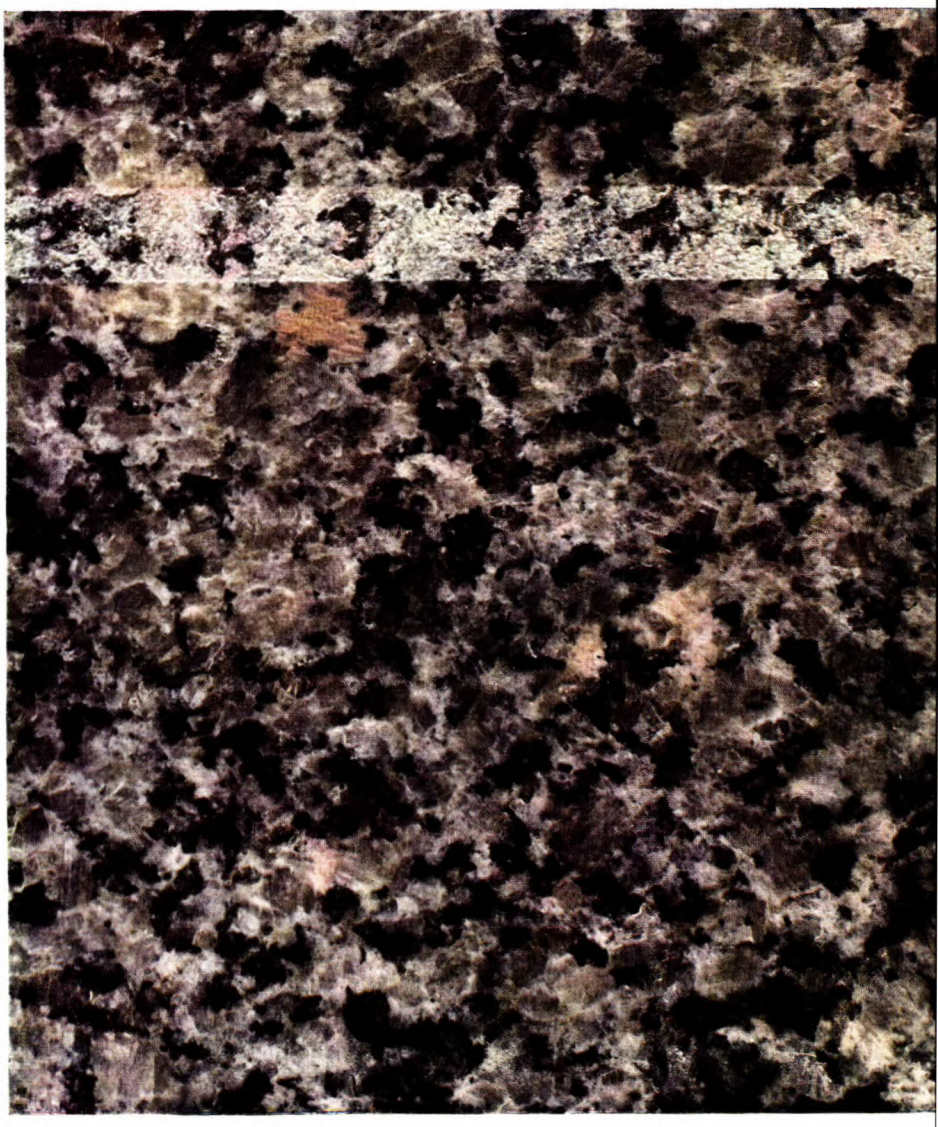


Plate 8

ROSE-GREY GRANITE
Dumas and Voyer quarry
Rivière-à-Pierre District, Quebec.

the predominant colour to the rock. The quartz is generally clear to colourless, which gives "life" and "depth". Metallics can be seen with the microscope but do not occur in sufficient quantity to cause rusting. As Osborne (12) states, "The stone breaks readily and the joints are sufficiently widely spaced that large blocks may be easily and cheaply extracted, making this stone very suitable for construction work. The rift is approximately horizontal and parallels the cracks extending through the quartz". The stone shows up well on a large polished surface. At its contact with the older rocks, this rose-coloured granite is medium grained and slightly foliated. It cuts with ease, making it highly suitable for paving blocks, for which use it has been exploited to some extent. It has also been used for curbstone and for building purposes.

The first quarrying in the area was started around 1894 when a quarry was opened in rose granite to supply stone for the Langlier building in Quebec city. The same year a quarry was opened in blue-grey granite (12). Intermittent quarrying was carried on by various operators when there was a demand for the stone until the industry was well established, and in 1904 and 1905 heavy shipments of rose granite were made to supply the large blocks for the piers and abutments of the Quebec bridge, and later over 500 carloads were shipped for building the Lauzon dry dock at Levis, Quebec, the stone on account of its massiveness being specially adapted to this kind of structure.

During the past 25 years the industry has been rather quiet, especially as the market for curbstone and paving blocks has fallen off, but nevertheless, several large contracts have been supplied. One of considerable interest was the successful quarrying in 1934 of a monolithic cross weighing over 42 tons for erection at Gaspé, Quebec, as a memorial to Jacques Cartier's first landing in Canada. The cross is 32 feet long and 9 feet wide at the arms, and was extracted from the quarry of Auguste Dumas, which also furnished the stone for the Lauzon dry dock and the greater part of that used in the Quebec bridge.

Osborne describes (12) some thirty quarries in the area, three of which were located in the medium rose, twelve in the coarse rose, and the remainder in the blue-grey granite; three occur in Colbert township, the others in Bois township. In 1931, ten quarries were operating in the area, five in grey granite and five in rose granite, and production consisted mainly of curbstone, building stone, some paving blocks, and in one case, monumental stone. In 1934, only three quarries were operating.

At present there are four active quarries in the area, three of which are opened in rose-grey granite, the other in blue-grey granite. Stone from the two principal quarries, that of Scotstown Granite Company opened in blue-grey granite, and that of Dumas and Voyer opened in rose granite, is used almost entirely for building purposes, while the two other quarries, one of which is a boulder quarry, produce only curbstone.

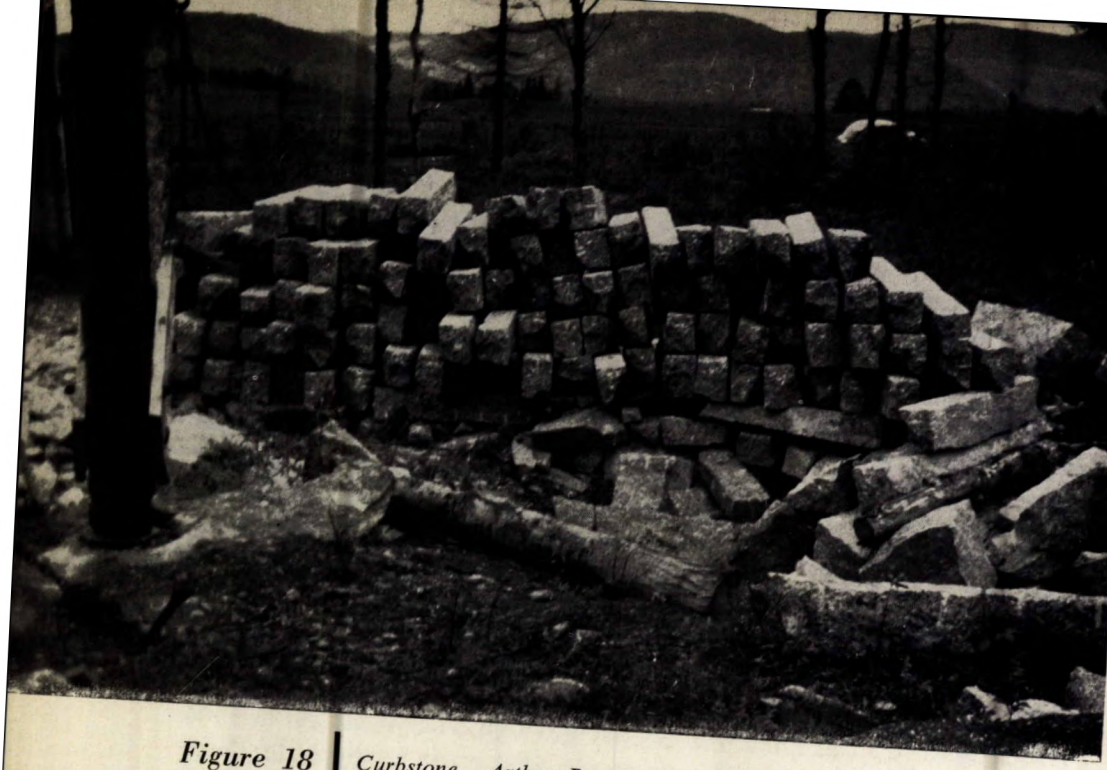


Figure 18 | *Curbstone. Arthur Perron quarry, Rivière-à-Pierre District, Que.*

Figure 19 | *Dumas and Voyer granite dressing plant, Rivière-à-Pierre District, Que.*

At the Dumas and Voyer quarry, the stone is rose-grey, similar to that of the other quarries in the district, having perhaps a slightly deeper pinkish tinge. The quarry has a length of around 250 feet and is opened on the northern slope of a granite ridge and to date has been worked to a depth of 37 feet below the surface. The sheets are nearly horizontal and range from 2 to 8 feet thick at the top of the quarry, to one 10-foot and one 27-foot sheet below the surface. The main joint has a strike of N12°E and dips at 75 degrees to the southeast, and another strikes N25°E and dips at 72 degrees to the southeast. The rift is horizontal and grain vertical. Occasional knots and seams occur but do not present any problem.

Stone from this quarry has been extensively used for curbstone, building stone, and rock faced ashlar; a small amount has also been used for stepping. It has been used in the construction of banks, churches, sanatoria, and other buildings. Three important structures illustrating the use of this stone are the National War Memorial in Confederation Square, the French Embassy building on Sussex Street, Ottawa, and the Bank of Canada Building, Montreal. At present, production is mainly rough and dressed dimension stone for the building trade, for which purpose the stone is excellently suited. Due to the near absence of joints and the great thickness of the bottom sheets, very large blocks can be obtained at this quarry; one block recently quarried measured 63 feet in length, 20 feet in width, and 10 feet in depth.

The other principal quarry in this area, that of Scotstown Granite Company, is located about 4,000 feet south of the Rivière-à-Pierre railway station, on the side of a hill which slopes to the west. The opening is about 175 feet in length, 50 feet wide, and the face is 50 feet high. The principal set of joints strike N85°E and dip at 80 degrees to the south, and are spaced anywhere from 2 to 20 feet apart. The sheets are nearly horizontal, dipping about 5 degrees to the west, and vary from 2 to 15 feet in thickness. The rift is approximately horizontal, and the grain and foliation strike N35°W and are vertical. The stone contains a considerable proportion of hornblende which is definitely aligned, so that the gneissic structure is seen on all except the grain faces, which are considerably darker in tone than the others. The gneissic structure is not so evident on the hammered surfaces, which are a very attractive light greenish-grey in colour and contrast well with the equally attractive dark bluish-grey polished surfaces. It takes a high polish and fills well under the polishing, and would form a good trim to the lighter grey granite quarried so extensively south of the St. Lawrence. It is known to the trade as 'Dark Blue Pearl'.

This blue-grey granite has been used in the construction of many important buildings, a few of which are listed below:

International Aviation Building, Montreal, Que.
Phillips Square Building, Montreal, Que.
Palais de Justice, Quebec, Que.
Cathedral, St. Roch, Que.

Cathedral, St. Thècle, Que.
Cathedral, Chicoutimi, Que.
Public Building, Niagara Falls, Ont.
Public Building, Welland, Ont.
Bank of Toronto, London, Ont.

Hydroelectric power is available in the area and is used to some extent at the two main quarries. The compressors are of the electric, steam, or gasoline-operated type, and the derricks have gasoline, steam, or compressed-air-powered hoists.

This district is noted for the large blocks which can readily be obtained from many of the quarries and for the great amount of stone which has been quarried for such uses as building stone, curbstone, paving blocks, rock faced ashlar, stepping, and monumental stone. The ease of splitting and working the stone made it ideal for curbstone and paving blocks, and many carloads of these products were shipped to Quebec and Montreal during the early part of the century. There are many fine examples of its use in buildings and other large structures and the area should continue to be a very important producing centre for this kind of stone. The material is not in great favour as a monumental stone as the rose-grey granite is too coarse grained and the blue-grey tends to be gneissic in character. Both these qualities however, have resulted in fine types of building stones.

There are great opportunities for further development of quarries in this area. The outcrops rise well above the valley floors and initial openings can be made at little expense.

Lake St. John Region

Lake St. John region encompasses Roberval, St. Gédéon, Ile d'Alma, Peribonca River and Chicoutimi Districts.

Extensive masses of igneous rocks of Precambrian age occur in the Lake St. John region between Port Alfred on the Saguenay river on the east, and Roberval, about 65 miles to the west. There are three main formations of importance as a source of structural and monumental stock, the anorthosites, Roberval granites, and pyroxene granulites. Gneisses of Grenville and Laurentian age are also present, and in the vicinity of Chicoutimi they have been exploited to a limited extent, mainly for the production of crushed stone.

Probably the most important rock formation in the region is the anorthosite found to the east and north of Lake St. John. Although the exact boundaries have not, as yet, been definitely determined, this is one of the largest areas of anorthosite in Canada, if not in the world (13). The St. Gédéon and Peribonca river districts are underlain by rocks of this formation.

The Roberval granites are the youngest Precambrian rocks in the region. Extensive masses of this coarse grained red granite occur in the Roberval

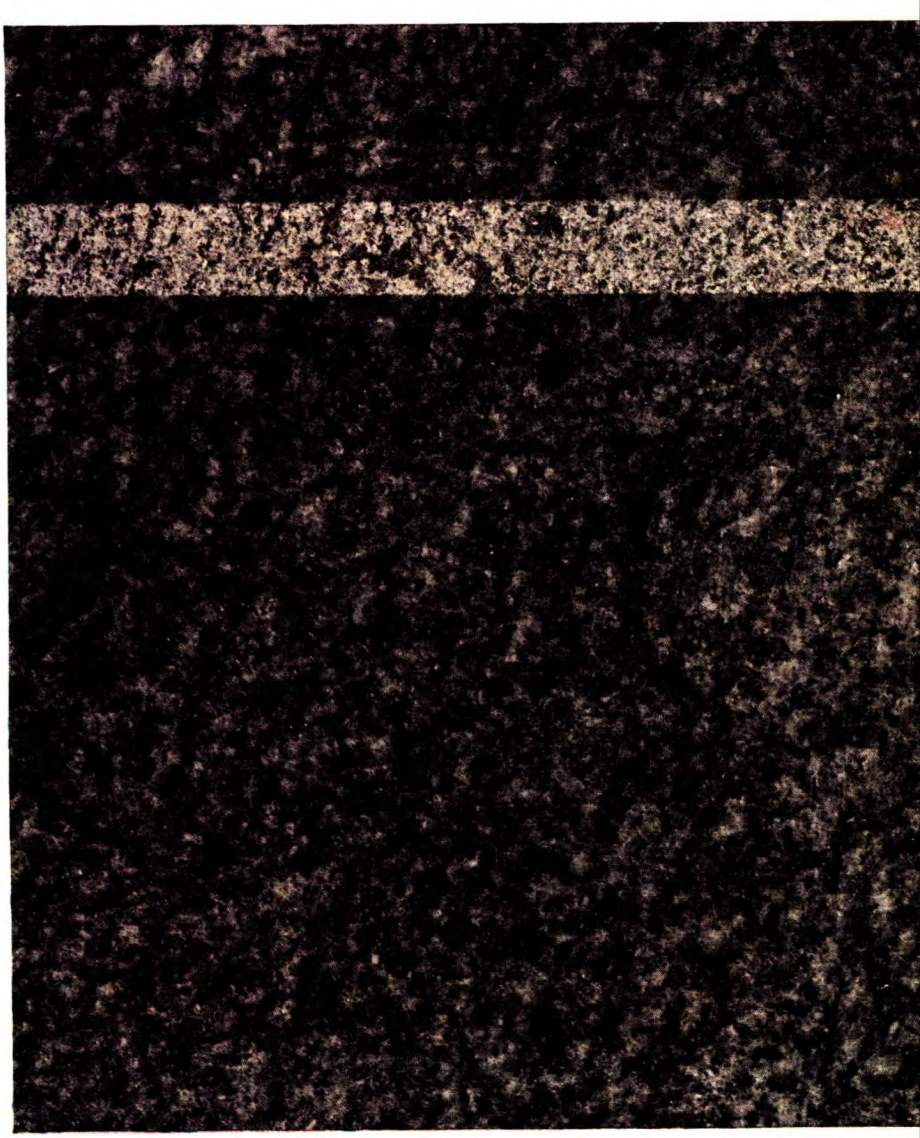


Plate 9

DARK BLUE GREY GRANITE
Scotstown Granite Company Limited quarry
Rivière-à-Pierre District, Quebec.

district on the west shore of Lake St. John, while other exposures are found to the east in the Ile d'Alma and Chicoutimi districts. In the eastern part of the region this rock contains less quartz and it probably passes by gradation into a basic syenite which is present in the vicinity of Chicoutimi.

In the vicinity east of Chicoutimi, on both sides of the Saguenay river, occur numerous outcrops of a medium grained dark green rock which has been classed by Osborne (13) as pyroxene granulite. This rock has been quarried to some extent for both monumental and building stock and is characterized by a granulated structure and the presence of small red garnets. The bodies vary in composition, containing varying amounts of quartz, feldspar, pyroxene, and sometimes biotite. They form sill-like bodies in the Grenville series but appear to be older than the Laurentian series.

For a detailed description of the formations, and the quarries which have operated in this region, the reader is referred to Osborne's report (13).

More than 100 years ago the first colonization of this region was undertaken and a settlement established in 1837 at the lower end of Ha! Ha! bay. Records of the first quarrying are not available but, as some of the oldest buildings in the early settlements have foundations of local granite, the early settlers were apparently aware of the possibilities of the local stone for building. Quarrying in the Roberval granite, north of Roberval, was started about 1902 and has furnished stone mainly for local buildings and monuments. From 1910 on, a number of small quarries were opened in various kinds of igneous rocks in the region, the stone being used for buildings and monuments, road building and concrete aggregate, several piers and breakwaters. About 1930 the anorthosite rocks were first developed for monumental stock, and have since become quite popular throughout the country for building and monumental purposes.

When visited, there were three granite quarries, two black and one red, operating in the Lake St. John region, all of which were producing stock for monumental and building purposes. The black granite quarry, in the St. Gédéon district, and the red granite quarry located on the Ile d'Alma, are operated by National Granite Limited in conjunction with its finishing plant near St. Gédéon and its sawing plant near St. Joseph d'Alma. The other quarry is in the Peribonca river district and is operated by Cie des Carrières Moreau Enrg., with dressing plant at Hebertville Station. Annual production is around 100,000 cubic feet of dimension stone. When visited (June, 1952), no quarries or dressing plants were operating in the Roberval or Chicoutimi districts.

8. ROBERVAL DISTRICT

In this district which centres about 2 miles northwest of Roberval, in Roberval township, Roberval county, three quarries have been opened in granite of the Roberval series. The district is served by the Dolbeau branch

of the Canadian National Railways from Chambord. By rail it is 188 miles from Quebec city and 279 miles from Montreal. By paved highway it is some 200 miles from Quebec city and 370 from Montreal.

The stone was used locally for public buildings and monuments, and some was shipped to Montreal and Quebec city (13). Most of the stone was dressed and finished in cutting sheds at Roberval operated in conjunction with the quarries. No granite quarrying has taken place in this district for a number of years and the dressing sheds have long since been dismantled.

The granite is coarse grained and has a porphyritic appearance, the latter due to the relatively large feldspar crystals. The predominant feldspar is microcline, but albite is also found. Quartz is present in variable amount, and biotite and hornblende are also visible in hand specimens. The colour varies in different deposits from a bluish rose to a deep pink, the blue colour being mostly due to the colour of the quartz while the red or pink tint comes from the feldspar. The stone takes a high polish, but exhibits minute hair-line cracks both through the crystals and between them. The contrast between polished and other surfaces varies from very good to excellent. The stone shows to better advantage when used in massive structures rather than in small blocks. Gneissic structure is visible in places and the whole shows a marked foliation or alignment of the constituent minerals.

From an examination of the quarries, it is seen that the rift is horizontal and grain vertical, and occasional aplite or pegmatite dykes occur cutting the granite. The jointing and sheeting, and the direction and dip of the foliation vary with each quarry; the joints may be numerous, well developed, or widely spaced, and the sheets may be poorly developed or well-defined, and may be horizontal or sloping at 20 degrees to the southeast.

The largest quarry operated in the district was that known as the Bernier quarry which opened about 1908 and operated until the thirties. According to Osborne (13), two distinct varieties of granite were quarried, a bluish or bluish-rose variety in the northern part and a rose or pink variety in the southern part of the quarry. Both varieties are coarse grained and consist of large crystals of microcline set in a ground mass of quartz, albite, hornblende and biotite. Sheeting, although well developed, varies in thickness and dip, but, on the whole is fairly massive, thicknesses of 5, 8 and 11 feet being measured. The general dip is about 20 degrees to the southeast. The most pronounced set of joints is vertical and spaced at wide intervals so that large blocks can be obtained.

The granite from the Bernier quarry was used locally for monumental and building purposes, and some monumental stone was shipped to Montreal and Quebec. Buildings constructed from this stone include the courthouse and church at Chambord and the church at St. Prime. Other buildings constructed wholly or in part are the church and city hall at Roberval and the railway station at Jonquière (13).

Plate 10

BLACK GRANITE
National Granite Limited quarry
St. Gédéon District, Lake St. John Region, Quebec.

9. ST. GÉDÉON DISTRICT

This district, situated on the southeast side of Lake St. John, is served by good rail and road communications. By rail St. Gédéon Station is 191 miles from Quebec city, and 282 miles from Montreal. By paved highway the area is approximately 170 miles from Quebec and 340 miles from Montreal. It comprises some 70 square miles and takes in the township of Signay and part of Labarre township, extending from Hebertville on the south to the south branch of the Saguenay river on the north, and as far east as St. Bruno. The district is underlain by anorthosites and consists essentially of a comparatively flat low-lying plain, part of the Lake St. John lowland, through which a number of low ridges or hills rise to elevations of from 10 to 100 feet above the general level. These exposures of anorthosite furnish the sites for several quarries, the largest of which is that of National Granite Limited, with head office at St. Joseph d'Alma. This quarry, which was originally opened in 1930 for monumental stone, is about 5½ miles by road north of St. Gédéon Station, in Signay township. It has a length of 580 feet, a width of 250 feet, and the face at the highest point is 35 feet. It has been worked to a depth of 35 feet, where it has a length of 175 feet and a width of 80 feet.

The stone from this quarry is a brownish to purplish-black anorthosite usually of very coarse grain which is known to the trade as 'Peerless Black'. The mixture is uneven, large masses of the rock being composed of various-sized crystals of plagioclase feldspar, whereas in others segregations of ilmenite or magnetite fill the spaces between the feldspar grains giving the polished surface a noticeable mottling. The feldspar is transparent to translucent, of a smoky brownish-black colour due, according to Osborne (13), largely to minute inclusions of ilmenite. The feldspar is crazed with minute hair-line cracks. Occasional crystals of light to dark green pyroxene impart a slight greenish cast to some of the rock. This was noticed on several polished surfaces of the finer grained anorthosite which was marketed as 'Quebec Black'.

It is comparatively free from sulphides so that staining on exposure is infrequent, and it stands up well on weathering. Occasionally blind seams of a white material cut through the deposit and these show up only on polishing, so that great care has to be taken in selecting only blocks free from such blemishes. The stone takes an extremely high polish and there is good contrast between polished surfaces and sandblasted or chiselled surfaces. Polished monuments have a pleasing appearance and great 'depth' and richness. The excessive fracturing renders the stone very brittle, so that for decorative use it would be necessary to cut thicker slabs than is usual, in order to avoid excessive loss in manufacture. Due to its brittleness and to the large grain size, more difficulty is experienced in working this stone than the finer grained Canadian granites.

Quarrying in the anorthosite is rather a difficult operation. There are a few fractures which persist to depth, but sheeting is not developed and the horizontal breaks depend upon the presence of irregular horizontal fractures or more commonly upon beds, spaced from 10 to 15 feet apart, that are developed by drilling and blasting. The rift is approximately horizontal, but poorly developed, and the rock is hard to split into rectangular blocks with smooth faces, on account of the coarseness of the crystal grains. For this reason, the near absence of joints, and the brittleness of the feldspar, the best results with quarrying are obtained when channelling machines are employed. Channelling prevents shattering and assures the mining of blocks of the desired size and shape with the least amount of waste. Large blocks can be readily obtained at this quarry. Some veins and hair-line fractures are found in the stone, but these are sorted out and discarded at the quarry.

In addition to the above quarry, a dozen or more small operations have been carried on in similar exposures in the district. The rock is essentially the same, with slight variations in texture and colour. Some of these 'motions' have been for the distinct purpose of obtaining road metal and concrete aggregate, others have supplied small quantities of dimension stone for the monumental and building trades, but none has operated continuously, all being worked only when there was a demand for their product. None is operating at present. Probably the chief cause of the failure of most of these quarries opened for dimension stone was a lack of knowledge in quarrying methods as they were operated by individuals with little or no previous experience in the granite business. The occurrence of quartz veins in the stone was another important factor.

Hydroelectric power is available in this district and is employed to operate the compressor and dressing plant machinery. The derricks have gasoline-powered hoists.

This district has become an important source of black granite for building and monumental purposes. The granite is widely used for ornamentation and base courses in buildings throughout Canada and in many cities of the United States. Among the outstanding buildings faced with this granite during the past few years are the Imperial Bank of Canada building, Victoria, B.C., the Telephone Building, Chicoutimi, Que., Postal Station "B", Montreal, Que., and Postal Station "Q", Toronto, Ontario. At present about one-third of the stone produced is used for monumental and two-thirds for building purposes. Most of the monumental stock and about two-thirds of the building stock is shipped from the district in the form of rough undressed stone.

10. ILE d'ALMA DISTRICT

On the island formed by the two outlets of the Saguenay river from Lake St. John is an occurrence of fine to coarse grained red granite. It covers a relatively small area and is probably related in age to the large body of coarse red granite which was quarried for many years in the Roberval District. Several quarries have been opened in this granite near St. Joseph d'Alma. The largest of these and the only one operating at present, that of National Granite Limited, is about 5 miles northwest of St. Joseph d'Alma.

The quarry is connected by road to St. Joseph d'Alma on highway No. 55 and the Isle Maligne branch line of the railway from Saguenay Power. The distances by road and rail from Montreal and Quebec are approximately the same as those given for the St. Gédéon district immediately to the south.

At the operating quarry, which was first opened in 1938, the stone is a medium grained hornblende granite consisting essentially of pink feldspar, quartz, hornblende and biotite. The stone is a deep pink in colour and has a slightly gneissic structure similar to that from Roberval, although not as pronounced. It take a high polish and has an attractive appearance both on polished and rough surfaces. It is known to the trade as 'Saguenay Red'.

The quarry, of the side-hill type, has an overall length of 300 feet, a width of 150 feet, with a face 30 feet high. The sheets are well developed, average from 4 to 6 feet in thickness, and slope to the west at 10 degrees. The rift is parallel to the sheeting and extremely well developed so that large

Figure 20

Splitting granite by means of 'plug and feather' at National Granite Limited red granite quarry, Ile d'Alma District, Que.

granite blocks can be broken down into building blocks with ease. The joints are spaced sufficiently far apart that large blocks can be quarried, but are close enough for easy breaking. The main set strikes approximately north-south and dips at 80 degrees to the east, with the spacing ranging from 5 to 30 feet. One or two joints, also dipping at 80 degrees, were noticed cutting the main joints at right angles. The grain varies slightly in the quarry, but the colour is uniform, and blemishes, such as white or black spots and streaks, are rare. As a result, the granite is fairly easy to quarry and work, and it is not necessary to employ channelling machines as at the other quarries operating in the Lake St. John region, drilling and blasting being sufficient at this quarry.

As at the St. Gédéon quarry, the compressors here are powered by electric motors and the derrick by a gasoline-operated hoist.

Although there is little contrast between polished and sandblasted surfaces, the stone is quite popular for monuments. It also makes an attractive building stone and many small buildings in the Lake St. John area have been constructed from this granite. Because of the ease with which it can be quarried this granite should continue to be a popular stone for building purposes. A considerable amount of the stone, which would ordinarily be classed as waste, is broken down at the quarry and sold to contractors for use in the foundations of private houses. At present, approximately 70 per cent of the granite from this quarry is used for monumental purposes, the remainder for building. All the monumental stock is shipped as rough undressed stone, while most of the building stock is shipped from the area in the dressed form. A large percentage of production is exported to the United States.

Among the outstanding buildings faced in whole or in part with this granite are the Hail Insurance Building, Calgary, Alta., the Westmount Theatre, Montreal, Que., Simard Drug Store, Quebec, Que., and the Newfoundland Hotel, St. John's, Nfld.

Since the writer's visit to the area in September 1952, National Granite Limited has reopened a large quarry beside its sawing plant half a mile west of St. Joseph d'Alma. The stone is a fine grained grey granite with a pinkish tinge; it works well, is used solely for building purposes, and is known to the trade as 'River Bend Grey'.

11. PERIBONCA RIVER DISTRICT

Operations were commenced in this district in October 1948 when Cie des Carrières Moreau, Enrg., with office and dressing plant at Hebertville Station, opened a quarry in 'black granite' about 8 miles north of L'Ascension, in Garnier township, Lake St. John county. The quarry is 10 miles northeast of Lake St. John on the south bank of the Peribonca river, the

largest of several rivers which enter the lake. It is of the side-hill type and is operated by Polycarpe Moreau, who, in the past 30 years or more, has opened many quarries in the Lake St. John region for monumental stone.

The quarry is in the same body of anorthosite which underlies the St. Gédéon district about 15 miles to the south and is the largest body of anorthosite in the region. The stone is brownish to purplish-black and of coarse grain, similar to that which is quarried at St. Gédéon, and is marketed as 'Peribonka' black granite. The description already given of the stone from the St. Gédéon district holds equally well for that from the Peribonca quarry. An examination of the grout pile disclosed the presence of some hair-line cracks and white quartz veins in the stone, but both appear to be relatively scarce.

At the quarry the sheets slope gently to the south, paralleling the contour of the surface, and range from 6 to 8 feet in thickness. The most prominent joints are vertical and spaced from 20 to 35 feet apart. Other joints, at right angles to this main set, are also vertical and spaced 40 feet apart. The quarrying methods employed are machine drilling and blasting, and channelling. Compressed air to operate the drills and channelling machine is supplied by one portable diesel-powered compressor. The derrick is operated by a gasoline-powered hoist.

The quarry is 31 miles by road north of the dressing plant and railway at Hebertville Station; approximately two-thirds of the haul is over paved highway No. 55, and the remainder over well-kept gravel road. By rail, Hebertville Station is 198 miles from Quebec city and 289 miles from Montreal; by paved highway, it is approximately 170 miles from Quebec and 340 miles from Montreal. Hebertville Station is 7 miles east of St. Gédéon.

The stone is used for both monumental and building purposes, approximately 40 per cent being used for monuments and 60 per cent for building at present. The greater part of both monumental and building stock is shipped from the area in the form of rough undressed blocks. It is the usual practice to saw the stone into slabs for monumental dies in such a manner that the faces will be at right angles to the rift and grain. As a result, on polished surfaces the grains appear smaller and more evenly distributed, the colour slightly darker, and the mottling more uniform than if the faces were parallel to the rift or grain.

The stone is very popular as a monumental stone throughout Canada and is also becoming quite popular for monuments in the United States. A number of monuments manufactured from this granite were seen at one Ottawa memorial plant. The stone takes an excellent polish and the monuments have a very attractive appearance. Among the numerous structures in which this stone has been employed are the St. Catherine Street branch of the Canadian National Bank in Montreal, and the War Memorials erected at Desbiens, Quebec, and at Edmundston, New Brunswick.

12. CHICOUTIMI DISTRICT

This district, in Chicoutimi county, comprises some 250 square miles and extends from Jonquière on the west to Ha! Ha! bay on the east. By rail the city of Chicoutimi is 227 miles from Quebec city and 318 miles from Montreal; by highway the distances are 130 and 300 miles respectively.

Osborne (13) describes 24 quarries which have been opened in the igneous rocks of the area; three were opened in dark-purple anorthosite, three in Grenville gneisses, ten in rose coloured granite and syenite gneisses of Laurentian age, five in grey and rose granite and syenite belonging to the Roberval series, and three in green pyroxene granulite. Five of these quarries were opened for dimension stone for building or monumental purposes—two each in the Roberval and Laurentian formations, and one in pyroxene granulite. The remainder of the quarries were opened by local municipalities and contractors as a cheap source of crushed rock for concrete aggregate and road metal, as well as for rough building construction, and filling for wharfs and piers. These openings, operated only as occasion demanded, have, in the aggregate, supplied a large tonnage of stone.

The most important quarry to operate in the district, the Delwaide and Goffin quarry, is located on the south bank of the Saguenay river about 2 miles northeast of Chicoutimi. It is divided into two sections, the main or large quarry which was operated by Riverin and Riverin, of Chicoutimi, for building and construction stone, and the smaller quarry, to the south, operated by Delwaide and Goffin for monumental stone.

The stone at this quarry, according to Osborne (13), is a medium grained green pyroxene syenite (granulite) containing only a small amount of quartz. The texture varies in different parts of the quarry, being considerably coarser in the northeast end of the quarry than in the southwest corner. The stone fills well on polishing and takes a good lustre and there is splendid contrast between the several types of finishes, as is well illustrated in the city hall of Chicoutimi, built of this stone. The stone was also used in the hospital at Chicoutimi, and many monuments of the stone were erected in the local cemetery and were also shipped to Quebec city.

The stone is cut by numerous closely spaced joint planes (from 1 to 5 feet apart) and these, together with a number of pegmatite dykes and stringers make it difficult to obtain stone of monumental grade. Blind seams, many of which do not show until the stone is polished, have to be watched for carefully. The rift is approximately vertical, and not well developed due to the small amount of quartz present.

Not included with the above mentioned quarries are two small quarries opened in Simard township about 5 miles northwest of Chicoutimi and 3 miles west of Ste. Anne. These quarries, the most recent to operate in the area, were worked intermittently by two Quebec city memorial firms, H. LaForce et Fils, and Delwaide and Goffin; neither quarry has operated in recent years. The stone is a coarse grained purplish brown syenite belonging

to the Roberval series. Osborne mentions (13) that both the syenite and the granite of the Roberval series found in the district are characterized by a pink or mauve tinted microcline, with subordinate plagioclase feldspar; the syenite has a pleasing appearance, in deep rose to mauve or brown tones, and should be very suitable as a monumental or building stone. National Granite Limited has recently purchased one of these quarries and, during the latter part of 1952 (since the writer's visit), extracted 8,000 cubic feet of dimension stone, 2,500 cubic feet of which have been used in the Jonquière hospital. The stone has an attractive appearance, takes a high polish, and, according to the company, is very similar to the black anorthosite both in quarrying and cutting, in contrast to the Roberval granite which is the hardest sawing and cutting granite they have encountered to date.

SOUTH OF ST. LAWRENCE RIVER

13. MONTEREGIAN HILLS

The Monteregian hills are a series of isolated hills running from Montreal in the west to Waterloo, about 50 miles to the east. They rise abruptly through the drift-covered Palæozoic plain, which lies between the Laurentian highlands on the northwest and the Appalachian uplift on the southeast, to form very distinctive landmarks in that part of the province.

The hills, eight in number, are Mount Royal, St. Bruno, Beloeil, Rougemont, Yamaska and Shefford mountains, Mount Johnson, and Brome Mountain. The first six form a line running approximately east and west, Mount Royal being the most westerly and Shefford mountain the most easterly, while Mount Johnson and Brome Mountain form a parallel line several miles to the south. Their heights above sea-level range from 715 feet in the case of St. Bruno, to 1,755 feet for Brome Mountain. Brome Mountain is also the largest member of the group, having an area of 30 square miles, while Mount Johnson, the smallest, has an area of less than half a square mile.

According to Adams (2), "The Monteregian Hills are a series of ancient plutonic intrusions. Some of them (e.g. Brome Mountain) are apparently denuded laccoliths, one of them (Mount Johnson) is a typical neck or pipe, and it is probable that some, if not all, of them, represent the substructures of volcanoes which at one time were in active eruption in this region". He considers them to be of late Devonian or early Carboniferous age.

Adams states (2) that the rocks of the Monteregian hills are "characterized by a high content of alkali and in the main intrusion of almost every mountain two distinct types are found associated with one another, representing the products of the differentiation of the original magma"—nepheline syenite and essexite. The nepheline syenite in some cases is replaced by or

associated with pulaskite (a variety of syenite) and other rocks, while the essexite may be represented by yamaskite (a very basic rock), etc. On the whole, the rocks are medium to coarse grained and range from medium-grey to dark-grey, being slightly darker than the ordinary grey granite.

Although Mount Johnson is the only hill on which a quarry is operating at present, Burton (4) states that quarrying has been carried on in the past on Mount Royal, Yamaska, Shefford and Brome mountains. These quarries, none of which were very extensive, operated around the turn of the century and produced stone mainly for local building construction or railway bridge abutments, while in one case a small amount was used for monumental purposes.

Mount Johnson.—Mount Johnson is in the parish of St. Gregoire, Iberville county, 6 miles northeast of the town of Iberville, and 22 miles in a direct line eastsoutheast of Montreal. Iberville is served by the Canadian National, Canadian Pacific and Central Vermont railways.

Mount Johnson rises sharply to a height of 875 feet above sea-level, about 700 feet above the surrounding plain, and forms a very striking feature in the landscape. The granitic rock of which the hill is composed is elliptical shaped at the base, measuring 3,500 by 2,500 feet.

In Burton's (4) words, Adams (2) has shown Mount Johnson to be the "erosion remnant of a volcanic neck or pipe which has intruded the flat-lying sediments . . ., altering them at the contact to a fine-grained, dark hornstone. The igneous core is made up of four more or less distinct types of rock, together with associated dykes and pegmatite. . . ." Burton continues, "The four types of igneous rock occur in somewhat concentric bands. The other one is a coarse-grained pulaskite (a variety of syenite), white to light-buff in colour, which grades into a transition zone of darker coloured stone, with large porphyritic feldspars. This in turn passes into a normal coarse grained essexite, and the latter to a fine grained essexite, richer in pyroxene and biotite and containing a little olivine, which forms the innermost zone."

Quarrying operations have been confined to the essexite, and although three varieties, coarse, medium, and fine grained, have been quarried here in the past, the only product for the last 20 or more years has been the medium grained essexite which is known to the trade as 'Ebony'. The coarse-grained variety formerly quarried was quite similar in colour and composition to the 'Ebony', and was marketed as 'Canadian Quincy'.

The 'Ebony' granite is dark grey and has a fairly uniform texture. It is composed essentially of plagioclase, nepheline, orthoclase, hornblende, pyroxene, biotite, and magnetite; the feldspars, according to Burton, account for about 80 per cent of the stone by volume.

The first quarrying was done on Mount Johnson over 50 years ago. When Parks visited the area in 1911 (15), two quarries were operating, one located on the southeast side of the mountain and the other on the north-

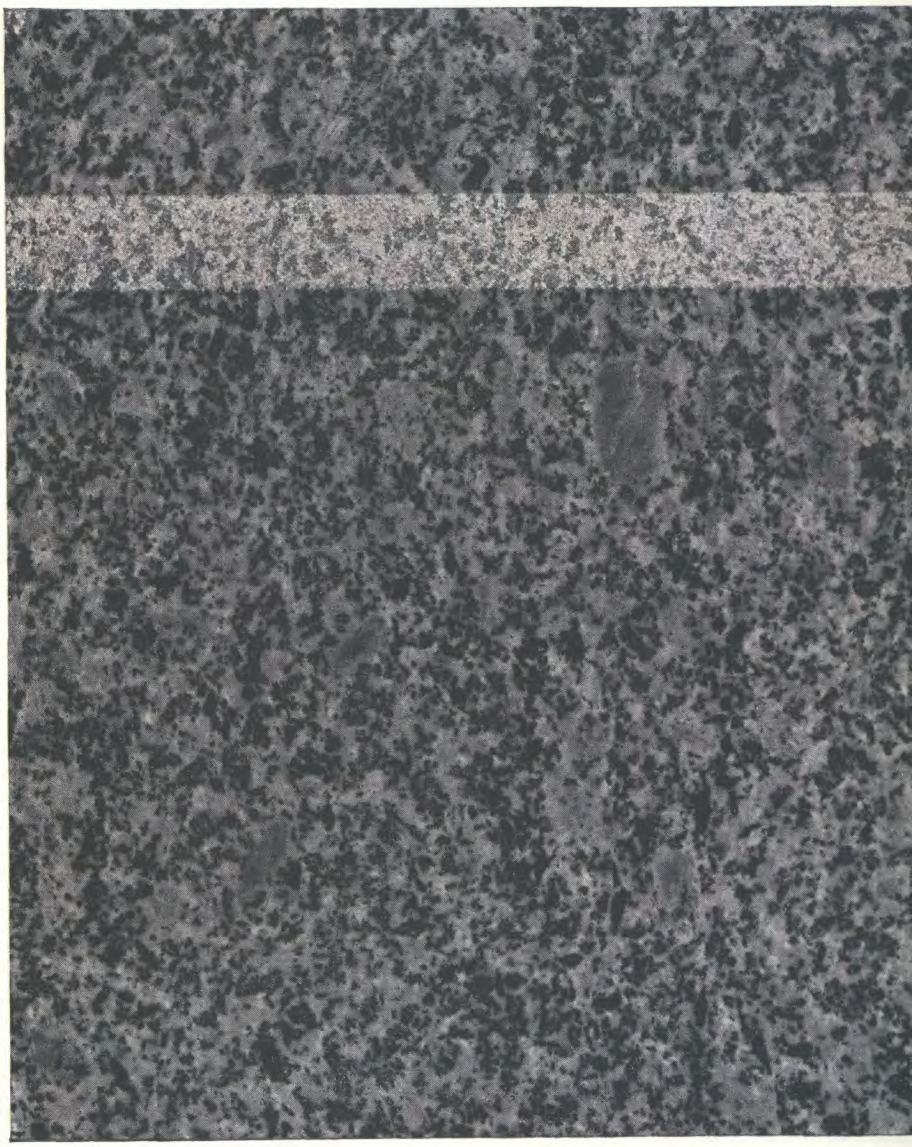


Plate 11

DARK GREY GRANITE
Brodie's Limited quarry
Mount Johnson, Quebec.

west side. Parks mentions that the stone was practically free from black knots at these quarries, but, due to the presence of fine white lines in the stone, and to excessive jointing, approximately 70 to 75 per cent of the stone was discarded as unsuitable for monumental stock.

At the time of Burton's examination in 1931, the only quarry in operation was that of Brodie's Limited, situated on the southern side of the mountain. This quarry operated more or less continuously from that date until late in 1951, when it was decided to open a new quarry several hundred feet to the west where the joints were more suitably spaced for quarrying. It is stated that the stone is slightly finer grained and of higher quality at the new location.

The new quarry is approximately 90 feet in length, 50 feet wide, with a 10-foot face. The sheets dip to the south at 18 degrees and average about 4 feet in width, with one sheet having a width of 8 feet. As revealed by quarrying to date, the joints are spaced sufficiently far apart to permit the quarrying of large blocks. The main joints are vertical with a north-south strike and are spaced over 20 feet apart. Only one joint was noticed at right angles to this set; it sloped to the north at approximately 45 degrees. The rift is poorly developed, strikes east-west, and is vertical, while the grain is vertical with a north-south strike, and the hardway horizontal. The average size of block being produced at this quarry measures 4 x 3 x 8 feet.

Quarries are perched on the side of the mountain, the stone requires channelling, and there is a large amount of waste due to the concentration of the feldspar into white lines and streaks in certain areas of some of the sheets. None of these white lines and streaks were noticed at the new quarry, but it is probable that they will be encountered here as alsewhere. The site offers easy disposal of waste over the side of the mountain.

The quarry face is parallel to the rift and is being advanced in a northerly direction. A free face is obtained by channelling, and succeeding blocks are quarried by channelling along the rift, then breaking the stone along the grain by 2 or 3 Lewis holes loaded with black powder. The writer noted such a break, 28 feet in length, in an 8-foot sheet, obtained by drilling 3 closely spaced holes along the grain to within 18 inches of the bottom of the sheet, and then blasting with black powder.

Hydro-electric power is not available at the quarry. Compressed air to operate the drilling equipment and the derrick hoists is supplied by one diesel-powered compressor.

This granite is one of the finest monumental stones in the country, and it is employed almost entirely for monumental purposes, although occasionally material for base trim of buildings is quarried. The granite takes an excellent polish and fills well, and there is a marked contrast between hammered and polished surfaces so that lettering and carving stand out well.

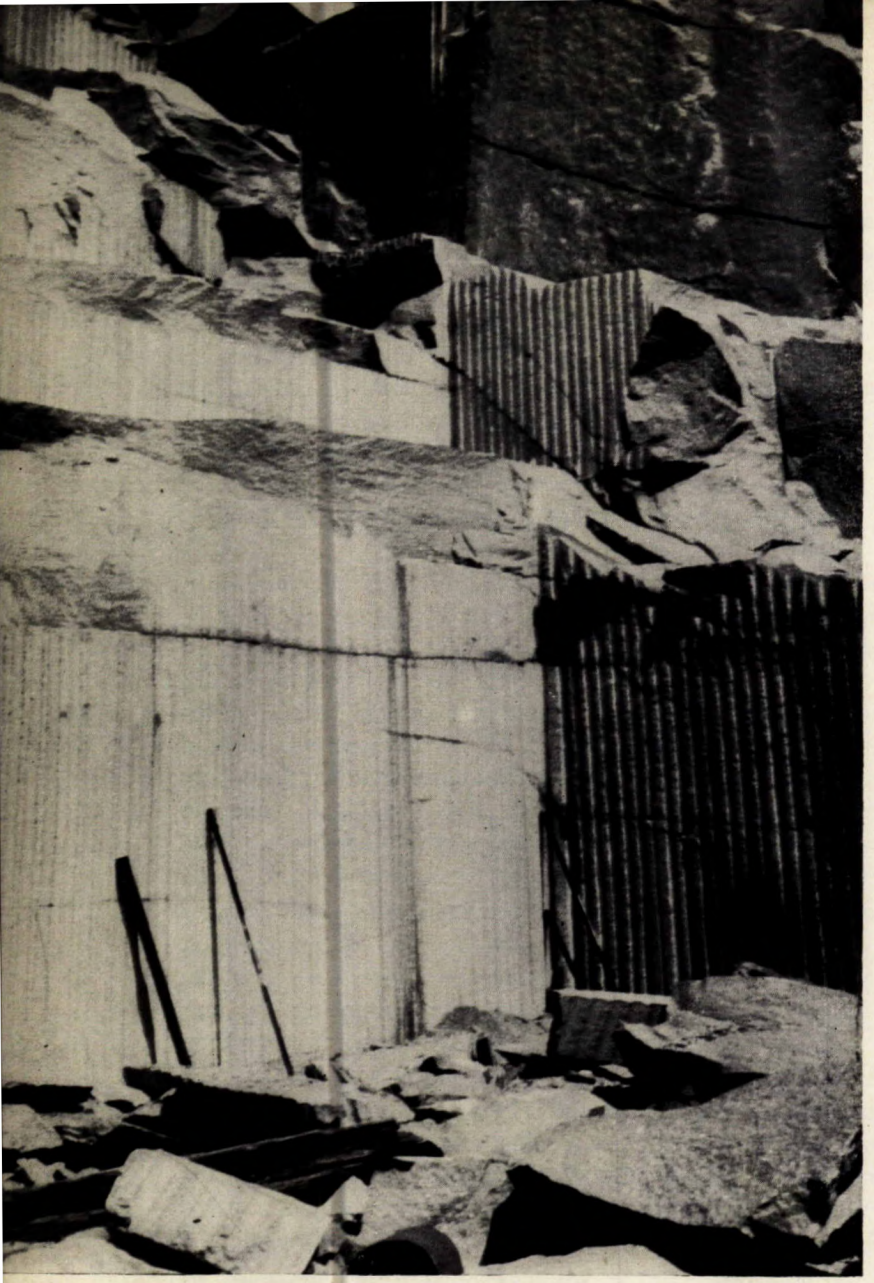


Figure 21 | *Brodie's Limited quarry, Mount Johnson, Que., showing channelled faces.*

For a more complete description of the geology of the Monteregian hills and their possibilities for supplying building and monumental stone, the reader is referred to the following reports:

The Monteregian Hills, by F. D. Adams; Geol. Surv., Canada, Guide Book No. 3 (1913), pp. 29-80.

Commercial Granites of Quebec, Part I, South of the St. Lawrence River, by F. R. Burton; Que. Bur. Mines, Ann. Rept. 1931, pt. E.

Report on the Geology and Petrography of Shefford Mountain, Quebec, by J. A. Dresser; Geol. Surv., Canada, Ann Rept. (New Series) Vol. XIII, pt. L. (1900).

Report on the Geology of Brome Mountain, Quebec, by J. A. Dresser; Geol. Surv., Canada, Ann. Rept. (New Series) Vol. XVI, pt. G. (1904).

The Geology and Petrography of Mount Yamaska, Province of Quebec, by G. A. Young; Geol. Surv., Canada, Ann. Rept. (New Series) Vol. XVI, pt. H (1904).

St. Hilaire (Beloeil) and Rougemont Mountains, Quebec, by J. J. O'Neill; Geol. Surv., Canada, Mem. 43 (1914).

Figure 22 | *Brodie's Limited dressing plant, Iberville, Que.*

14. STANSTEAD DISTRICT

This is one of the most important granite producing areas in Canada, and one of the first to become prominent in the granite industry of the country. Centred about the small town of Beebe, the district is served by the main line of the Quebec Central Railway running from Newport, Vermont, to Sherbrooke, Quebec, where connection can be made with either the Canadian National or Canadian Pacific railways. By rail, Beebe is 181 miles from Quebec city and 133 miles from Montreal. Good paved highways pass within a few miles of the area and much of the production is now shipped by road, Beebe being about 100 miles by road from Montreal.

Quarrying has been carried on in this district continuously for over 80 years, the first appreciable production being made, according to Burton (4), by Jonathan Haselton who came to the province from Massachusetts at about the end of the American Civil War. As Ells remarked (7), attention was first called to the suitability of this stone for building by officers of the Geological Survey in 1847-48 (9) and again in 1863 (10).

The Stanstead intrusive, in which all the quarries in the Stanstead district are located, lies on the east side of Lake Memphremagog near the International border. The granite covers an area of about 6 square miles in the township and county of Stanstead, having a length (east-west) of 3 miles and a width of 2 miles. It is one of several such grey granite masses of Devonian or earlier age which are found intruding the Ordovician sediments of the Eastern Townships (6). The extent of these outcrop areas is relatively small but most are located where they are surrounded by good roads and railways and by fairly heavily populated areas. Consequently, although very small in total area, they met the general conditions for early development.

The stone may be described as (4) "a biotite-muscovite granite of medium to coarse texture, with colour ranging from light grey, almost white, to fairly dark grey, and, rarely, quite dark", the variation in colour being due to the distribution and quantity of dark minerals present. It is composed of a uniform mixture of white orthoclase, plagioclase, quartz, biotite, muscovite, and the occasional accessory mineral such as zircon and garnet.

The stone is marred by the occasional presence of small black knots, pyrite, white streaks and knots, and dark biotite streaks. Pyrite is the most serious of these defects as it weathers and causes iron stains; it is found in certain quarries, but the stone for the most part is free from this impurity. In referring to the defects which may occur in the Stanstead granite, Burton (4), who examined some forty quarries in the area, states that the stone in the vicinity of Graniteville "is inclined to be rather higher in 'iron' and small black knots, but comparatively free from dark streaks, whereas that to the east of House Hill is finer grained, lighter in colour, and rather free from iron, but with numerous dark streaks".

Figure 23 | *Surfacing machine and large block of granite being surfaced. Stanstead Granite Quarries Company, Limited, dressing plant, Beebe, Que.*

Figure 24

Stanstead Granite Quarries Company, Limited. Circular saw in dressing plant at Beebe, Que.

The stone polishes well but there is little difference in the colour between the polished and hammered surfaces so that it finds its best application in bush hammer work. It is rather light to make attractive monumental dies, and is therefore mostly used for building purposes and monumental bases; however many important memorials have been constructed from this granite, some of which are listed herein.

During the many years quarrying has been maintained, numerous changes have occurred in the number of operating companies, some locations being operated almost continuously and others only intermittently. When Parks (15) visited the district in 1911, there were eight companies engaged in the granite industry of the area, employing a total of approximately 185 men. About half of these were employed by the Stanstead Granite Quarries Company, Limited, which has operated in the area since 1899, and which today, at Beebe, operates one of the largest granite finishing plants in the country. Parks mentions that a total of around 95,000 cubic feet of building and monumental stone and nearly 2,000,000 paving blocks were produced annually from this district at the time of his examination.

In 1930, fourteen quarries were in operation (5), whereas in the following year this number had increased to thirty-five (4) as a result of the larger companies curtailing operations and many of their former employees opening up small quarries or "motions" of their own to produce curbstone. Production from the area in 1930 was approximately 300,000 cubic feet of building and monumental stone, 250,000 paving blocks and 250,000 linear feet of curbing. The principal operators at that time, as at present, were the Stanstead Granite Quarries Company, Limited and Brodie's Limited.

When visited in June, 1952, there were seven granite companies active in the area, operating a total of six dressing plants and four quarries. Present annual output is around 80,000 cubic feet of dimension stone which is used for building and monumental purposes. In addition, some paving blocks are still produced by one company.

One of the basic reasons for the popularity of the Stanstead granite is the relative ease with which the stone can be quarried and worked. In most places the sheets are reasonably thick and the jointing is well-defined and spaced so that quarrying is relatively easy. The rift is usually horizontal or gently sloping more or less paralleling the flat-lying sheets, the grain is vertical, and both are strongly developed. The stone is remarkably uniform in distribution of its minerals, with consequent minimum wastage.

The largest of the operating quarries, and one of the largest in the country, is that operated by Brodie's Limited. It was originally opened in 1898 and has been operated by the present owners since 1929. The other three quarries were opened about 30 years ago. All four were originally of the side-hill type but are now being worked below the surface at depths

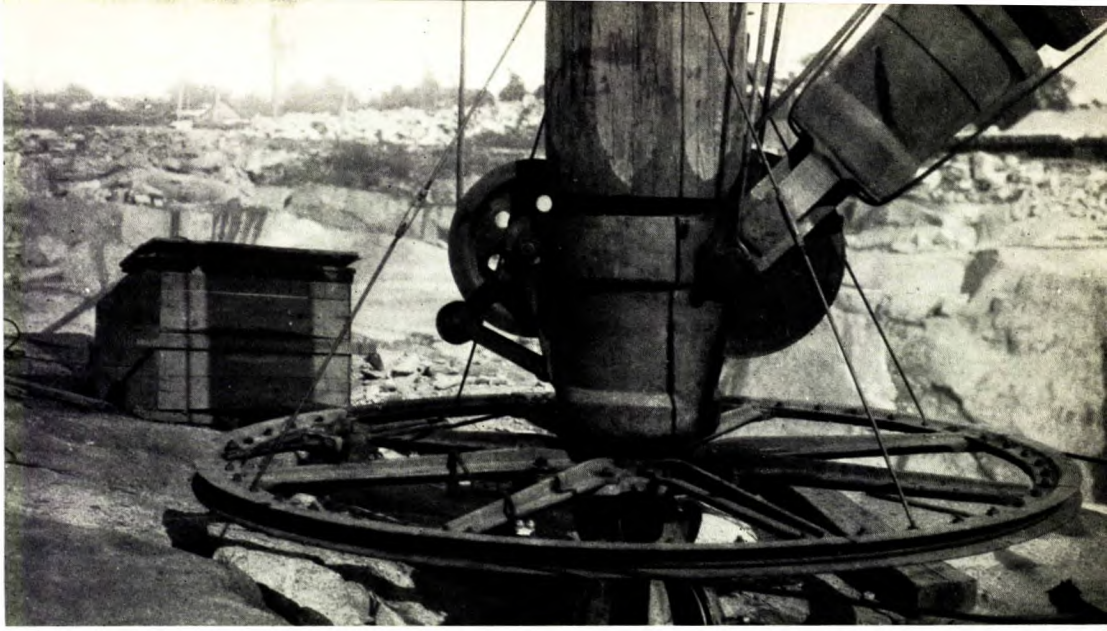


Figure 25 | *Details at base of large derrick, Brodie's Limited quarry, Graniteville, Quebec.*

ranging from 20 to over 100 feet. The sheets dip at angles ranging from 10 to 20 degrees, and those being worked at present are quite massive, having widths ranging from 6 feet at one quarry to over 30 feet at another. As a result, it is sometimes necessary to develop artificial bedding planes by drilling horizontal holes along the rift and blasting with black powder. The joints are widely spaced so that large blocks suitable for massive building construction and large monumental work can easily be obtained. Three of the quarries are equipped with channelling machines.

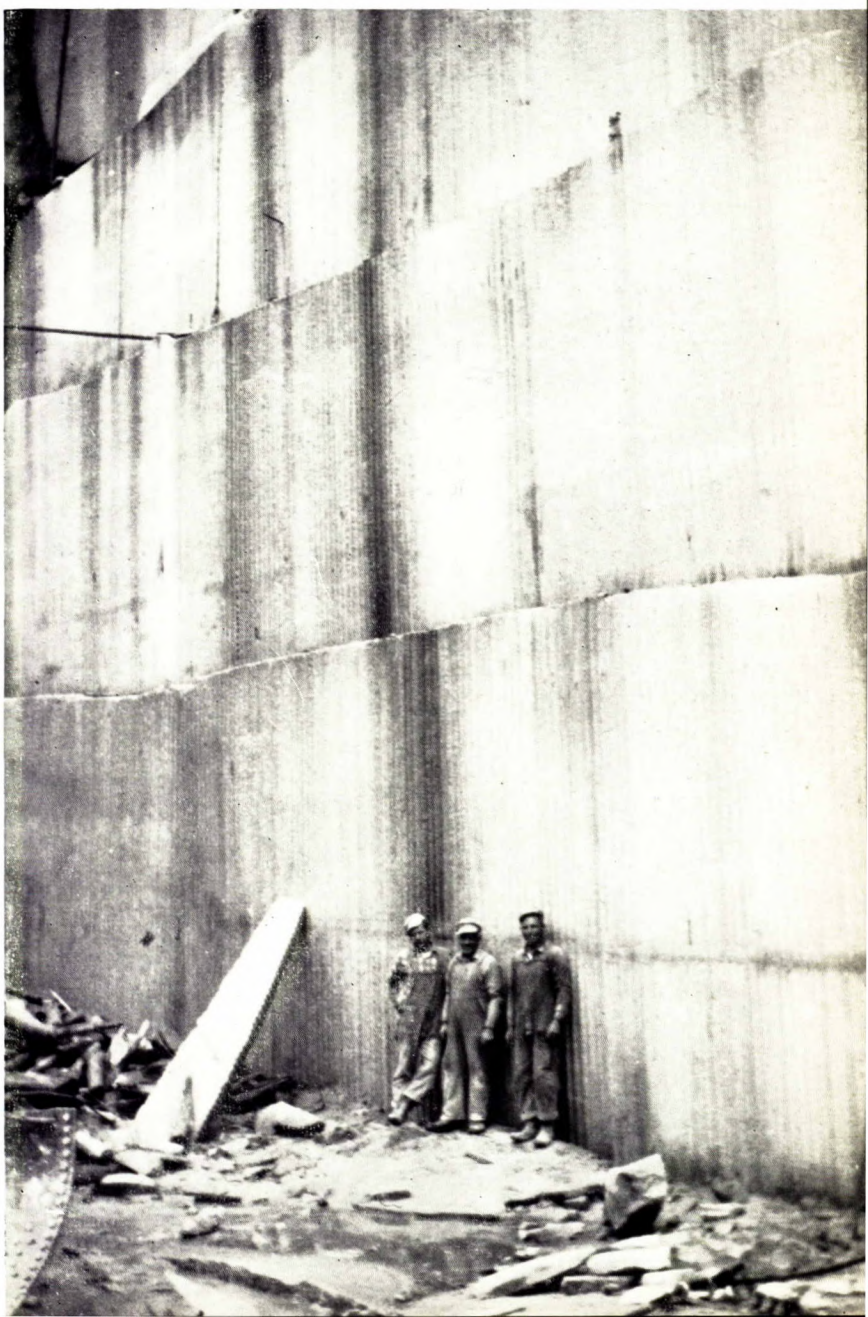
Most of the derricks and practically all of the compressors at the quarries are electrically operated, power being purchased from Southern Canada Power Company Limited; the others are operated by diesel, steam, or gasoline-powered equipment.

Three main types of granite are being quarried at present. The first and best known type is the 'Stanstead Grey' which is produced at Graniteville by Brodie's Limited, and which also occurs in the nearby inactive quarry of Stanstead Granite Quarries Company, Limited. The stone is light grey in colour, medium to coarse grained, and when polished is rather light in colour, but a hammered face is very attractive.

The second type is being produced by Haselton Granite Quarries at its quarry (formerly the Lacasse and Boulais quarry) situated southeast of House hill and about half a mile north of Beebe. This is a very light grey (almost white) stone of medium grain which would correspond with the 'Stanstead Light' or 'Lacasse White' varieties mentioned by Burton (4). It is not used as polished stone owing to its light colour, but makes a very fine hammered stone. It is used for both building and monumental purposes, and would be excellent for ashlar as it splits very easily in all three directions.

Figure 26 | *Brodie's Limited quarry at Graniteville, Que., showing granite benches and channelled face in background.*

Figure 27 | *Brodie's Limited quarry, Graniteville, Que., showing channelled faces.*



The third type is produced at the quarries of Adru Granite Inc. and R. L. Cloutier situated east of House hill and a mile northwest of Beebe. The stone is very like the 'Stanstead Grey', but may be slightly lighter in colour. That produced at the R. L. Cloutier quarry would correspond with the 'House Hill' and 'Cloutier Brothers' types mentioned by Burton (4). That from the Adru Granite quarry (formerly the Frank Wilkinson quarry) is known as 'Stanstead (Adru)' and corresponds with 'Stanstead Grey' except it is slightly lighter in colour and practically free from iron spots.

The Stanstead granite has gone into the construction of many important buildings throughout Canada from Halifax to as far west as Calgary. It has been widely used in all types of monuments, such as private memorials, war memorials, memorials to famous people, and many large mausoleums. It has also been used in dry dock and bridge construction, and in the past, large quantities of both paving blocks and curbing were shipped from this district. Among the many structures in which Stanstead granite has been utilized in part or completely, may be mentioned the following:

Sun Life Assurance Building, Montreal, Que.
Notre Dame Hospital, Montreal, Que.
Architects Building, Montreal, Que.
Cenotaph, Montreal, Que.
St. Vincent de Paul Hospital, Sherbrooke, Que.
Bishop Lafleche Monument, Trois Rivières, Que.
Supreme Court Building, Ottawa, Ont.
Chateau Laurier, Ottawa, Ont.
Bell Telephone Building, Ottawa, Ont.
Bank of Montreal, Main Branch, Ottawa, Ont.
Royal York Hotel, Toronto, Ont.
Federal Life Insurance Building, Hamilton, Ont.
Buffalo-Fort Erie Bridge.
Dry Dock, Saint John, N.B.
Nova Scotian Hotel, Halifax, N.S.
Canadian Bank of Commerce Building, Winnipeg, Man.
Bessborough Hotel, Saskatoon, Sask.
Bank of Montreal Building, Calgary, Alta.

A brief mention of the Sun Life Assurance Building in Montreal may be of interest as the entire exterior of this building is of Stanstead grey granite. Over 500,000 cubic feet or 40,000 tons of stone were utilized in the construction of this outstanding building. The exterior walls contain 60,200 separate stones, 2 of these stones weighing over 17 tons each, 53 weighing from 10 to 17 tons, and 818 weighing between 5 and 10 tons each.

Figure 28 | *Channelling operations in granite. Stanstead Granite Quarries Company, Limited, quarry, Graniteville, Que.*

Figure 29

Adru Granite Inc. dressing plant, Beebe, Que., showing gang saw blades over completed cuts.

In this building are 114 free-standing columns weighing over 6,000 tons and having a total length, including bases, of 4,700 feet. If the courses were put end to end they would extend 45 miles (5).

15. STANHOPE DISTRICT

This grey granite district centers around the village of Stanhope which is about 15 miles due east of Stanstead. The Montreal-Portland line of the Canadian National Railways, and paved highway No. 22 from Norton, Vermont, to Sherbrooke, Quebec, both pass through the centre of the Stanhope district. By rail, Stanhope is 129 miles from Montreal and 158 miles from Quebec city; by road, these distances are 130 and 175 miles respectively. The stone is trucked from the dressing plant to the railway siding at Stanhope, over a gravel road 1·5 miles in length.

The granite mass is quite large, extending along the International boundary for about 14 miles and having a maximum width in Canada of 2½ miles. It is situated mainly in Barnston and Barford townships of Stanstead county. As in the case of the Stanstead intrusive, this granite mass is considered to be of Lower or Middle Devonian age and intrudes sediments classed as Ordovician (7) (20).

The stone is a light grey, medium grained biotite-muscovite granite of uniform composition. It is slightly coarser in grain than the Stanstead granites, but is essentially the same in mineral composition and very similar in appearance. It is almost identical in appearance to the 'Stanstead Light' being produced at the Haselton quarry, but is slightly darker. A typical sample from the Gingras et Frère quarry, by Burton (4), contained quartz, 29 per cent; feldspar, 67·8 per cent; dark coloured minerals and muscovite, 3·1 per cent; and accessories, 0·1 per cent. The feldspar is white similar to that in the Stanstead granites, but the quartz is smoky or slightly coloured; whereas in the Stanstead varieties it is white and translucent. The stone is practically free from iron and from narrow pegmatite veins and stringers, but occasionally white or black streaks and knots are present.

The first production from the district was made, according to Burton (4), to supply stone for bridge piers and abutments for construction of the Grand Trunk railway about 60 years ago. When Parks (15) visited the area in 1911, he mentions that stone had been quarried at several points to the west of Stanhope and that the region had long been known as a producer of granite for structural purposes. The only quarry in production at that time was on the face of a cliff half a mile west of the Stanhope railway station, the stone being dressed in a small dressing plant beside the railway.

The only quarry operating at present, that of Gingras et Frère Ltée, with office at St. Marc des Carrières, is on the side of a steep hill about one

and a half miles north of Stanhope and about a mile west of the railway. It was first opened in 1930 to supply building stone for the construction of two churches and has operated more or less steadily since that date.

The quarry is about 100 feet above the valley level and has a length of 250 feet, a width (along the dip) of 190 feet, and a depth of 50 feet at its deepest point. Overburden is generally less than a foot, and in many places the rock surface is smooth and bare. The sheets dip about 25 degrees to the east down the slope of the hill, and on the whole are relatively thin; near the top they range from 6 inches to 5 feet in thickness, but they improve with depth and one sheet was noticed in the lower part of the quarry with a thickness of approximately 20 feet. The joints also, while relatively numerous near the surface, improve with depth, and permit the quarrying of large-sized blocks at this particular quarry.

According to Burton (4), the rift has about the same attitude as the sheeting, and the grain is vertical with a strike of N65°E. The granite is fairly easy to quarry and the disposal of waste is extremely easy as it can be dumped over the side of the hill. The stone is fairly uniform in texture and contains practically no iron sulphides or oxides which might stain on weathering. It is comparatively free from white streaks, but black streaks and black knots or mica concentrations occur occasionally.

The blocks are quarried by drilling and blasting, and by channelling machines. Both quarry and dressing plant are equipped to handle blocks of large size, the steel derrick having a capacity of 60 tons, and the larger of the two gang saws can handle blocks 13 feet long, 8 feet wide and 7 feet high. The largest block quarried to date is stated to have weighed 38 tons.

Hydro-electric power is available in the area and both compressor and derrick are operated by electric-powered equipment.

At present the stone is used almost exclusively as a building material, and very little, if any, is used for monumental purposes. The following are a few of the buildings in the province of Quebec which have been constructed in whole or in part from the Stanhope granite:

Canadian National Bank Building, Montreal, Que.
Seminary, Trois Rivières, Que.
Ste. Thérèse Church, Drummondville, Que.
Christ Roi Church, Levis, Que.
St. Paul du Buton Church, Montmagny, Que.
Notre Dame du Chemin Church, Quebec City, Que.
St. Esprit Church, Quebec City, Que.
Begin Sanatorium, Ste. Germaine, Que.
Bishop's College, Lennoxville, Que.

99246—9

The stone has also been used for monuments, rough ashlar, curbing, paving blocks, and bridge construction. It is rather light in colour for polished monumental work, but can be used to good advantage where hammered finishes are required.

There are many sites available for stone quarrying in this area, but the sheets are relatively thin and the jointing is excessive, making the quarrying of large blocks a difficult and expensive operation. However, as at the Gingras et Frère quarry, quarrying conditions would probably improve considerably with depth. The distance from heavily populated centres is also a slight handicap to the development of the granite industry of this area.

16. SCOTSTOWN DISTRICT

Scotstown is 30 miles east of Sherbrooke and 20 miles north of the International boundary. Situated on the Montreal-Saint John (New Brunswick) line of the Canadian Pacific Railway, it is 150 miles east of Montreal. By paved highway it is 125 miles from Montreal and 130 miles south of Quebec city.

Two types of granite are produced in this district, grey granite from a quarry in the neighbourhood of Scotstown, and green syenite from one on Mount Megantic, several miles to the southeast. When visited in June, 1952, both quarries were closed, but it was stated that work would commence later on in the season.

For purposes of description, the district may be conveniently subdivided into two areas—the Scotstown area and the Mount Megantic area.

Scotstown Area.—In this area, which lies in the townships of Lingwick and Hampden, Compton county, there are two intrusive bodies of grey biotite granite, both of which are roughly circular in outline. The larger body, with an area of some 20 square miles, lies immediately to the north of Scotstown, while the other, approximately half a mile in diameter, lies immediately to the south. These granites intrude the St. Francis group of Middle Ordovician and are classed by Cooke (6) as Middle Devonian in age, along with the Stanstead granites.

According to Burton (4), there are two distinct types of granite in this area. Both are of the same age and mineral composition, but one is medium to coarse grained, while the other fine to medium grained. All quarrying has been confined to the coarser grained type of the main intrusive body, which is a light grey stone of good mixture and pleasing appearance. It is slightly lighter than the 'Stanstead Grey', but darker than the 'Stanstead Light' from the Haselton quarry, and is known to the trade as 'Scots Grey'. Burton gives the mineral composition of a specimen from the Scotstown quarry as follows: quartz, 23·1 per cent; feldspar, 64·4 per cent; dark coloured minerals, 12·0 per cent; and accessories, 0·5 per cent.

Burton (4) states that stone was quarried here for paving blocks 60 to 70 years ago, "but the area did not become important until the reopening of the Scotstown Granite Company's quarry about 1920". The quarry has been operated more or less steadily by the company since that date and is the only one that has operated in this area for many years. Present annual output is around 15,000 cubic feet of dimension stone, all of which is shipped to the company's finishing plant at Cap St. Martin to be dressed.

The Scotstown quarry is on the north side of a gently sloping hill, about 1½ miles northwest of the Scotstown railway station. It is connected with the main paved highway by a road 0·6 miles in length, and is also served by a siding from the railway, 1¼ miles in length. It has a length (east-west) of 600 feet, a width of 100 feet, and the face has a maximum height of 30 feet. Overburden is rather light in the area, usually less than 3 feet.

At the quarry, iron is practically absent and white pegmatite dykes are rare. In certain parts of the quarry black streaks and knots of dark minerals are numerous and inclusions of sediments also occur. This occasionally causes much difficulty in quarrying large clear blocks for monumental and polished work and accounts for the great amount of waste which has accumulated around the quarry, especially on the north side of the track. Other sections, however are comparatively free of these defects and large blocks free from flaws can be obtained.

The rift is vertical, striking approximately N60°E and the grain is horizontal. There is no development of sheeting; if present, the sheets are probably vertical, paralleling the rift. The jointing is rather heavy, but will permit the quarrying of the larger-sized blocks frequently required for massive building construction; both sets of joints are steeply dipping, and occur approximately at right-angles to one another. Due to the absence of sheeting it is necessary to break the stone along the grain by drilling horizontal holes spaced 2 feet apart and blasting with black powder. The stone is loosened along the hardway and rift by drilling and blasting and channelling methods.

At this quarry, both derricks and one compressor are driven by steam-powered equipment; the other compressor is gasoline-operated.

As it contains little or no iron, and works exceptionally well, it is an excellent building stone and as such has been used in many large buildings in Eastern Canada. Following are a few of the structures in which the stone was used in whole or in part:

National Research Council Building, Sussex St., Ottawa.
Crescent Building, Montreal, Que.
St. Germain Church, Outremont, Que.
Sénéchal Building, Montreal, Que.
Lachapelle Bridge, Black River, Montreal, Que.

99246—9½

Sherbrooke Trust Building, Sherbrooke, Que.
Maison Provinciale des Frères du Sacré-Coeur, Granby, Que.
Many schools, police and fire stations, Montreal, Que.

The stone was used for the polished base course of the new Bank of Nova Scotia Building, Toronto.

Polished surfaces fill well and show few incipient pits or fractures, but like many of the other light coloured grey granites of Quebec, there is little contrast between the polished and hammered surfaces, so that when used in monumental work with inscriptions, a hammered finish is preferable to polished faces.

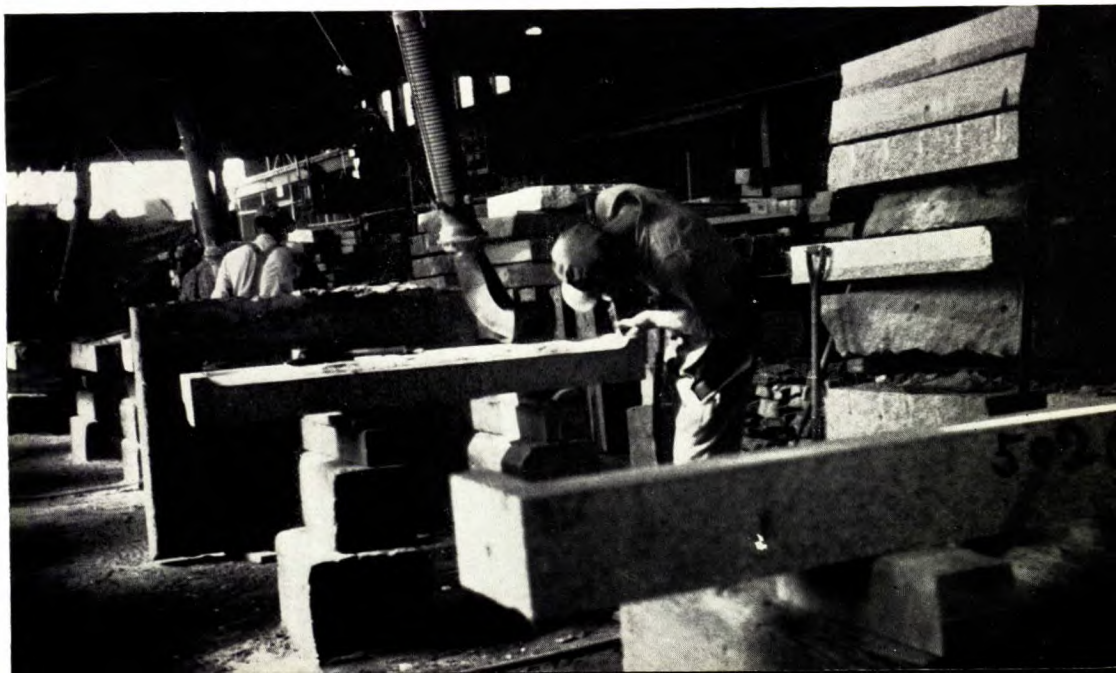
Mount Megantic Area.—Mount Megantic is 7 miles southeast of Scotstown in Hampden and Ditton townships (Compton county) and Marston and Chesham townships (Frontenac county). It has a maximum height of 3,625 feet, some 2,000 feet above the general level, and covers an area of approximately 30 square miles. According to McGerrigle (11), "It is a granite stock, around whose northern, eastern, and western sides a partial ring-dyke of nordmarkite, a rare variety of syenite, has been intruded between the granite core of the mountain and the country rock. . . The nordmarkite rim forms a ridge that is horseshoe-shaped in plan. . . The ridge is highest on the eastern side of the mountain, sloping gradually from the 3,500-foot peaks there to 2,100 feet at the northwestern side." The granite stock is classed by McGerrigle (11) as late or post-Devonian, and intrudes Ordovician sediments of the Compton formation; it is a medium grained grey granite which, according to Osborne (14), is almost identical in mineralogical composition and texture with that of the Scotstown area; it has never been exploited. Osborne (14) states that "The Megantic nordmarkites are very similar to those of Brome and Shefford mountains, and there is little doubt that they belong to the Monteregian province."

The nordmarkite is a medium grained dark green rock of uniform mixture. The principal minerals are cryptoperthite, a green, irridescent, soda-bearing variety of potassic feldspar, and micro-perthite, an intergrowth of microcline and albite. Also present are quartz, pyroxene, hornblende, olivine, biotite and several accessory minerals, such as apatite and titanite (14). The mineral composition of a typical specimen taken by Burton (4), was found to be as follows: quartz, 2·5 per cent; feldspar, 91·5 per cent; dark coloured minerals, 5·0 per cent; iron (sulphides and oxides), 0·5 per cent; and accessories, 0·5 per cent. The stone takes an excellent polish, has a very attractive appearance, and there is good contrast between polished and hammered or sandblasted surfaces. It makes an excellent monumental stone and is ideally suited for interior decoration in buildings. The stone is very hard, the large blocks ringing like a bell when struck with a hammer.

Figure 30

War Memorial at Scotstown, Que., showing a combination of polished Victoria Mountain green granite set in Scotstown grey granite.

Figure 31 | *Scotstown Granite Company Limited. View inside Cap St. Martin dressing plant, showing dust collecting equipment.*



Quarrying in this area has been confined to the northwestern flank of the mountain. The first work was done in 1930 by A. M. Mackenzie, of Scotstown, President of Victoria Mountain Granite Company, Limited, present owners of the property. The deposit has been worked intermittently and on a small scale since that time. During recent years it has been operated by the Scotstown Granite Company and the rough stone shipped to the Cap St. Martin finishing plant to be dressed. Present annual output is around 2,000 cubic feet of dimension stone, which is used mainly for monuments.

The quarry is 7 miles by road southeast of Scotstown. It has a length of 100 feet, a width of 75 feet, with a face 8 feet high. The east and west walls are marked by vertical joint planes which strike N18°E. According to the Scotstown Granite Company's foreman the rift slopes to the north at 40 degrees, paralleling the sheets; the grain is vertical paralleling the two joint planes; and the hardway is perpendicular to the rift and grain. The sheets range from a few inches up to 5 feet in thickness, increasing with depth. Fair sized blocks sufficiently large for moderate monumental stock can be obtained at this location, but the stone contains numerous dark brown streaks and knots. As a result, this quarry was recently abandoned in favour of another location a quarter of a mile to the east where the stone is practically free from these blemishes. At this new location, the blocks are quarried from large boulders which have rolled down to the foot of the mountain. Blocks weighing up to 15 tons have been obtained at this location.

The derricks are operated by steam or compressed-air powered hoists and the compressors are of the gasoline or steam-powered type.

17. ST. GÉRARD DISTRICT

Although a relatively new granite area, the St. Gérard district is at present one of the most important in the country, both with respect to the number of men engaged in the industry and to the amount of granite produced annually. The district produces an attractive grey granite used mainly for building purposes and to a lesser extent for monumental purposes.

St. Gérard is served by both good rail and road communications. It is on No. 1 paved highway and on the main line of the Quebec Central Railway running from Newport, Vermont, to Quebec city. It is 137 miles east of Montreal and 97 miles south of Quebec city by road; by rail, the distance to Montreal is 140 miles, and to Quebec city, 105 miles.

The granite mass lies about 3 miles east of St. Gérard in Stratford and Weedon townships (Wolfe county), Lingwick township (Compton county) and Winslow township (Frontenac county). It has a maximum length (northeast-southwest) of 6½ miles, a maximum width of 5 miles, and covers an area of some 19 square miles. On the east and southeast, the granite intrudes the St. Francis group of Ordovician sediments, and on the north-

Plate 13

DARK GREEN GRANITE
Scotstown Granite Company Limited quarry
Victoria Mountain, Scotstown District, Quebec.

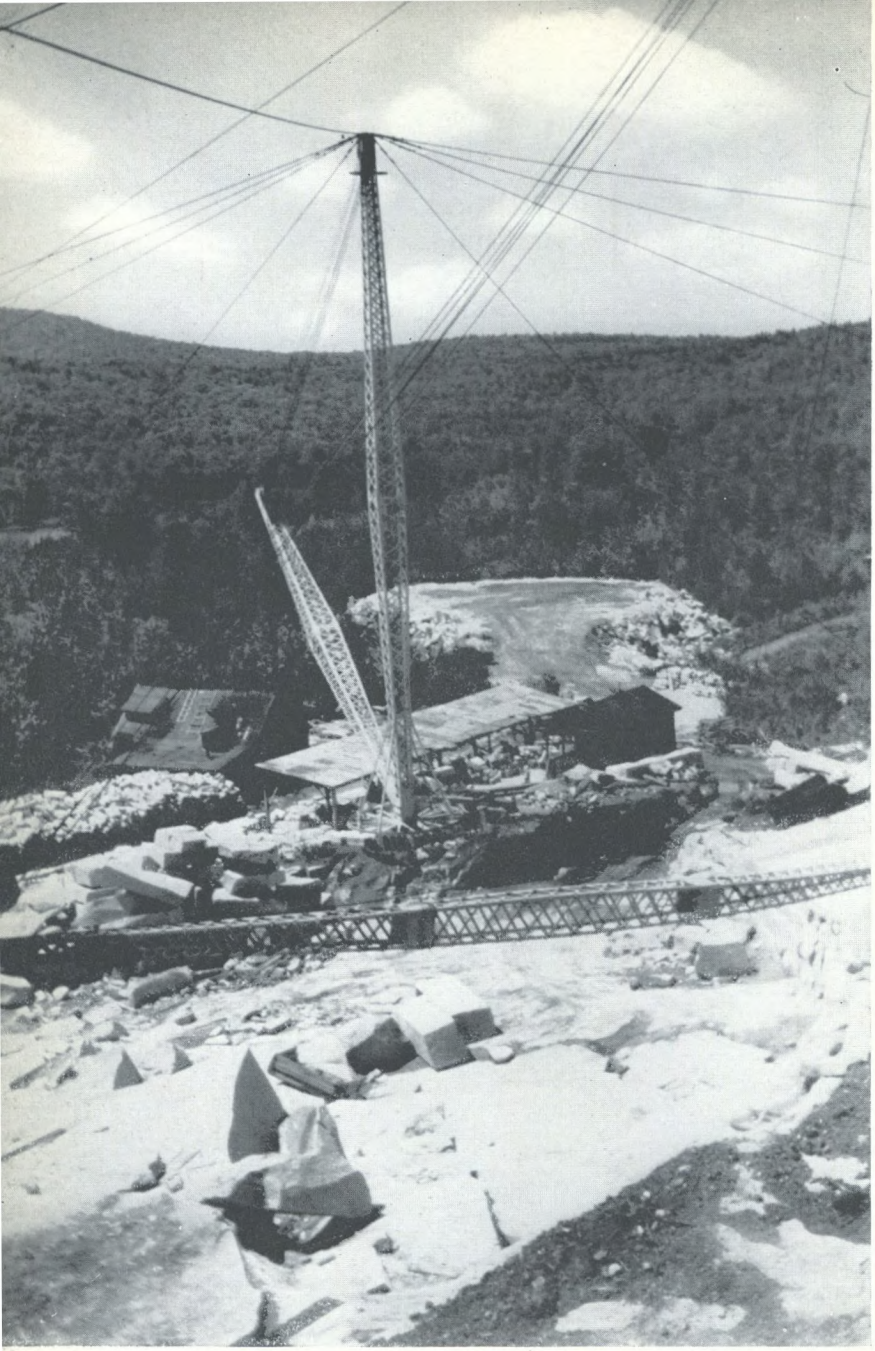


Figure 32 | *Derricks at Deschambault Quarry Corporation quarry, 5 miles east of St. Gérard, Que.*

west, west and southwest, it intrudes Silurian intrusives belonging to the Sherbrooke group. The granite is considered by Cooke (6) to be of Middle Devonian age.

The stone has been described (4) as "a medium-grained, light grey, biotite-muscovite granite of good mixture and pleasing appearance". It is lighter in colour and slightly finer grained than the 'Stanstead Grey', but is not quite as light in colour as the 'Stanstead Light'. That from the Deschambault quarry has a slight pinkish tinge which shows up plainly on polished surfaces. The mineral composition of a sample from this quarry was found by Burton (4) to be as follows: quartz, 17·4 per cent; feldspar, 80·6 per cent; dark coloured minerals and muscovite, 1·8 per cent; accessories, 0·2 per cent. The stone is of medium hardness, breaks very well, and takes a good polish, but there is little, if any, contrast between the polished and hammered or sandblasted surfaces. The stone appears to be free of iron but a few black streaks were seen at both operating quarries, while some black and dark brown knots were seen at one of them. However, these impurities are relatively scarce, and large blocks free from them can be easily obtained.

According to Burton (4), several attempts were made in the twenties to quarry the granite of this district but none were successful. The most important attempt was made by Mr. Plamondon, a Sherbrooke monument dealer, during the period 1928-31. Little further work was done until 1937, at which time the Plamondon quarry was reopened by Deschambault Quarry Corporation.

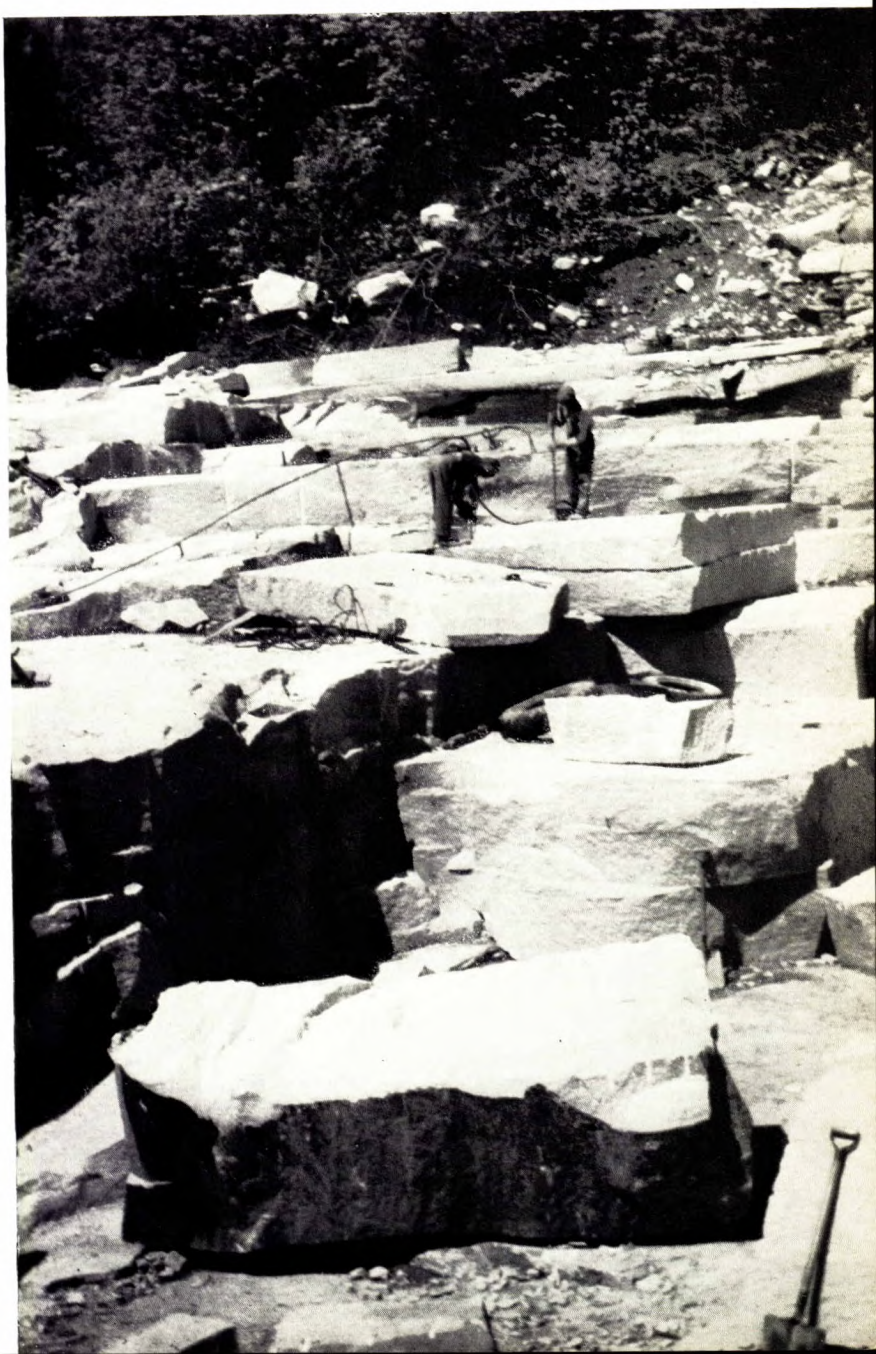
At present (June, 1952) there are two quarries operating in the district. One is operated by Deschambault Quarry Corporation,* with head office at St. Marc des Carrières and finishing plant at St. Gérard; the other, by the White Diamond Granite Company Limited, with head office and finishing plant at Trois Rivières. Both quarries are in Stratford township 4·7 miles by road east-southeast of St. Gérard, and are connected with No. 34 gravel highway, which passes through St. Gérard, by a narrow improved road 2·7 miles in length. The route is principally down grade, the quarries having an elevation of approximately 1,300 feet compared to St. Gérard's elevation of 850 feet. The quarries are situated on the southern slope of a steep hill about a mile from the northern contact of the granite with the sediments.

The Deschambault quarry, originally opened in 1928, has now a length of 300 feet, a width of 300 feet, and a maximum height of 40 feet. Two types of stone are produced at this quarry, the regular light grey granite

* La Cie Pierre de Taille Martineau Ltée. of 5000 Thirteenth Ave., Rosemont, Montreal, recently acquired the Deschambault Quarry Corporation with limestone quarries and dressing plant at St. Marc des Carrières which they continue to operate along with the granite quarry and dressing plant at St. Gérard.

Figure 32 | *Derricks at Deschambault Quarry Corporation quarry, 5 miles east of St. Gérard, Que.*

Figure 33 | *White Diamond Granite Company Limited quarry, St. Gérard District, Que.*



described above, which constitutes the bulk of production, and a finer grained greenish-grey variety which is produced in limited amount. The light grey granite has a slight pinkish tinge which is easily seen on a polished surface.

At the Deschambault quarry, the sheets strike N60°E, slope to the southeast at 10-12 degrees, and range in thickness from 2 to 10 feet, with an average thickness close to 10 feet. It was noticed however, that the sheets in the western section of the quarry, where the greenish-grey stone is produced, are fairly thin, ranging from 2 to 3 feet. The rift parallels the sheeting and the grain is vertical with a strike of N57°E. With the exception of one section where the joints are closely spaced, the joints at the quarry are widely spaced and permit the quarrying of large sized blocks quite easily; it was stated that one block was recently produced measuring 2 x 3 x 25 feet. The major joints strike N68°W and dip to the southwest at 78 degrees and are spaced from 6 inches to 50 feet apart, with an average of 30 feet. Several joints were seen striking N15°E and dipping at 33 degrees to the northwest, also one vertical joint striking N2°E.

The White Diamond quarry, opened by the present operators in 1947, has a length of 300 feet, a width of 150 feet and a maximum height of 40 feet. It is several hundred yards west of the Deschambault quarry at approximately the same elevation. Three types of stone are produced at this quarry, a grey, a bluish-grey, and a light-pink variety. The grey is the principal product and is the typical St. Gérard grey granite. The bluish-grey and light-pink varieties are finer grained than the grey, the light-pink variety resembling the Guenette granite, except that it is slightly coarser grained and lighter in colour. The bluish-grey variety is a slightly darker grey than the 'Stanstead Grey' and has a slight bluish tinge.

The sheets at the White Diamond quarry are nearly horizontal and average 2 to 4 feet in thickness. The rift is horizontal while the grain, according to the quarry superintendent, is vertical with a strike that ranges from north-south at the southwest end of the quarry to east-west at the northeast end of the quarry. The joints are scarce; several were seen striking N48°W and dipping 80 degrees to the southwest, and another striking N13°W with the same dip.

Quarrying is relatively simple in this area as the outcrops afford convenient quarry sites, the sheets and joints are well developed, and the streaks and knots are not plentiful. No weathering was noticed along the joint planes, but some discolouration, in the form of a 3-inch pinkish-coloured band, occurs along the sheet planes in the green granite at the Deschambault quarry. No channelling has been necessary at the Deschambault quarry but at the White Diamond quarry, where the joints are relatively scarce and the grain irregularly developed, channelling is frequently resorted to. Both quarries are equipped to produce large-sized blocks for massive building construction.

Compressed air to operate the drilling equipment and two of the derrick hoists, is supplied by four diesel-operated compressors and one gasoline-operated compressor. Two other derricks have gasoline-operated hoists.

When visited (June, 1952) it was expected that the total output of dimension stone for the area, including that used for rough stone walls, would be in the neighbourhood of 110,000 cubic feet for 1952. The total output of Deschambault Quarry Corporation, and the greater part of the White Diamond Granite Company's output, is used for building purposes; the remainder is used for monumental purposes.

This is a very popular building stone and as such has been used in the construction of many buildings such as post offices, churches and hospitals. It was used in the construction of St. Charles Garnier church, at Sillery, Que., the Assumption church, at Granby, Que., and was recently used in a church at Campbellton, N.B. and a public building at Fredericton, N.B. It has also been used for bridge piers and for monumental purposes. The Shawinigan War Memorial is an example of its use in an important monument.

18. ST. SAMUEL-ST. SÉBASTIEN DISTRICT

This district is one of the most important producers of grey granite in the province and at present contains more operating granite quarries than any other area in the country. It is sometimes referred to as the Little

Figure 34 | *Hand dressing granite blocks. St. Samuel Granite quarry, St. Samuel-St. Sébastien District, Que.*

Megantic or Little Mount Megantic district but as the industry is now centred about 2 miles northwest of St. Samuel Station and 3 miles southeast of St. Sébastien Station, it may be correctly referred to as the St. Samuel-St. Sébastien district.

The district lies approximately 20 miles due east of the St. Gérard district and covers an area of some 10 square miles, occupying parts of the townships of Whitton and Gayhurst, Frontenac county. It is situated in the Little Megantic mountains about 10 miles north of Lake Megantic and is, as Burton (4) states, "quite rugged, with cliffs 150 feet high and hills rising 1,400 feet above the general elevation". Ste. Cecile mountain, which rises to a height of 2,900 feet, is in the south of the area.

The Tring Junction-Megantic branch of the Quebec Central Railway passes through the area a short distance to the south of the operating quarries. St. Sébastien Station and St. Samuel Station, both on this branch line, lie respectively 98 and 103 miles from Quebec city and 195 and 190 miles from Montreal. The quarries are about 12 miles north of No. 34 paved highway with which they are connected by good gravel roads. By road, the distance to Montreal is about 180 miles and to Quebec city, 120 miles. Transportation has been chiefly by rail although the roads are now improved so that truck transportation is quite common for short hauls.

The granite mass is oval-shaped and has a general strike of north-northeast, a maximum length of 6 miles and a maximum width of 2 miles. It intrudes the Beauceville series of Ordovician sediments which apparently correspond with the St. Francis group occurring to the west of the district. The granite is classed as post-Ordovician on the 'Megantic Sheet, West Half', while on the 'Southern Quebec, Centre Sheet' it is classed as Lower or Middle Devonian along with the other grey granites of the Eastern Townships. Lord (19) mentions that the granite does not show "much variation even to within a few inches of the contact" but that the alteration in the sediments in places extends "as far as a mile from the contact".

The stone is a grey biotite granite varying from medium to coarse in grain, and is usually darker than most of the Stanstead granites. A slight pinkish tinge can be noticed in much of the stone, especially in the coarser grained variety. The medium-coarse variety from the Silver Granite Company's quarry and the 'Stanstead Grey' variety show very little difference on polished surfaces when compared side by side. However, a sample of the coarser grained granite from the Bussière et Frère quarry appeared almost identical in colour and texture with a sample from the Stanhope district. The mineral composition of a sample of medium grained granite from the Silver Granite quarry was found by Burton (4) to be as follows: quartz, 21·3 per cent; feldspar, 68·0 per cent; dark coloured minerals and muscovite, 9·2 per cent; iron, 0·8 per cent; accessories, 0·7 per cent. Both medium and coarse grained varieties are of close, even texture and good

Plate 14

GREY GRANITE
Silver Granite Company Limited quarry
St. Samuel-St. Sébastien District, Quebec.

mixture and present an attractive appearance on rough and polished surfaces. Both take a high polish but due to their light colour there is very little contrast between the polished and hammered or sandblasted finishes. At present, the finer grained type is being produced at most of the quarries and production of the coarser grained variety is confined to the Bussière et Frère St. Sébastien quarry, located 4 miles by road northeast of the plant, and to the Silver Granite Company's quarry where both varieties are produced.

According to Burton (4), granite quarrying has been carried on in this district on a small scale for many years, but it was not until the Lacombe and D'Allaire quarry was opened in 1911 that the industry became well established. Parks (15), who visited the area in 1912, gave the 1911 production of the above quarry as 80,000 paving blocks and 3,000 cubic feet of building stone and monumental bases; he mentioned that a total of 40 men were employed by this company at times. He describes four other quarries, all small, that had operated fairly recently but which were inactive at the time of his visit.

When Burton (4) visited the area in 1931, there were two operating quarries, both of which were "of large size and adequately equipped to handle medium to large-size building blocks". One quarry, the old Lacombe and D'Allaire quarry, was operated by Frontenac Quarries, Limited (later reorganized as Bussière et Frère Enrg.) and the other was operated by the Silver Granite Company, Limited, which commenced operations in the district in 1924. Both companies operated dressing plants in conjunction with their quarries. Burton gives the 1930 production for the area as 100,000 cubic feet of dressed building stone, 15,000 cubic feet of rough building stone, and 1,100 cubic feet of monument stone, with a total value of $460,000.

When visited (June, 1952), there were four companies active in the district. The 1951 production amounted to approximately 75,000 cubic feet of dimension stone, the greater part of which was used for building and the remainder for monumental purposes; approximately 80 per cent was supplied by the Silver Granite Company, Limited and Bussière et Frère Enrg., both of which operated large dressing plants, that of the former company being one of the largest of its kind in the country. The Silver Granite Company's plant is located at the quarry while that of Bussière et Frère Enrg., is about a mile due west of the latter, near the old Lacombe and D'Allaire quarry.

Operations were suspended at the old Lacombe and D'Allaire quarry in 1951 due to high quarrying costs. This quarry, opened on a flat lying ridge, is probably the largest in the district, having a length and width of several hundred feet and a depth of 80 feet. Quarrying costs were high as a result of the large amount of water encountered in the quarry, the expense of hoisting the stone and the large amount of waste to the surface, and to the difficulty experienced in drilling the stone; in addition, channelling was required quite frequently. The stone is harder than the ordinary stone of this

class, but on this account it lends itself admirably to carving, retaining its sharpness on exposure to weathering over long periods. Bussière et Frère Enrg. now obtains its finer grained stone (the typical medium grained stone of the district) from a new quarry about a mile east of their plant.

Including the Silver Granite Company's quarry, which reopened shortly after the area was visited, six quarries operated in this district during the 1952 season. Five of these occur along a half-mile section of the road running from St. Samuel Station to St. Sébastien Station, on the south slope of a steep hill; their distances from the road range from a few feet to several hundred yards; four are located north of the road in Gayhurst township, while the other, the Antonio Bolduc quarry, is situated south of the road in Whitton township. The sixth quarry, the Bussière et Frère coarse granite quarry, is situated 1½ miles to the north of the others, along the road running from St. Samuel-de-Gayhurst to St. Sébastien-de-Beauce.

With the exception of the Silver Granite Company's quarry which was opened in 1924 to provide stone for the basilica at Ste. Anne de Beaupré, the quarries are relatively new, having operated less than 10 or 15 years. All are of the side-hill type, but one or two have been worked a short distance below the surface. They range considerably in size from the Bolduc quarry, which is little more than a "motion", to the Silver Granite quarry, one of the largest in the country.

At three of the quarries the sheets are nearly horizontal and at the other three they dip at approximately 10 degrees. The sheets range from 6 inches to 7 feet in thickness, with an average ranging from 2 to 3 feet at the Bolduc quarry to 5 to 6 feet at the Bussière et Frère medium grained quarry. The sheets sometimes show variations in dip at individual quarries, as for instance at the St. Samuel Granite quarry where dips as high as 20 degrees were seen. The rift parallels the sheeting and the grain and hardway are vertical, with the grain, as measured at four of the quarries, having a strike very close to east-west.

Joints are numerous in the area, and as a result there are usually one or more sections at each quarry where the stone is too badly cut up to be of any use, while the spacing elsewhere permits the quarrying of medium and large sized blocks. At each quarry there is usually a major set of joints dipping 75 to 80 degrees, with the joints spaced from a few inches to over 20 feet apart, and a minor set with the joints well spaced but sometimes dipping at angles as low as 25 degrees.

No iron spots were seen at any of the quarries. Black streaks and knots were numerous in two quarries, rare in others, and absent in others. White streaks were common at ane quarry and relatively scarce at another, and a few pegmatite dykes with widths approximating 1 inch were seen at one or two quarries.

Plate 15

GREY GRANITE

Bussière et Frère Ltée quarry

St. Samuel-St. Sébastien District, Quebec.

On account of the well pronounced joints and the good rift of the stone it is generally possible to quarry large blocks with the use of very small amounts of powder. At the new Bussière et Frère medium grained quarry and the Silver Granite Company's quarry, where the joints may be widely spaced, some of the stone is channelled and then loosened by small charges of black powder. Generally speaking, the percentage of stone discarded as waste is rather high due to the relatively thin nature of the sheets, the numerous joints, and the large amount of black and white streaks which may be present.

Hydro-electric power is available in this district and is employed to operate about half of the compressors and one derrick. The remaining compressors are either steam or gasoline-operated, and the majority of the derricks have steam-powered hoists.

Although a fair amount of this stone is used for monuments, its chief use is for building purposes, for which it is ideally suited. It is relatively easy to work, and the finished stone is quite attractive on both rough or polished surfaces. The following are a few of the buildings which have been constructed in whole or in part from the granite of this district.

Parliament Building Annex, Quebec City, Que.
Provincial Museum, Quebec City, Que.
St. Dominique Church, Quebec City, Que.
Laval University, Quebec City, Que.
St. Sacrement Church, Quebec City, Que.
St. Alphonse d'Youville Church, Montreal, Que.
St. Joseph Oratory, Montreal, Que.
Notre Dame Church, Sherbrooke, Que.
Basilica, Ste. Anne de Beaupré, Que.
Notre Dame College, Levis, Que.
St. Joseph College, Trois Rivières, Que.
Church at Disraeli, Que.
Church at St. Agathe, Que.
Church at Mont Joli, Que.
Church at Moncton, N.B.
Church at Edmundston, N.B.

Among the outstanding buildings faced with granite from this district during the last few years were the church of the Dominican Fathers, at Sherbrooke, an extension to the Saint Joseph Oratory, at Montreal, and a seminary at St. Georges, Beauce County, Que.

The stone has been widely used for monuments, two of which are the Ste. Jeanne d'Arc Monument at Bergerville, Que., and the Dollard Desormeaux Monument, at Montreal, Que.

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(16) **Wilson, M. E.:** "Timiskaming County, Quebec", Geol. Surv., Canada, Mem. 103 (1918).

(17) *Geological Structure in the St. Lawrence Lowlands;* Que. Bur. Mines, Ann. Rept. 1930, Pt. D. Map 112.

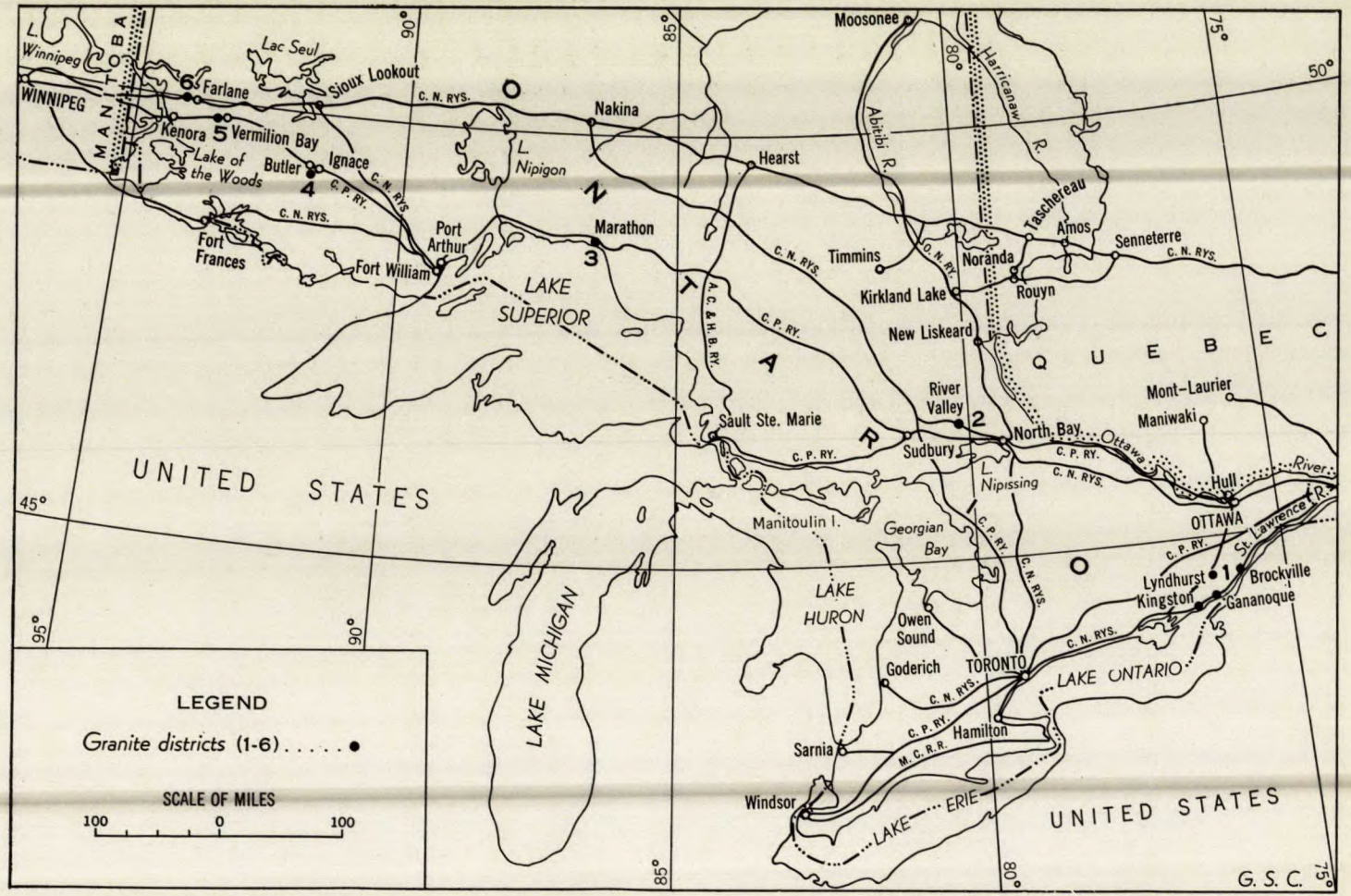
(18) *Opasatika Sheet, Témiscamingue County, Quebec;* Geol. Surv., Canada, Map 240 A. (1930).

(19) *Megantic Sheet (west half), Frontenac County, Quebec;* Geol. Surv., Canada, Map 379 A. (1938).

(20) *Southern Quebec, Centre Sheet;* Geol. Surv., Canada, Map 704 A. (1943).

N.F.B. Photo

Figure 35 | *National War Memorial, Ottawa. Rivière-à-Pierre rose grey granite.*



Sketch map of Ontario

CHAPTER 7

GRANITES OF ONTARIO

Although Ontario contains large areas and numerous outcrops of granitic rocks, they have not been exploited to any great extent, and the industry, even in the early thirties when there was a large demand for paving blocks, has never been very extensive. The industry is rather quiet at present, with actual production being confined to the Vermilion Bay area where a medium grained pink granite is produced, to the River Valley area where a medium grained black granite is produced, and to the Lyndhurst area where a coarse grained red granite is produced. None of these operations is large and, with one possible exception, none is equipped to handle very large building contracts without the installation of additional machinery and equipment. The stone is used for both building and monumental purposes and is shipped in the form of large crude blocks for sawing and dressing at the point of destination.

Ontario is rather differently situated with respect to markets than some of the other provinces inasmuch as the large consuming centres are in the southwest of the province, where no granite deposits occur but where quarries of high-class limestone have been developed. All the deposits of granite are to be found in the southeast, north, and northwest of the province. Thus high freight costs and strong competition from other kinds of stone, coupled with competition from granite producers outside the province, has seriously handicapped the Ontario granite operators. However, the provincial market for both monumental and building granite is extensive, as there are over 73 cities and towns with populations over 5,000, and 151 towns and villages between 1,000 and 5,000.

The province may for purposes of description be divided into two divisions, lower or southern Ontario, and northern and northwestern Ontario, the boundary line being the French river, Lake Nipissing and the Ottawa river.

The rocks of southern Ontario are about equally divided into those of igneous origin and those of sedimentary origin. The area in which the ancient crystalline rocks occur, lies to the eastward of a line drawn from Kingston northwestward to the mouth of the Severn river on Georgian bay, and westward of a line drawn roughly from Brockville on the St. Lawrence river to the vicinity of Sharbot lake, thence to Smiths Falls and from there

to the Ottawa river near Arnprior. This area contains all the granites, gneisses, and the rarer decorative, igneous rocks to be found in southern Ontario.

Practically the whole of northern and northwestern Ontario, with the exception of an area to the south and west of James Bay, is part of the Canadian Shield and as such is considered a likely field in which to find igneous rocks suitable for building or monumental stock. With the exception of a few localities along the Canadian Pacific and Canadian National railways, where several quarries have operated, this is practically virgin territory as far as the granite industry is concerned and it affords an excellent field for prospecting for quarry sites in a diversified series of rocks.

The Precambrian rocks already exploited have provided a wide variety of stone, both in colour and texture, and there is reason to believe that many new forms may be found on careful search. The actual total production remains insignificant and quite out of proportion to the possibilities of the province, but it is believed that the industry will show substantial gains as a result of the coming into production of the Vermilion Bay and River Valley areas. The large scale development of any granite industry requires that there be ample supplies of good quality grey granite, and so far, Ontario has failed to find supplies of this granite in areas favourable to development.

For convenience in description, the more important areas in which quarrying has already been carried on are arbitrarily divided into six districts as follows:

Southeastern Ontario

1. Gananoque-Brockville District

Northern Ontario

2. River Valley District

Northwestern Ontario

3. Marathon-Port Coldwell District
4. Ignace District
5. Vermilion Bay District
6. Farlane District

In addition to these, there are a number of other localities where deposits have been developed in a small way or where interesting rock types have been located. Although a few of these types, such as the Bancroft sodalite, the feldspar porphyry from near Rahn lake, and several occurrences of graphic granite, take a high polish and have a very striking appearance, they appear to be badly jointed or otherwise unsuitable for dimension stone, and for this reason will receive no further mention in this report.

SOUTHEASTERN ONTARIO

1. GANANOQUE-BROCKVILLE DISTRICT

Travelling westward along highway No. 2 between Brockville and Kingston one passes over the southern extension of the Archaean area, which extends southward for a short distance into the United States; the width of these rocks along the highway here is close to 40 miles. In this area bordering the St. Lawrence and for about 15 miles north, numerous quarries have been operated in past years. Granite has been quarried near Kingston, Findlay (1), Brockville, Escott, and Lyndhurst, but the main operations have centred around Gananoque and on the adjacent islands in the river.

The Precambrian rocks in this area include granites and gneisses of various colours, from dark brown to deep red, with some having a decided greenish tinge. The stone is in general medium to coarse grained, contains knots and some hair-line cracks, and much of that quarried to date is syenite rather than a true granite. The area is of interest from the wide variety of coloured stone which has been produced, and stone contractors looking for a special coloured type, might be well advised to do some prospecting in this area.

Most of the early quarrying in this district was on the islands in the St. Lawrence river near Gananoque. These quarries, the larger ones being on Grindstone (U.S.), Leek, Juniper, and Granite islands, were in fine to coarse grained granite ranging from light to dark red in colour. The stone polished and filled well and most of the production was used either for monumental purposes or for paving blocks(8). These quarries have been idle for many years, and it is unlikely that operations will be resumed in the near future due to the difficulty of obtaining large blocks free from blemishes resulting from the rather excessive jointing and the presence of black knots in much of the stone. However, shipping facilities are excellent and much of the stone presents a handsome appearance when polished.

The more recent work has been on the mainland to the north of Gananoque, and in the Escott and Lyndhurst areas. Much of the production has been paving blocks although some material has been quarried for building and monumental purposes. Most of the openings are small and scattered over a large area, no large operators having entered the field. Although the amount of stone produced in the aggregate is large, no large tonnage has been obtained from any one quarry. The practice in the past has been to make new openings from time to time rather than to develop any one point extensively. This is only to be expected when it is considered that the biggest production has been paving blocks, produced by small operators employing only a few men working with hand-operated derricks and hand drills. When operating conditions in an opening became difficult

and expensive, it was a simpler matter to move the equipment to a new locality on the surface, than go to the expense of installing larger machinery to work at greater depth.

Writing in 1911, Parks (8) described the firm D. J. Gordon and Son, of Gananoque, as the only important producer of granite in the district. The company obtained its stone from quarries in the Gananoque, Escott, and Lyndhurst areas. The annual output was about $50,000 in paving blocks and $5,000 in building and ornamental stone.

According to Baker(2), the chief producers in 1922 were the Woodburn Granite Quarries, Gananoque, operated by Charles Gordon and associates, and the Lyndhurst Granite Quarries, at Lyndhurst, belonging to A. C. Brown. There has been little activity in the district since the thirties. At present operations are confined to the old A. C. Brown quarry which was reopened during 1953 for the production of monumental and building stone by Dominion Granite and Marble Company, Limited, of Toronto. This operation is described below.

For convenience the granites of the Gananoque-Brockville district are described below under the following headings:

1. Gananoque Area
2. Escott Area
3. Lyndhurst Area
4. Kingston Area
5. Brockville Area

1. ***Gananoque Area.***—Numerous quarries have been opened in the Gananoque area, most of them in convenient knolls on property owned or leased for short terms by the operator, so that sustained operations on any one property for more than 2 or 3 years has been rare. For the purpose of this report it will be sufficient to describe the largest and most important quarry to operate in the area, the old Gordon quarry situated on lot 10, concession III, township of Leeds, Leeds county (4).

The quarry is opened on the north side of a low-lying bluff with a relief of not more than 30 feet above the surrounding country. The sheeting is massive and horizontal, running up to 10 feet in thickness, and joint planes are well defined and spaced wide apart. The rift is horizontal, paralleling the sheets, and the grain is vertical, paralleling the main joint planes. Large blocks may be obtained but extreme care must be taken to obtain blocks free from the black knots prevalent in this quarry.

The stone may be described as a coarse to medium grained augite syenite of fair mixture. Its colour is a dark brown with a decided reddish tinge, and it was known to the trade as 'Excelsior Brown'. It is composed essentially of orthoclase, plagioclase, hornblende, and augite, with smaller amounts of quartz and magnetite. The chief mineral constituent is dark

brown orthoclase which occurs in crystals up to half an inch and larger in diameter. The stone polishes well and takes a high lustre, and when polished in large slabs has a very pleasing appearance.

2. *Escott Area.*—The granite just north of highway No. 2 on lots 10 and 15, concession II, township of Escott, has been extensively quarried for paving blocks in the past. Cole (4) reported the presence of fifteen to twenty small openings on lot 15 at the time of his visit in 1934, at which time several hundred thousand blocks were cut and piled ready for shipment.

The stone is a fine grained reddish-brown granite with numerous feldspathic stringers and pegmatite dykes of a light pink colour running through it; in addition, black knots may be present. These make the stone unsuitable in most cases for building or monumental use, but on account of the remarkable ease with which it breaks on the rift, grain, and hardway, it is ideal for paving blocks and curbing. The jointing is well developed so that large stone can readily be obtained. When free from imperfections, this granite, as Parks (8) stated, "presents a uniform grain and a very pleasing colour; it should make a desirable material either for decorative or rock face work". However, there is little contrast between the polished and hammered surfaces.

3. *Lyndhurst Area.*—The Lyndhurst quarries are situated on lots 9 and 10, concession IX, township of Leeds, about 5 miles southwest of the village of Lyndhurst. They are situated near the southwestern end of a large mass of Algoman granite which extends from Lyndhurst in a southwesterly direction to Whitefish lake, for an overall length of 6 miles. Operations at present are confined to the old A. C. Brown quarry which was reopened early in 1953 by Dominion Granite and Marble Company, Limited, of Toronto. To date, several carloads of monumental stone have been shipped to Vermont, and about 50 tons of rough stone have been shipped to Toronto for the production of terrazzo chips. When visited in December, 1953, it was expected that shipments would be resumed shortly. Shipments by rail are made from Elgin, about 7 miles north of the quarry along No. 15 highway.

The quarry has been opened on the east side of an exposed ridge about a quarter of a mile west of No. 15 highway. It has a length of 150 feet, a width of 100 feet, with the face ranging up to 30 feet in height. The sheeting is very irregular, changing in strike and dip from place to place, with an average strike of east-west and dip of 25 degrees to the north; the sheets vary considerably in thickness, from several inches to over 10 feet. The formation is cut by several sets of joints, the most prominent set having a strike of N75°W, a vertical dip, and spacing ranging from 5 inches to 10 feet and averaging 4 feet. Large dimensioned blocks can readily be

obtained, but on account of the angle at which the joint planes cross each other, and on account of the irregular sheeting, a fair proportion of rock is wasted in producing rectangular blocks. According to J. Jones, the rift is approximately horizontal and the grain vertical.

The stone is a coarse-grained granite of uniform colour and texture and fair mixture. The principal constituents are feldspar, quartz, and biotite. The quartz is clear to translucent, and the feldspar has a rich warm colour, which gives the stone in the rough a pleasing reddish-pink colour. The stone takes an excellent polish, fills well, and is a deep rich red in colour. It is known to the trade as 'Lyndhurst Rose'. A good example of its use may be seen in the Lyndhurst war memorial. Blemishes are confined to black knots, averaging from 1 to 2 inches in diameter; these appear to be rather numerous, making it difficult to obtain large blocks of monumental grade. Aside from the knots, the mixture appears to be rather coarse and not sufficiently uniform for high class monumental work. It would make an excellent building stone, however.

4. ***Kingston Area.***—Many years ago the granite at Deadman bay, a cove on the north shore of the St. Lawrence river at the east end of Barriefield Common, was worked on a fairly extensive scale. The stone was used for ornamental purposes, columns for buildings, etc. Although operations have been discontinued for many years, the situation of this mass of Algoman granite close (2 miles) to Kingston makes it of interest as a future source of stone for building purposes. The stone is badly jointed and it would be hard to get blocks of large dimension from the present workings, but there are places where good tonnages of random coursing could be readily obtained. Parks(8), who was of the opinion that a large amount of stone was still available, describes the granite as follows:—

"This stone presents a general bright red aspect with light bluish dots. It consists of red feldspar (orthoclase), blue quartz, and a small amount of black mica which is in places replaced by hornblende. Under the microscope, it is seen that decay has begun in the orthoclase and to some extent in the mica, but nevertheless the rock is comparatively fresh. A small amount of pyrite, as well as other accessory minerals, is present. The polished surface has a unique appearance due to the bluish cast of the quartz".

5. ***Brockville Area.***—The name 'Brockville granite' is given to the granite outcropping in the town of Brockville and to the southwest on the islands of the Brock group and at intervals along the St. Lawrence. It has an overall length (northeasterly-southwesterly) of about 4 miles and a maximum width of 1½ miles (13). In the past, quarries were opened in this granite at various times and a small amount of building and monumental stone was produced. Examples of the use of this stone may be seen in the waterworks building and in the electric station at Brockville.

Plate 16

BLACK GRANITE
Nipissing Black Granite Company Limited quarry
River Valley District, Ontario.

The granite varies in colour from red to light pink and in texture from medium to coarse. Wright (13) gives the average mineral composition of the Brockville granite as: quartz, 22·7 per cent; potash feldspar, 39·2; plagioclase feldspar, 21·1; microperthite, 0·4; biotite, 13·4; hornblende, 0·9; and accessories, 2·6 per cent. Several secondary minerals are also present but the stone does not reveal any serious decomposition. He reports the granite as massive and well-jointed, and easily worked and polished, but mentions that in a great many specimens, mica and magnetite occur in round bunches and spoil the appearance of the polished surface. However, Parks (8) concluded that "Architects desiring a granite of subdued red tones and one capable of receiving a good polish without undue cost would find a readily accessible material in the Brockville stone".

NORTHERN ONTARIO

2. RIVER VALLEY DISTRICT

This district is situated along the main (Montreal-Vancouver) line of the Canadian National Railways about 45 miles northwest of North Bay. It is the source of one of the highest quality black granites ever produced in Canada. The stone is produced by Nipissing Black Granite Company Limited from a quarry on the northern half of lot 12, concession VI, township of Gibbons, District of Nipissing. This is a relatively new granite producing area, having first entered into production in 1949. The stone is shipped from the area as rough undressed blocks, and to date has been shipped mainly to Montreal, Toronto, and the United States (Vermont and New Hampshire).

The quarry is about 4 miles northeast of River Valley. Where the quarry road meets the railroad and highway, 2 miles north of River Valley station, a two-car spur of the railroad has been constructed, and the stone is transferred from truck to flat-car by means of an overhead travelling crane. River Valley is 20 miles northwest of the Trans-Canada Highway at Sturgeon Falls. By rail, the distance to Montreal is 386 miles, to Toronto 270 miles, and to Winnipeg 973 miles.

In this district to the north of River Valley and running in a general northwesterly direction more or less paralleling the railroad, are a series of outcrops varying in composition from diorite to anorthosite, with the latter predominating. As a rule the anorthosite is fine grained in texture, but in some cases it is slightly coarser in grain and as such resembles the finer grained parts of the Lake St. John anorthosite. Very few main cracks or joints were noted in the principal outcrops, and although the occasional light-coloured dyke was seen, in general the rock appeared free of any such flaws or blemishes. These rocks are undoubtedly related in age to a larger area of similar rocks of Keweenawan (Precambrian) age which occur in the townships of Dana, Janes, and Pardo, several miles to the northwest (3).

The quarry has been opened along the southeast side of an outcrop which has been traced for over 500 feet in a northeasterly-southwesterly direction. This outcrop rises to a height of 50 feet above the surrounding country, and the southeastern slope, in which the quarry has been opened, is very steep in places, averaging 40 to 50 degrees. The rock is exposed for some distance back from the edge of the southeastern slope, but as it starts to slope towards the northwest at a low angle it becomes soil and brush covered.

The stone is a medium to medium coarse grained anorthosite. Under the microscope it is seen to consist of 85 to 90 per cent feldspar (labradorite), 5 to 10 per cent pyroxene (hypersthene), 2 to 3 per cent hornblende, less than one per cent quartz, and less than one per cent iron oxides. The feldspar is uniformly clouded by what are probably sub-microscopic inclusions which likely account for its black colour. Otherwise it, along with the other minerals present, has a fresh appearance indicating little or no secondary alteration. The iron oxides present are probably magnetite or ilmenite and are mainly inclusions within the pyroxene; they vary in size from 0·01 to 0·10 mm.

The stone on polishing is a beautiful black with a slight brownish cast. The coarser grained material shows a wide variety of colours when moved at different angles to the light source. The outcrops show little sign of weathering action and it is believed that this stone will stand up well for a great number of years. The stone takes an excellent polish and there is a strong contrast between sandblasted and polished surfaces. It makes an excellent building and monumental stone.

The quarry has been opened for a length of 60 feet, a width of 40 feet, and a height of 30 feet. The formation, as exposed in the quarry and along the outcrop, can be regarded as quite massive. There are very few major joints cutting the formation, and the sheeting planes, although not well-defined, are widely spaced, so that blocks of the largest size required by the industry may readily be obtained. Some small surface joints or fissures are still visible in some of the blocks, but as more depth is obtained relatively fissure-free stone can be expected. The stone shows no rift or grain and consequently channelling methods have been used almost exclusively in quarrying the blocks. In subdividing the blocks by 'plug and feather' or blasting methods, the holes are commonly spaced on 5 or 6-inch centres and drilled the full depth of the block; very little black powder is used in blasting. Although this makes for expensive quarrying, the stone is relatively soft compared to other granites, and the height of the outcrop above ground level is such that operations below water line will not be necessary. At present about 40 per cent of the stone quarried is discarded as waste.

Figure 36 | *Yard of the Nipissing Black Granite Company Limited quarry, River Valley District, Ont.*

Figure 37 | *Vermilion Pink Granite Company Limited quarry, 6 miles west of Vermilion Bay, Ont.*

Compressed air to operate the hand drills and channelling machine is supplied by two compressors, one diesel, the other gasoline-operated. The derrick is equipped with a gasoline-operated hoist.

The stone is shipped from the area in blocks weighing from 6 to 12 tons, and occasionally 12½ and 13 tons, in the form of rough undressed blocks, but plans call for the erection of a dressing plant and the installation of sawing, polishing, and other equipment. The company will then be in a position to place on the market sawn and polished slabs such as are required by the majority of the monument dealers throughout the country. A great deal of money has been spent in developing and equipping this quarry, and the company is now in a position to market the stone in quantity. At present the quarry operates eight months per year. Production for 1950 amounted to 2,500 cubic feet of monumental and building stone; production is slightly higher at present.

NORTHWESTERN ONTARIO

In the area of northwestern Ontario lying to the north of Lake Superior and thence westward to the Ontario-Manitoba boundary, are many exposures of granite and other igneous rocks, but only a few have been seriously studied as to suitability for building or monumental use. Quarrying has been carried on at Marathon and west along the C.P.R. right-of-way at Angler, in the vicinity of Butler and Ignace, and at Farlane on the Canadian National railway, east of Minaki. In recent years quarrying has been confined to the Vermilion Bay district on the Canadian Pacific railway, where a high-quality, medium grained pink granite is produced.

With these exceptions the area has not been prospected for building or monumental stone, and there is a good opportunity for finding suitable deposits, especially along the shore of Lake Superior as well as along the main lines of the two railways. The area is practically bare of overburden and there are numerous rock-cuts along the lines of both railways, so that there are excellent opportunities for studying not only the different kinds of stone available but also, the jointing being well exposed, whether conditions would be favourable for large-scale quarrying.

Quarrying, to be profitable in the Lake Superior area, must produce a stone of superior colour and quality which, although costing more in our main markets, would still be in demand due to its superior properties. Sufficient work was done during the late twenties and early thirties to indicate the syenites of the Marathon-Port Coldwell district to be of such quality. This district, in particular, contains a great variety of intrusive rocks and, as much of the area is more or less barren, would be a suitable place to prospect for other special types of commercial granite.

The Vermilion Bay district, on the other hand, is about 400 miles farther west, and situated so that shipments can be fairly cheaply made to the prairie provinces and to the north central parts of the United States. The haul to the eastern markets, however, is a correspondingly greater distance.

The first quarrying in this region of northwestern Ontario was done by the railway companies who opened quarries to obtain stone for bridge pier and abutment work during the period of railroad construction. Notable among these quarries was one to the west of Marathon, from which stone was obtained by the Canadian Pacific Railway for the construction of several large bridges in that area. The granite west of Ignace was worked by the same company for a similar use.

For convenience in describing the various granite areas which have been active at one time or another, they have been grouped into four districts, already listed. For reasons indicated above, the Marathon-Port Coldwell district is treated at greater length than ordinarily for a district which has been inactive for over 20 years.

3. MARATHON-PORT COLDWELL DISTRICT

The Marathon-Port Coldwell district is in the Thunder Bay district about 175 miles east of Port Arthur. It has a length (east-west) of about 15 miles and is meant to include that portion of the north shore of Lake Superior occupied by a group of instrusives referred to collectively by Kerr(7) as the Port Coldwell syenites. These syenites are of Precambrian age and occupy a known area of approximately 100 square miles. They occupy the entire coastline from 3 miles east of Marathon, to as far west as the Canadian Pacific Railway station at Middleton, and also form all the islands in the neighbourhood(7).

The district is well situated with respect to rail, road, and water transportation. It is served by the main line (Montreal-Vancouver) of the Canadian Pacific Railway and is connected with paved highway No. 17 at Terrace Bay by 40 miles of gravel road. Situated as it is within easy reach of water transportation on the Great Lakes, it should be possible to find markets not only in Ontario but in some of the large cities in the United States bordering the lakes. In addition to Marathon, where the Marathon Pulp and Paper Company operates a modern dock, there are several other well-protected harbours where docks might be constructed to afford shipping facilities. By rail the distance to Winnipeg is 607 miles, to Toronto 624 miles, and to Montreal, 802 miles. The road distance to Winnipeg is 620 miles, and to Duluth 360 miles.

In this district there are many exposures of rock of excellent quality for building and monumental use. In spite of this, production has been

small and intermittent, and confined mainly to the general vicinity of Marathon (formerly known as Peninsula) where both black and red granites were produced. Sufficient work was done, however, to show that both varieties possess the physical characteristics necessary for a good building and monumental stone, and to show that both could be readily obtained in blocks of the largest size required by the industry.

The black granite was first quarried at Marathon about 70 years ago by the Canadian Pacific Railway for the construction of bridges over the Pic and Little Pic rivers(11). Apparently no further work was done until 1927, when a group of claims were staked by Wm. Morrison, and quarrying carried on under the name of Peninsula Granite Quarries, Limited. Shipments were first made early in 1928, and Thomson (11) reports that during 14 months of operation in 1929 and 1930, twenty-four carloads of black, and two carloads of red granite were shipped from the area. The black granite was first obtained from the old railway quarry a short distance north of the station, but this was soon abandoned for an opening on the shore of Lake Superior near the harbour, where large blocks of good grade were obtained. The red granite was obtained from surface blocks on the east side of the C.P.R. right-of-way about 2 miles north of the railway station. The company property extended from the railway station for 2½ miles north along both sides of the railway.

In 1931 the Cold Spring Granite Company, Limited, of Cold Spring, Minnesota, purchased the black granite claims of Peninsula Granite Quarries, Limited. The new company operated during 1931 and 1932, shipping an appreciable quantity of black granite to the United States during that period. The granite was obtained from a new quarry immediately east of the C.P.R. right-of-way, three quarters of a mile north of the station, the former quarry being abandoned to eliminate an 1,800-foot haul to the railway. The new quarry was served by a siding of the railroad, and Thomson (12) reports that at the time of his visit in the fall of 1931 twenty carloads of black granite, with blocks weighing as much as 35 tons, had been shipped to Cold Spring. Operations ceased in 1932 and there has been little if any activity in the area since then.

The black granite of the Marathon-Port Coldwell district is an augite syenite which "Both in general appearance and . . . in mineralogical and chemical composition, . . . bears a striking resemblance to the famous Norwegian laurvikite"(7). It consists essentially of augite and feldspar, a microperthitic intergrowth of albite and orthoclase, with subordinate amounts of hornblende, olivine, biotite, apatite, and magnetite. "The rock is as a rule fairly coarse textured, the feldspar crystals being from a quarter to a

third of an inch long, and from less than one-tenth to a quarter of an inch wide. . . . The rock varies in colour from dark brownish grey to black in certain localities, while in other places it ranges from reddish grey to dull red, . . . The dark grey to black type is the most prevalent" (7).

Thomson (11) also noted its resemblance to the "beautiful monumental laurvikite of Norway". The following is taken from his description of the stone from the old quarry on the lake shore. The remarks might apply equally well to the stone from the Cold Spring Granite Company's new quarry, about the only difference being that the latter variety was coarser grained:—

"The granite, as a whole, is a dense, medium-textured rock uniform throughout the quarry. . . . The colour, when closely observed, is dark greenish-brown but at a short distance is black. . . . At the quarry the granite shows a marked uniformity of colour. Segregations and hair lines are absent. Pegmatite dykes a few inches in width occur at wide intervals.

"Examination of a dressed and polished specimen of the black granite shows that it is suitable for fine types of finished work. Owing to the large size of individual crystals, the rock breaks with a somewhat uneven surface. The colour of the hammered face is bluish-grey with a dark-green mottling. The polished surface is of pleasing appearance, the colour being much livelier than that of the rock face. Much of the charm of the rock is due to the light-blue iridescence of the feldspars . . . A detailed examination of the surface shows a pronounced greenish-brown shade speckled throughout by irregularly shaped shining black minerals. The surface is also dotted with small grains of magnetite made noticeable by their metallic lustre. The polished rock, viewed at the distance of a few feet, exhibits a bright lustrous black colour enhanced by the delicate sheen of the feldspars. The beauty of this unique type of black granite should assure it a ready market as an ornamental stone".

At the Cold Spring Granite Company quarry, which has a length of 85 feet, a width of 60 feet, and a depth of 20 feet, there are two sets of well-defined and widely spaced joints. The sheets vary in thickness from $1\frac{1}{2}$ to 8 feet and dip at a low angle. As in the quarry on the lake shore, the rock is massive and large blocks, of a size limited only by plant capacity, can be obtained. Channelling methods were employed in conjunction with drilling and blasting, and very little waste resulted from quarrying operations. According to Cole(4), the rift is vertical and parallel to one of the major sets. He described the stone as capable of taking a high polish and being somewhat similar to that found at Angler but having a slightly more greenish tinge.

The red granite of the district may be described as a medium to coarse grained red hornblende syenite of uniform texture and colour. It is composed of "feldspar and hornblende with varying amounts of biotite, augite and sphene. Apatite and magnetite are the chief accessory minerals"(7). The feldspar, which usually makes up five-sixths or more of the rock, "varies from orthoclase to microperthitic intergrowths of albite and orthoclase"(7). The stone is "usually deep red in colour, but varies greatly in this respect as it passes into the darker laurvikite, or into the lighter coloured nepheline syenite" (7). Thomson (11) describes the stone from the quarry as follows:—

"The granite is a medium-textured rock of a dull old-rose colour variegated with considerable amount of black material. Lath-shaped crystals of reddish orthoclase up to one-third of an inch in length are prominently exhibited. As observed at the quarry, the rock is of uniform colour and segregations are rarely of consequence. Hair lines and weathering stains were not noticed".

"The sawn surface of the red granite exhibits a light-pink matrix mottled with fine, irregular anhedra of blue-green hornblende. The rock takes a good polish and exhibits a uniform granular pattern. Orthoclase, hornblende, and scattered grains of magnetite are the most prominent minerals".

Another red granite quarry was opened by Peninsula Granite Quarries Limited in the same area, but apparently only a few blocks were removed from this location before operations were suspended. The stone was quite similar to that described above.

"Peninsula black granite has been used in the construction of several buildings in Canada and the United States. In Toronto, it can be seen in the new building of the T. Eaton Company, McConkey's restaurant, the Creed Building and the Woolnough Building. Numerous buildings in Chicago, Detroit, and other midwestern cities of the United States contain this granite" (11). A market had also been established in Western Canada. Both red and black granite were sold for monumental purposes.

About the same time or shortly after the Marathon area was active, a small amount of granite was produced along the railway at Angler, several miles west of Marathon, by Angler Granites Limited. Openings were made in several kinds of rock, from a deep red to a dark brownish black and almost jet black. Both red and black granites, of the type described above, were being produced and a polishing shed was being erected, when Cole(4) visited the property in 1932. He describes both types as taking an excellent polish and highly suitable for both monumental and building purposes. The formation was massive at both quarries, permitting the quarrying of large blocks, but numerous pedmatite dykes had to be avoided.

4. IGNACE DISTRICT

The Ignace District lies between Butler and Ignace on the Canadian Pacific railway and is served by the main line from Montreal to Winnipeg and by the new Trans-Canada Highway. By rail, the distance to Winnipeg is 272 miles and to Fort William, 148 miles.

There are numerous outcrops of a massive pale-grey biotite granite in this district, several of which have served as a source of building and monumental stone in the past. This granite, which is considered to be of Archaean (early Precambrian age), is also reported to have been quarried near Bonheur, about 18 miles east of Ignace (15).

The first quarrying in this district was done by the Canadian Pacific Railway, which opened several quarries along its right-of-way west of Ignace to obtain stone for bridge pier and culvert construction (6). The next operation was in 1912 (5) when Bannerman and Horne opened a quarry 2 miles west of Ignace for the production of paving blocks and building stone. It is reported (9) that the stone used in the construction of the Port Arthur Armoury came from here. This quarry was abandoned several years later in favour of a new location near Butler, 9 miles west of Ignace (10).

When Cole (4) visited the district in 1932, the stone was being obtained from a flat-lying granite exposure about one-third of a mile east of Butler station and on the south side of the railway. When visited again in 1935 a number of small openings had been made further south of the station, and only a small quantity of stone was being produced. Operations were being conducted by Wm. Horne. There has been little, if any, activity in the area since the late thirties or early forties.

The large opening first visited by Cole (4) had a face of 15 feet, a length of 140 feet, and had been worked back for a distance of 40 feet. Only the surface lift or top sheet was being worked. There was a solid face of 14 feet to the first parting plane, but the sheeting appeared very irregular and not continuous for any great length. The formation was cut by two sets of vertical joints, a major set striking N2°W and a minor set striking N71°W. The rift was vertical and parallel to the main joint planes, and the grain was horizontal and parallel to the sheeting.

According to Cole (4) the stone is a light grey medium grained biotite granite, with a decided gneissic structure. The feldspar is white and opaque and the quartz highly vitreous with a smoky tinge. The biotite mica is small in amount and unevenly distributed and there is also a small amount of metallics present. Large blocks weighing up to 20 tons can be obtained at this locality, but owing to the uneven distribution of the dark minerals, care has to be taken in the selection of blocks for monumental use. The

99246—11

rock splits well along the rift and grain and takes a fair polish, but there is little contrast between polished and hammered faces. Curbstone, paving blocks, dimensioned building blocks and monumental bases were produced from this quarry and marketed as far west as Winnipeg.

5. VERMILION BAY DISTRICT

The Vermilion Bay district, in the Kenora area, about 85 miles east of the Manitoba boundary, is Ontario's newest granite producing center. It is about 6 miles west of the Canadian Pacific Railway station at Vermilion Bay. By rail the distance to Winnipeg is 182 miles, to Fort William 238 miles. By paved highway the distance to the International border is 150 miles.

Quarrying commenced in the district in 1948 with the opening of a quarry in Docker township about 6 miles west of Vermilion Bay. The stone, an attractive, high quality granite of Archaean (early Precambrian) age (14), is produced by the Vermilion Pink Granite Company, Limited, of Winnipeg. There has been no production since 1951 but it is expected that operations will be resumed in the near future. No difficulty should be experienced in marketing this stone, situated as the district is, within easy reach of the United States and the Winnipeg market.

The stone may be described as a medium grained pink biotite granite of uniform colour, composition, and texture. It is composed mainly of orthoclase, microcline, and quartz, with minor amounts of plagioclase, biotite, and hornblende; magnetite (or ilmenite) is the common accessory mineral. The quartz is glassy clear and the feldspar is translucent to opaque. Biotite makes up about 2 per cent of the stone, and hornblende about 1 per cent. Pyrite is absent, and the mineral constituents, with the exception of the orthoclase, some of which has been altered to white mica, are in an excellent state of preservation. The stone takes an excellent polish and there is a fair contrast between sandblasted and polished surfaces. It has a pleasing appearance and should become quite popular both as a building and as a monumental stone.

The workings are situated several hundred yards north of the highway, on the crest and south side of a low ridge which slopes to the south at a low angle. The openings are small, as quarrying to date has consisted in working several of the sheets down their dips for a short distance, and along their strikes for 100 to 200 feet. The sheets strike approximately east-west, paralleling the highway, and dip to the north at 13 degrees. They are extremely well-developed, and where exposed in the southern opening, measure in ascending order, 7, 2½ and 3 feet; in the northern opening, sheets

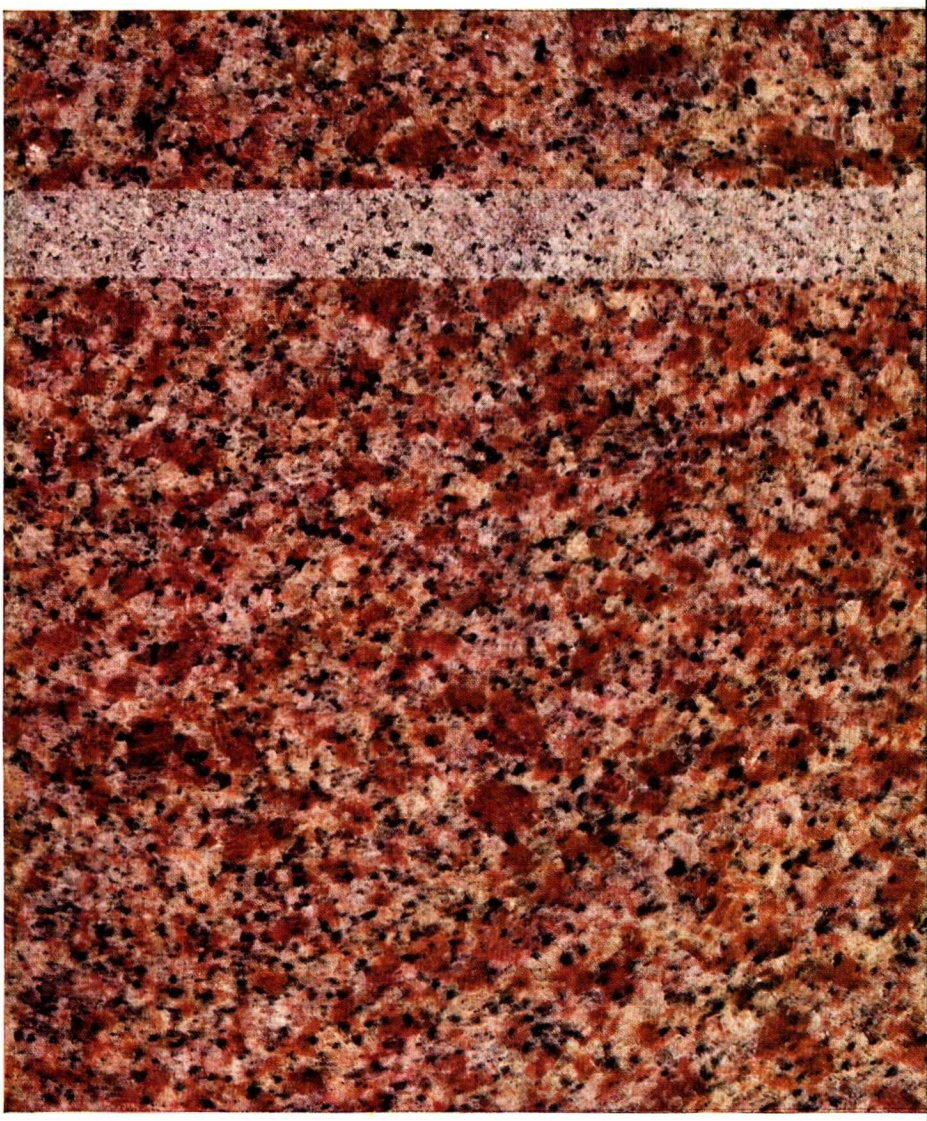


Plate 17

PINK GRANITE
Vermilion Pink Granite Company Limited quarry
Vermilion Bay District, Ontario.

3½ and 8 feet thick are exposed. In the northern opening one or two widely-spaced joints were seen striking approximately east-west, but cross joints were absent. In the southern opening, and in the surrounding area as revealed by the absence of overburden, joints appear to be almost entirely lacking.

The stone appears to have been quarried mainly by 'plug and feather' used in conjunction with drilling and blasting methods. The 'plug and feather' method was sometimes used alone to break the blocks loose from the face and to subdivide the more massive sheets by artificial sheeting planes; these holes were commonly spaced on 6-inch centres and drilled to a depth of 3-4 inches. This method of quarrying such a massive deposit was extremely wasteful and resulted in the production of a large amount of waste. An examination of the waste pile failed to disclose the presence of knots, rust stains, or variations in colour and texture in the stone; blemishes were confined to the occasional thin black seam or to occasional feldspar-rich zones or lenses.

This appears to be an excellent location at which to open a large quarry. With the institution of channelling methods in conjunction with drilling and blasting, very little of the stone would be discarded as waste, and blocks of any desired size could be readily obtained. About the only disadvantage that the location offers is that the sheets slope away from the present working faces, rather than towards them.

During 1951, the last year of operation, about 6,000 cubic feet of monumental and 2,000 cubic feet of building stone were shipped from the area. Most of the stone was shipped to the United States, with smaller amounts going to Western Canada and one or two shipments to Eastern Canada. This stone may be seen in the police station annex at Winnipeg, where it was used as a base course, and in the Vermilion Bay war memorial.

The derricks have either gasoline or compressed-air powered hoists, and compressed-air is supplied by diesel-powered equipment.

6. FARLANE DISTRICT

A number of years ago quarrying operations were carried on adjacent to the Canadian National railway a mile west of Farlane, a station 10 miles east of Redditt and 139 miles by rail east of Winnipeg. The stone, a red granite of Archaean (early Precambrian) age, was produced by the Ontario Granite Company, Limited.

The bluff in which the opening was made rises about 55 to 60 feet above the level of the railway; the stone was taken out in benches. The sheeting is fairly massive, but varies in places, and has a general dip of

99246—11½

10 degrees to the west. The rift follows the sheeting and the grain is vertical, paralleling the main joints which strike N13°W. Medium sized blocks can be obtained (4).

The stone is a fine grained, even-textured, light pink biotite granite with only a faint gneissoid structure. The colour of the stone is due to the red feldspars, but with the large proportion of quartz, and the biotite present only sparingly, the general colour of the stone is quite light. The rock takes a beautiful polish but there is not much contrast between the different finishes. It was used for monumental dies and should be suitable for building stone (4).

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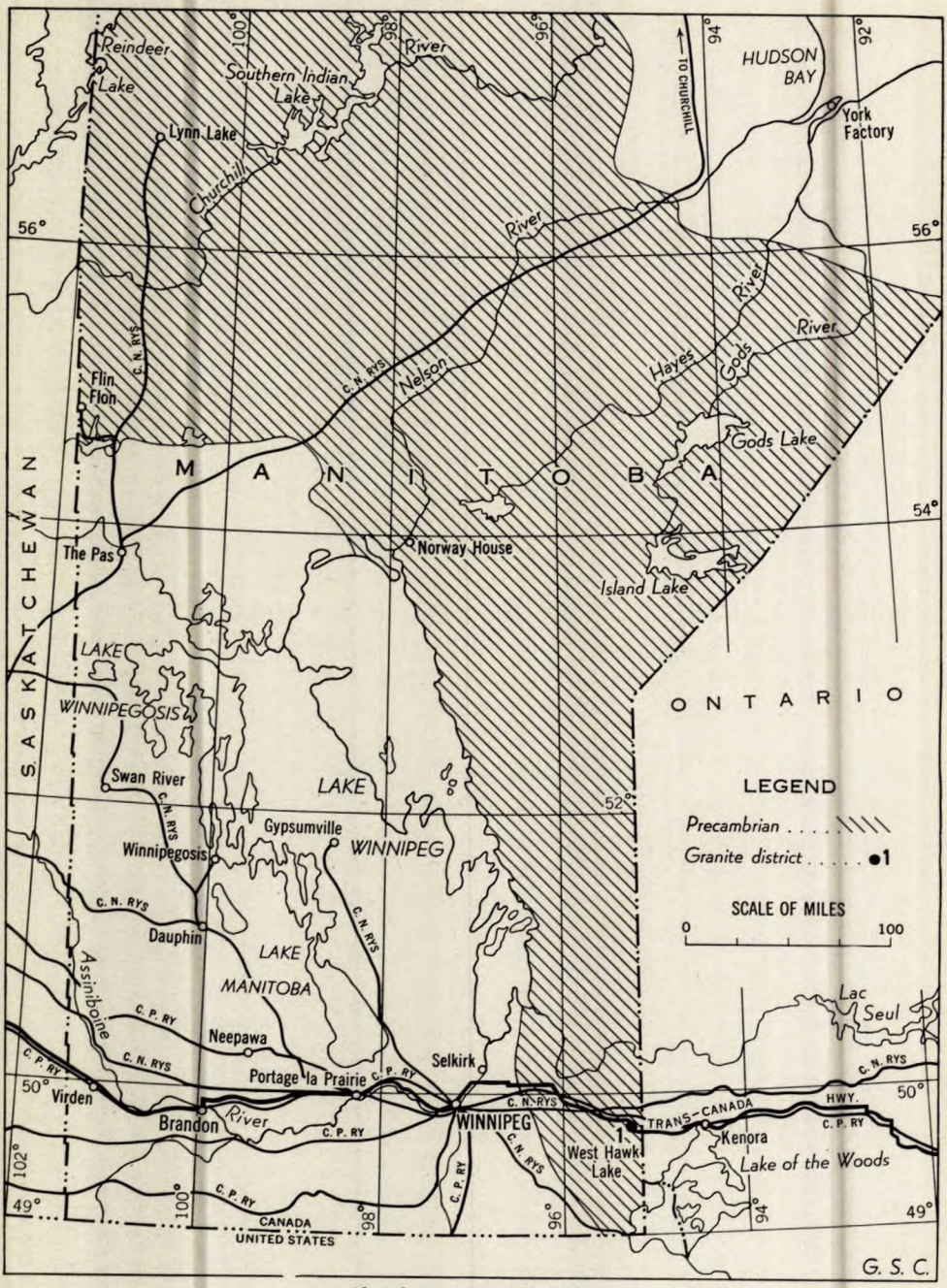

Sketch map of Manitoba

CHAPTER 8

GRANITES OF THE PRAIRIE PROVINCES

Granites, granite-gneisses and allied rocks of Precambrian age occupy a large part of eastern and northern Manitoba, northern Saskatchewan, and the extreme northeastern corner of Alberta. Very little of this area, however, is served by rail and road, and the only district where quarrying has taken place in recent years lies about 100 miles east of Winnipeg, close to the Ontario boundary. The granite areas on the east shore of Lake Winnipeg were at one time exploited in a small way both for dimension stone and for crushed aggregate, but these operations ceased many years ago. All other granite areas are too remote at present for economic working, except perhaps the territory adjacent to the railway lines running north from The Pas. These northern areas have not yet been examined for deposits suitable for quarrying.

While there is an extensive market for granite in the prairie provinces, production at present is confined to three quarries, all in Manitoba, which operate only intermittently and on a small scale. An appreciable amount of the granite used in the three provinces is imported from the United States, Sweden and Finland, but the greater portion comes from Quebec, with smaller amounts from British Columbia and Ontario.

The market, both for monumental and building granite, is good, and especially for monumental. In Manitoba, Saskatchewan and Alberta there are 22 towns and cities with a population of over 5,000, and 99 smaller towns and villages with a population between 1,000 and 5,000. As many are comparatively young communities compared with those of the older settled districts of Canada, there should be a good opportunity to urge the employment of granite in the construction of public and semi-public buildings being erected in these municipalities.

With the extensive exposures of granite in parts of eastern Manitoba, there is good opportunity for an intensive search for suitable deposits of granite of both monumental and building grade. Care will need to be taken in choosing any locality to see that the material to be quarried is free from knots or blemishes, which would detract from the suitability of the stone for either purpose. Only by careful selection of clear stock can a market be developed in the face of present competition from imported granites and other kinds of stone. Although a quarry producing only one

variety of granite would find a good market for its material, the granite industry, like many other industries, needs a wide range of products to satisfy all customers. Before, therefore, the industry in the prairie provinces can hope to cater even to its local market, it will be necessary to find and develop a diversified range of granites similar to those now imported by the finishing and memorial plants in operation.

MANITOBA

Precambrian rocks, made up chiefly of granite and allied rocks with their gneissic equivalents, form the bedrock in about three-fifths of Manitoba. With the exception of a relatively small area of later formations adjoining Hudson Bay, these Precambrian rocks occupy the entire northern and a large portion of the eastern part of the province. Cole remarked (2) that "A line projected through the major axis of Lake Winnipeg from the southeast corner of Manitoba and thence westerly to the middle of the western boundary of the province, is roughly the southwestern limit" of these Precambrian formations.

Large areas of Precambrian gneisses and granites are exposed on the east shore of Lake Winnipeg. Several of these areas were described by Tyrrell and Dowling (5) as early as 1898, but, as far as is known, none of these granites has been quarried for dimension stone, although a small amount of gneiss is reported to have been quarried for building purposes incidental to operations for crushed stone. Parks (3), who visited the area in 1914, reported that the only locality which seemed to have been investigated by prospective quarry operators was Rabbit Point, where a medium to coarse grained reddish-grey granite occurs. The following paragraph is taken from his description of the Rabbit Point locality:—

"The Rabbit Point granite is of medium to coarse grain and is rather dull in colour: it is not uniform either in colour or in grain and therefore does not present great possibilities as a high grade building stone. In places the fracturing is excessive but in others the formation would permit the extraction of fair sized blocks. In my opinion the stone is suitable for foundations and for the lower storeys of large buildings, but not for ornamental purposes or for buildings of the monumental type."

Parks describes one quarry, situated about 20 miles south of Rabbit Point on the east shore of Lake Winnipeg opposite Bull Head, which was being operated as a source of crushed stone. The crushed stone was transported by barge down the lake to Selkirk and thence to Winnipeg. He describes the stone as a "hard, compact, indistinctly laminated, fine-grained gneiss of a general dark greyish-red colour".

In 1927, Wallace and Greer (6), in referring to the "promiscuous scattering over the prairies of pre-Cambrian boulders, mainly of granite", mention that "In the absence of other structural materials they have been used to some extent for building purposes". As prominent examples of such work in Manitoba, the court house at Morden, the Mission Church at Pine Creek on Lake Winnipegosis, and the Indian Industrial School (R.C.) at Cross Lake, are cited. They also mention that the only granite which had been quarried in Manitoba for monumental purposes was a red pegmatite granite from Brookville (M 79, G.W.W.D.). They write:—

"The granite is intrusive into a grey sheared granite, and shows a coarse, pink feldspar, which on polishing, gives a fine play of colour. The stone requires to be carefully selected, and is of unusually large grain for the trade, but is undoubtedly handsome. A mill was installed at the property for sawing and polishing and work was continued until 1923, since when no stone has been shipped from the property. At the quarry, where a depth of 50 feet was reached, there is a width of 60 feet of effective red granite between the walls of the grey sheared granite on either side. A spur line is run in from the G.W.W.D. line at mile 79 northwards to the quarry a quarter of a mile".

At the present time there are two granite companies operating in Manitoba, Winnitoba Granite Company Limited (Memorial Marble & Tile Company Limited), Winnipeg, and Shoal Lake Granite Company, East Braintree. The principal operator, the Winnitoba Granite Company Limited, operates a large finishing plant in Winnipeg and two quarries, one in grey, the other in black granite, in the West Hawk lake area of eastern Manitoba. When visited in July, 1953, both quarries were inactive, having last operated in 1951. In the granite section of the finishing plant (one section is reserved for limestone) a total of eight men were employed in dressing various types of granite, including both local varieties. It was stated that the greater percentage of the time was devoted to preparing stone for the monumental trade, the remainder to building stone. The quarrying operations of the Winnitoba Granite Company Limited are discussed below under "West Hawk Lake District".

Time did not permit a visit to the Shoal Lake Granite Company's operation, and the following description is taken from a recent report by Springer (4):—

"The Shoal Lake Granite Company operates a quarry about 3 miles northeast of Glenn in section 10, township 8, range 15, east of the Principal meridian. The quarry is situated in a small medium-grained black diorite boss, which measures about 200 feet by 350 feet. Some fine-grained diorite is taken from the margin of the intrusive. Formerly rough blocks were shipped to the Winnipeg market, but at the present time the total production is cut and polished into a variety of monumental stones at the quarry site".

The 1950 production of the above company is given (7) as 143 square feet of polished granite.

WEST HAWK LAKE DISTRICT

The West Hawk lake granite district is in the Lac du Bonnet Mining Division of southeastern Manitoba adjoining the Ontario boundary. For convenience, the district is regarded as embracing township 9, range 17, east of the Principal meridian, an area of 30 square miles. It is in this district that the two principal granite quarries of the province are situated.

The rough quarried blocks were formerly hauled to the Canadian Pacific Railway station at Telford, a distance of 10 miles, for loading. In recent years, however, all shipments have been by truck direct to the plant at Winnipeg. By road, the distance to Winnipeg is 106 miles, to Regina 485 miles, and to Calgary 1,000 miles.

Grey Granite.—The grey granite quarry of the Winnitoba Granite Company, first opened during the summer of 1933, is situated on section 29, on the east side of the Trans-Canada Highway, and adjacent to it at a point 105·8 miles east of Winnipeg where the highway runs in a northerly direction around West Hawk lake. It has been opened on a deposit of grey granite bordering on or upon a hornblende granite gneiss.

The stone is a medium-grey biotite granite of medium-fine grain and is known to the trade as 'Wingrey'. It is of uniform texture and mixture and the constituent minerals show virtually no decomposition. The quartz grains are translucent to clear, with a faint bluish cast, which gives depth and a decided bluish-grey tint to the stone. The stone tends to show a slight banded structure which is quite pronounced at the south end of the quarry, at which point it also has a decided pinkish colour and is known to the trade as 'Winred'. The 'Wingrey', which makes up the bulk of the stone, is slightly darker than the light greys of the Eastern Townships.

The stone is close grained and takes an excellent polish and there is a marked contrast between polished and hammered surfaces. It is well-suited for carving or moulding by hand, machine, or sandblasting. Occasional minute crystals of pyrite may be observed under the microscope, but monuments manufactured from this stone show no sign of rust or stain after years of exposure. Occasional crystals of garnet, about one-tenth of an inch in diameter, may be seen in hand specimens.

The quarry is of the side-hill type, with the floor approximately level with the highway, and has a length (north-south) of 250 feet, a width of 75 feet, and the face has a maximum height of 25 feet. The sheets exhibit some variation in dip and strike; for the most part they dip at 10 degrees in a southerly direction, and vary from 1 to 2 feet in thickness, with an average of 1½ feet. The stone is badly cut up by numerous steeply-dipping joints, making it

impossible to obtain large blocks for building construction without the production of a large amount of waste. The stone, as exposed in the quarry face, is practically free from black knots or segregations, but is cut by numerous small white-to-pinkish pegmatite dykes which contribute heavily to wastage; knots have been objectionable in the past, in places they gave rise to a distinct banding of the stone. As a result of the numerous joints and pegmatite dykes occurring in the stone, it is estimated that approximately 80 per cent of the stone quarried is finally discarded as waste. The rift appears to be horizontal and the grain vertical.

Drilling is done by jackhammers and tripod drill, using large 'plugs' and 'feathers' for the breaking. For springing large blocks, powder is occasionally employed. Hoisting equipment consists of 2 wooden derricks, both of which have gasoline-powered hoists. The compressed air is supplied by a portable gasoline-powered unit.

When first opened, only monumental stock was quarried, both dies and bases, and this material was shipped to the finishing plant at Winnipeg and to other monumental dealers in the prairies. Later, the stone was also used for building, one example of its use being the large Government office on Main Street in Winnipeg, some blocks for which were of large size. At present the stone is seldom used for building construction or for monumental dies, but is used extensively for monumental bases. The company still has a sufficient supply on hand for this purpose, although the quarry has not operated since 1951. The 1950 production of the grey quarry is given (7) as 149 tons, compared with 228 tons for the previous year and 160 tons for 1948.

Black Granite.—The black granite quarry, on section 17 about 3 miles south of the grey quarry, was first opened by the Winnitoba Granite Company about 1938. It is located about a mile south of the Trans-Canada Highway along the branch road to Falcon lake.

The black granite is actually a coarse grained black diorite and is a border phase of the Falcon lake stock. The Falcon lake stock, a small igneous mass 2·6 square miles in area, lies between Falcon and West Hawk lakes about 3 miles from the Ontario boundary.

According to Brownell (1), the Falcon lake stock consists of three distinct portions, with the outer or more basic portion containing some gabbro but consisting mainly of a coarse, black and white diorite. The diorite "consists of white-weathering crystals of plagioclase which are commonly one-quarter to half an inch long, with interstitial black biotite and hornblende . . . The plagioclase normally makes up about 75 per cent of the rock". The accessory minerals are magnetite, apatite, titanite, and zircon. Where quarried, "the diorite is quite black, although its textural and other features remain normal". The difference in its appearance from the normal black and white diorite, Brownell writes, is "due entirely to the

greater translucency of the plagioclase crystals in the black variety, which permits light to penetrate them and be absorbed by the surrounding black biotite and hornblende".

The stone takes a good polish and there is a good contrast between the polished and sandblasted or other surfaces. The main impurities in the stone are black stringers, as a result of which nearly 80 per cent of the stone quarried is finally discarded as waste. The sheets are up to 3 feet thick at the quarry, and the joints are spaced so as to permit the quarrying of large blocks such as are required for building purposes. The quarry, of the side-hill type, has a length of about 50 feet, a width of 30 feet, with the face having a maximum height of 40 feet.

The stone, known to the trade as 'Winblack', is used for building and for monumental dies and bases. In the relatively short time since quarrying commenced, it has become quite popular as a building stone, and the following are a few of the prominent buildings in Winnipeg in which the stone has been used:—

CBC Building
Tip Top Tailors Building
Greater Winnipeg Water District Building
Science Building, University of Manitoba
Kensington Building.

In the above structures, the stone has been mainly employed as a 2-inch facing, but it has also been used for columns and bases of buildings. There is a growing demand for this stone in building construction, and if quarrymen were obtainable, the quarry would be operating at present. The 1950 production is given (7) as 110 tons, compared with 124 tons for the previous year, and 190 tons for 1948.

SASKATCHEWAN AND ALBERTA

No quarries of granite are worked in either of these provinces and none is likely to be opened up for some time, as the only exposures of granite are mostly north of present lines of transportation, too far from the larger markets to make the working of such deposits economical.

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Sketch map of British Columbia

CHAPTER 9

GRANITES OF BRITISH COLUMBIA

British Columbia has vast areas of igneous rocks, many of which are close to the principal roads and railroads, and a great many of which are along the Pacific coast and favourably situated with respect to water transportation. In some, good stone has been developed which has become well known not only throughout the province, but also in the prairie provinces and in the Pacific coastal regions of the United States as well; other localities have been abandoned for lack of outstanding characteristics of the stone, or for other reasons. Grey granites of varying shades are the predominating type now being quarried, but in a few localities stone of other colour has been or is being worked in a small way. This province, with its large areas of granites and related rocks, might well be classed as our second greatest granite province.

The coastal region, which includes dozens of islands in addition to several hundred miles of coast line, contains almost unlimited places where granite suitable for building and monumental purposes might be obtained. Despite the potentialities of this large area, however, there has been very little development of a granite industry and, if we omit the quarries operated solely for the production of rip-rap, crushed stone, etc., only two quarries of importance are at present operated in the whole area. During August, 1953, there were approximately 36 individuals directly employed in the granite industry of this region.

There are many reasons for non-development of this great granite region, probably one of the chief reasons being the lack of variation encountered in the granites, as they can almost all be classed as grey granites, and the demand for grey granite can perhaps be best satisfied from one main quarry than from several smaller ones. Furthermore, the very nature of the coast line makes some areas almost inaccessible, and the granite in many places has flaws such as knots, irregular grain, gneissic structure, veins, and excessive jointing. In spite of this, however, there are undoubtedly many other areas where particularly good grey granite could be obtained, if and when there is sufficient demand for such a stone in the Pacific coastal areas. There is also a distinct possibility that granite sufficiently dark in colour to be classed as black granite might be found in this region.

In the interior of British Columbia there are other areas which have produced a limited amount of granite, probably one of the most important being that around and to the north of Okanagan lake. This district formerly

produced a pinkish grey granite but is inactive at present; it is described below under the Vernon district. Other localities in the interior from which building and monumental stone have been produced in the past are Nelson, Sirdar, Greenwood, Coryell, Rossland, and Ymir. At present operations are small and intermittent and confined to the Nelson and Sirdar areas.

Granites and other igneous rocks are of widespread distribution in the interior of British Columbia, but those localities mentioned are the only ones where active quarrying has taken place. In this portion of the province outcrops can be found as far north as the North Thompson river in the Clearwater area, and near the International boundary they extend over a length of 150 miles. When it is considered that more than half of this great triangular-shaped area is underlain by igneous rocks, there must be many localities where conditions are suitable for the production of granite for both building and monumental purposes. However, there are many factors against successful development in this region, chief of which may be given as the rugged terrain and the general inaccessibility of most of the country, as there are relatively few roads and railroad lines traversing the region.

There are also igneous outcrops on Vancouver Island, but apparently no development of granite quarries has ever been attempted. Some of these areas are described as gabbros, anorthosites, hornblendites, etc., by Clapp (8), and it is possible that a good black granite may be obtained from the island.

Granite has received favourable consideration for many of the large buildings, especially in the larger centres such as Vancouver and Victoria. There are in the province 15 cities with populations over 5,000, and 28 cities or towns of population between 1,000 and 5,000. Of these 43 urban centres, 20 are on the Pacific coast or tide water and account for approximately 85 per cent of the urban population of the province (23). Thus it can be seen that by far the largest market for building stone in the province is available only to those quarries on or adjacent to the Pacific coast, and unless a granite from any of the interior quarries has exceptional characteristics, the only market for such rock is the occasional public or semi-public building in a nearby urban centre.

For purposes of description the granites of British Columbia are divided into 5 districts as follows:

Coastal Region

1. Nelson Island
2. Haddington Island

Interior Region

3. Vernon District
4. West Kootenay District
5. Ice River District

COASTAL REGION

The Coast Range borders the Pacific ocean for a distance of nearly 1,000 miles, extending in a north-north-westerly direction from the Fraser river valley to the Alaskan boundary and beyond. This range takes in a fairly wide strip of the mainland and includes many of the islands along the coast. The whole area is composed of intrusive rocks in the form of a great series of batholiths which were intruded during late Jurassic and Cretaceous times. Parks (19) describes the general rock of the Coast Range as "a greyish granodiorite varying to quartz diorite or even to dark basic phases such as gabbro". Quarrying is at present confined to the actual coastal areas, to Nelson island, at the entrance to Jervis inlet, and to Haddington island, off the northeast coast of Vancouver Island. Both are described below under separate headings.

Very little information is available as to the early history of granite quarrying on the Pacific coast of British Columbia. At the beginning of the settlement on the coast, because of the abundance of timber available, all construction was of wood, and it was not until the settlements obtained some degree of permanency that stone of any kind was considered for use in construction. Probably the first building stone from British Columbia used in construction was sandstone from a quarry on Gabriola island, from which stone was shipped to San Francisco for use in the Treasury building previous to the year 1837. It was not until sometime after 1880 that granite was quarried.

About this time a considerable quantity of good grey granite was obtained at Victoria from boulders, and stone was also quarried from the shore of Burrard inlet, as well as from Nelson island (12). Numerous quarries have since been opened up at various localities at or near the coast, but with few exceptions have been abandoned.

The Jervis inlet stone, which is essentially a grey granodiorite, has been quarried the most extensively and is probably the best known of the British Columbia granites. Operations in this area are confined to Nelson island at present, but in the past quarries have been worked on Sechelt, Fox, Hardy, and Granite islands. As the stone from these localities is essentially the same as that produced at Nelson island, described in detail below, they will receive no further mention in this report. It should be mentioned, however, that the stone was extensively used for building purposes in Victoria and Vancouver, and was also employed for monumental dies and bases; that from Granite island, in particular, where several quarries have operated at various times, was employed in a number of large buildings in Vancouver, such as the Marine Building, Spencer's store, the post office, and the Bank of Commerce (main building).

99246—12

Stone not essentially different from the Jervis inlet type has been quarried in the Pitt river area, and between Agassiz and Thompson on the main line of the Canadian Pacific Railway. The granite quarried along the railway was used almost exclusively for rough building in connection with the railway, while production in the Pitt river area has been limited to a small amount of building stone from a quarry on the shore of Pitt lake (19). At present operations are confined to the production of poultry grit, stucco dash, sandblasting material, and sanding material for automotive vehicles, from a quarry near Rosedale, and to the production of granite for jetties, dykes, and concrete aggregate, from a quarry on Pitt river.

Both granite and hard volcanic rocks have been quarried in the north arm of Burrard inlet, and the output has been used chiefly as crushed stone. Definite quarrying for building stone in this area has been confined to Croker island, where a granodiorite somewhat similar to the Jervis inlet stone was produced on a small scale at one time (19). At present two quarries are being operated in the vicinity of Indian Arm for the production of jetty rock, rip-rap, and rubble.

Darker coloured stone of less granitic appearance occurs on the islands off the Skeena river, and also along the line of the Canadian National Railways from Sockeye at the mouth of the river eastward to beyond Nicol. One quarry has been operated for crushed stone on Smith island, in the mouth of the Skeena river, but apparently no attempt was made to use the stone for structural purposes. Parks (19) describes this stone as a medium to fine grained grey granodiorite, suitable for building purposes. Another quarry, 25 miles from Prince Rupert along the line of the railway, was opened in a dark coarse grained and somewhat gneissic quartz-diorite for the purpose of supplying railroad ballast.

In addition to the above areas in which actual quarrying has taken place, Parks (19) lists a number of unexploited areas as worthy of notice. Of these, probably the most promising is Walsh cove, on the eastern shore of West Redonda island near the northern end of Waddington channel. He described the stone from this locality as "a granite or granodiorite of general pinkish tone, with a grain comparable with that of the best varieties of Jervis Inlet stone". Bancroft (2) described the stone as "somewhat similar to the celebrated Baveno granite from the vicinity of Lago de Maggiore, in Italy, but the shade of pink is more delicate and its general appearance even more pleasing". As early as 1886, Dawson (11) had noted that this stone "was favourably situated for quarrying, as it is traversed by nearly horizontal jointage-planes and rises in a low cliff from the water's edge." The distance by water to Vancouver is 120 miles, and there is deep water close to the shore and good shelter.

Figure 38 | *Vancouver Granite Company Limited quarry, Nelson Island, B.C.*

1. NELSON ISLAND

On Nelson island, situated at the entrance to Jervis inlet, about 60 miles northwest of Vancouver, a high quality light-grey granite is being produced. This granite has been quarried for many years and has established an excellent reputation as a building and monumental material, not only throughout British Columbia and other parts of Western Canada, but on the Pacific coast of the United States as well. Known to the trade as 'Nelson Island Grey', it is produced by the Vancouver Granite Company Limited, of Vancouver, from a large quarry on the south end of the island.

The quarry can be reached from Pender Harbour, about 10 miles by boat to the south. Pender Harbour is reached from Vancouver by motoring to Horseshoe Bay, then taking the ferry to Gibson's Landing, which is connected with Pender Harbour by gravel road; the one-way trip takes 4½ to 5 hours.

With the exception of a narrow band of limestone in the northwestern part of the island (18), Nelson island is formed entirely of granitoid rocks of the Coast Range batholith. This batholith was provisionally placed in the Upper Jurassic by LeRoy (16), although on the Vancouver sheet (21) the intrusives are now classed as Jurassic (?) and Cretaceous. The stone from the Jervis inlet area, as Parks (19) remarked, "is essentially a grey granodiorite, varying in grain and in the relative proportions of the light and the dark-coloured components".

99246—12½

This is a very old quarrying district with a record dating back about 70 years. Dawson described the stone in a report of 1887-8 (12), and mentioned that it had already been exploited to a limited extent and had been used in the construction of the dry-dock at Esquimalt. The dry-dock at Victoria and the New Westminster bridge are other examples of its early use.

According to Parks (19), the first opening was made on the small point separating Quarry bay from Deadmans cove, while the second was opened shortly thereafter on the shore of Deadmans cove. These locations appear to have been abandoned by the company around the turn of the century in favour of the present location at the head of Quarry bay. Parks gave the 1915 production as 25,000 cubic feet, and mentioned that the stone was probably the best known of all the Coast Range granites. It had been largely used in Victoria and Vancouver, had been exported to the coast states, and sent in small quantity to Australia and Honolulu.

Production for 1923 was estimated (3) at approximately 96,000 cubic feet of building and monumental stone and 1,200 cubic yards of rubble. The major portion of the dimension stone was used for building purposes, mainly in the construction of the Federal Government dry dock at Esquimalt, and the new buildings of the University of British Columbia at Point Grey. Most of the monumental stone was exported to the United States. In 1926 the quarry was reported as producing around 50,000 cubic feet annually (4).

The quarry has operated more or less steadily since that time, normally from April to September. At Vancouver the rough undressed blocks are disposed of to local stone dressers for cutting and finishing, or exported to the United States or the prairie provinces. Much of the stone has been dressed in the finishing plant of A. S. Allan & Company Limited on the premises of the Vancouver Granite Company. At present this plant is being operated by Pacific Coast Granite Limited, of Vancouver.

The stone is an even grained light-grey granodiorite of medium texture. It is composed essentially of quartz, orthoclase and plagioclase feldspars, biotite, and a little black hornblende, with magnetite as an accessory mineral. The feldspars are mostly white and opaque, while the quartz is translucent to glassy-clear with a slight smoky tint, relieving the dead white of the feldspars. There is some evidence of a pinkish tinge in the general appearance of the stone, due to feldspars frequently showing a pinkish shade. According to Parks (19), "Some of the orthoclase crystals show incipient decay, but the plagioclase is usually quite fresh". The stone is free from pyrite, and knots and veinlets are very few and small.

The stone fills well and takes a high polish, and under oblique light the polished specimens show very few incipient hair cracks. There is little relief on polished specimens, only a few of the biotite crystals showing depressions among the surrounding minerals. There is fair contrast between

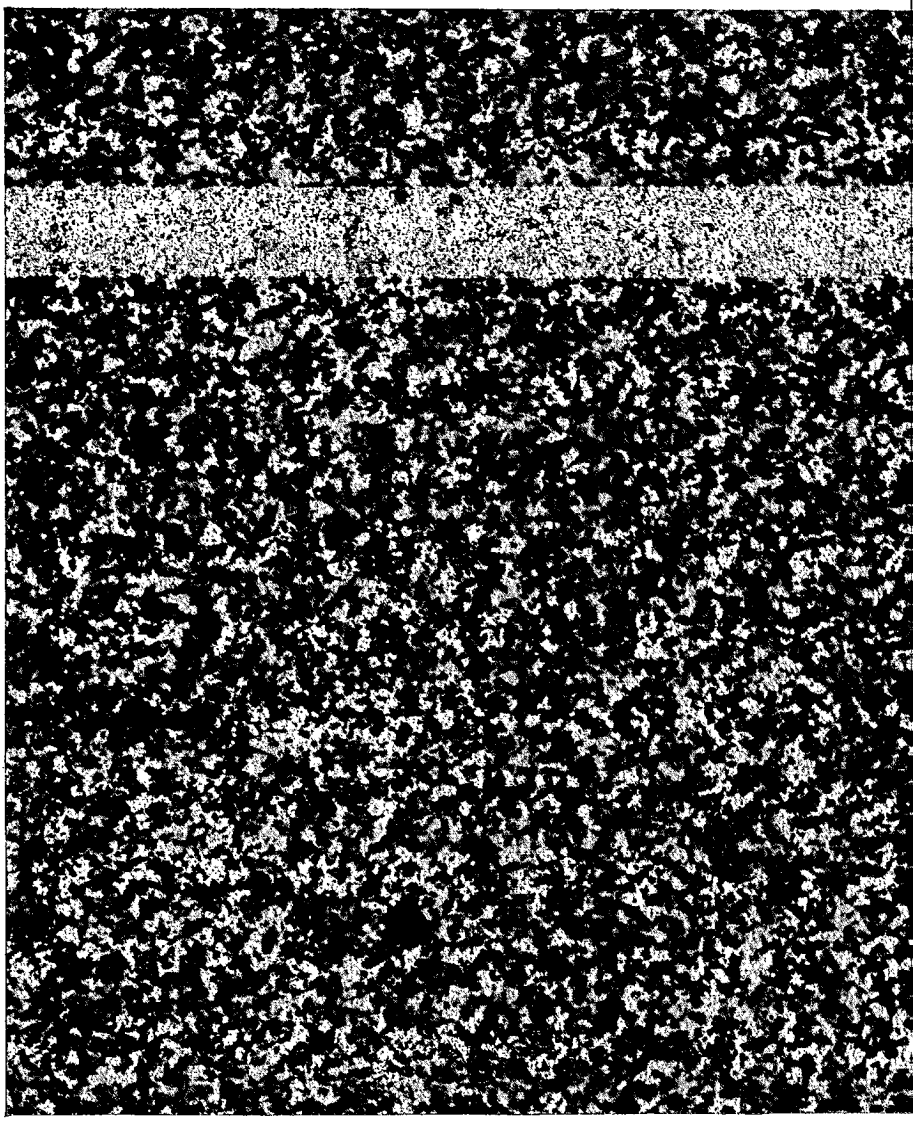

Plate 18

BLUE GREY GRANITE
Vancouver Granite Company Limited quarry
Nelson Island, British Columbia.

the hammered and polished faces, and this, together with its excellent polishing qualities and attractive appearance, makes the stone highly suitable for monumental and building stock.

The quarry is on the south side of a steep bluff at the head of Quarry bay, the opening being about 400 feet long and 200 feet wide at its greatest width. It has been worked in steps, as may be seen in the accompanying photograph (Figure 38). At its highest point, the quarry is approximately 250 feet above sea-level, while that part of the quarry floor on which two of the derricks and the compressor stand, is from 75 to 100 feet lower.

The sheeting dips to the south at a slight angle, veering to the southeast nearer the seaward part of the quarry, where the dip is about 10 degrees. The sheeting is massive, sheets up to 30 feet thick being observed, and at the point being worked in August, 1953, it presented the following section in descending order: 6 feet, 7 feet, 8 feet, 6 feet, and 24 feet. The rift is vertical with a strike of N30°W, the hardway is vertical striking N60°E, while the grain slopes at approximately 10 degrees to the south. Joints are widely spaced at this point, the main set being vertical with a strike approximately parallel to that of the hardway. A minor set, with widely spaced and vertical joints, was noticed cutting the major set at approximately right angles.

The stone is quarried by simple drilling and blasting, and the quarried blocks are sub-divided by 'plug and feather'. Due to the remarkable facility with which the stone may be split, and to the well-developed sheeting and jointing, large blocks can be easily obtained with the production of a very small amount of waste. Blocks up to 17 and 18 tons are frequently obtained, the general run being from 10 to 12 tons. These rough blocks are loaded by derrick onto scows for delivery to the yard at Vancouver.

The quarry derricks have steam-operated hoists and the compressed air is furnished by diesel-powered equipment.

In addition to the above quarry, the Vancouver Granite Company Limited has opened a small quarry in dark blue grey rock a quarter of a mile to the north. This quarry, situated at sea-level, had not previously been operated for nearly 20 years and was not visited during the present investigation. The following description is taken from Cole's (9) report.

The stone is fine grained and considerably darker than that found in the main opening and is probably a true diorite or grades into a quartz diorite. The ferro-magnesian minerals form fully 50 per cent of the mass, the remainder being largely feldspar, mostly plagioclase, with a small percentage of quartz and some magnetite. The dark minerals are biotite and hornblende in about equal proportions. It is considerably harder than much of the stone from this area, and when polished on the headway closes well to make a handsome monumental stone. In oblique light no incipient cracks show, and all the mineral constituents polish uniformly. It is known to the trade as 'Nelson Island Blue Grey'.

N.F.B. Photo

Figure 39 | *Vancouver City Hall, constructed in part from Nelson Island grey granite and Haddington Island andesite.*

At the quarry there is no definite jointing system, there are numerous blind seams and knots, and the stone is difficult to break even along the rift. However, in spite of these disadvantages it is possible to quarry blocks free from defects, and when such blocks are obtained they make ideal monument dies of a strikingly pleasing appearance. The rift is apparently vertical with a strike of N10°W, and the grain is horizontal.

During 1952 approximately 15,000 cubic feet of dimension stone were quarried and shipped from Nelson island. Of this amount about 75 per cent was used for monumental purposes, and the remainder for building. This compares with a production of 22,100 cubic feet during 1950, when some 60 per cent was used for monumental and 40 per cent for building purposes. It is expected that the 1953 production will be used in the same proportion. At present its use as a building stone is confined mainly to British Columbia, more particularly to Victoria and Vancouver, although an occasional shipment is made to Alberta. As a monumental stone, it is used in British Columbia, Alberta, Manitoba, occasionally Saskatchewan, and as far south as Oregon and Washington; about three carloads were exported to the United States in 1952. The stone is occasionally used for rubble, rip-rap, and crushed stone, and has been used for making paving blocks.

The following are some of the more important structures in which Nelson island stone has been used:

Parliament Buildings, Victoria (base).
New Post Office, Victoria (base).
New City Hall, Vancouver (base).
University of British Columbia Buildings (base).
Credit Foncier Building, Vancouver (base).
Merchants Bank, Granville & Pender Streets, Vancouver (base).
Canadian Bank of Commerce, Main & Pender Streets, Vancouver (base).
Court House, Vancouver (base).
Hudson Bay Company Store, Granville & Georgia Streets, Vancouver (base).
Lions Gate Bridge, Vancouver.
Songhees Dry Dock, Esquimalt.
Land Titles Building, Edmonton.
Elks Temple, Portland.

The stone has been extensively used for monumental purposes, and in this connection was used in the war memorials at Victoria, Vancouver, Chilliwack, Nanaimo, and Kamloops, in British Columbia; Boise, Idaho; McMinnville, Oregon; Calgary, Alberta; and several other localities in the prairie provinces. Other examples of its use are the Harding Memorial, Stanley Park, Vancouver, and a mausoleum at Portland, Oregon.

2. HADDINGTON ISLAND

A highly desirable building stone, an andesite, is obtained from a quarry on Haddington island, Broughton Strait, off the northeast coast of Vancouver Island. This island, which is approximately half a mile in diameter, rises 300 feet above sea level at its highest point, the slope to the water on the north and west sides being gradual, but more abrupt on the south and east where it has an angle of 30 degrees or more. Alert Bay, a settlement of about 500 population, and a regular port of call for coastal steamers, is about 4 miles east of the island. The distance by water from Haddington island to Vancouver is 200 miles.

Haddington island is in the Suquash coal area, in the southern part of the basin. Apparently the island is formed in whole or in part of andesite, a volcanic equivalent of diorite, which intruded the coal measures (mainly grey Cretaceous sandstones) of the area during the Tertiary period. Clapp (7), who referred to the stone as a trachyte porphyry, mentioned that it was being quarried extensively in 1911 and furnishing the best grade of building stone on the coast.

N.F.B. Photo

Figure 40 | *Empress Hotel, Victoria, B.C. Haddington Island grey andesite.*

Figure 41 | *Subdividing by 'plug and feather', Haddington Island, B.C.*

Stone was first quarried from Haddington island sometime in the early nineties, although as early as 1886 (11), and again in 1887-8 (12), Dawson had referred to its commercial possibilities as a building stone. Extensive quarrying appears to have started around 1895 when stone was obtained for the construction of the Legislative Assembly buildings at Victoria, completed in 1897. Operations continued on an extensive scale, and by 1904 it is reported (6) that two separate quarries had been opened up at the southern end of the island. In 1908 one large quarry was operated by McDonald, Wilson and Snider of Vancouver.

When Parks (19) visited the area in 1916, the quarry was not operating and operations at the two dressing plants in Vancouver had practically ceased. He gave the 1915 production as 18,000 cubic feet, and mentioned that the andesite had been used in the construction of some of the most important buildings in the province.

For a number of years past the quarry has been operated by J. A. and C. H. McDonald Limited, whenever the demand for stone warranted. The company operates a well-equipped dressing plant in Vancouver, which is capable of handling large building contracts. The plant is conveniently situated on the waterfront, permitting the stone from Haddington island to be transferred directly from scow to stockpile located beside the plant. The quarry and plant normally operate from 6 to 8 months each year. The 1952 production was approximately 20,000 cubic feet, all of which was used for building purposes, and all of which was dressed in the company's own plant.

The stone is of very uniform grain throughout, although there is some variation in colour. At present two varieties are being produced, namely, a bluish-grey variety, and a greyish-yellow or buff-tinted variety, which apparently is a result of the blue-grey having undergone a slow process of oxidation. The stone consists of a light-coloured homogeneous and minutely crystalline groundmass, which in the greyish-yellow or buff-tinted variety, is dotted through with light-brown specks up to 2 mm. in diameter that, on examination under the microscope, prove to be twinned plagioclase feldspar with a distinct zonal structure (19). Hoffmann (15), who refers to the stone as a quartz-andesite (dacite), gives the following analysis of a sample submitted by Dawson: "Silica 70·5, alumina with a little iron 18·7, lime 2·7, magnesia, a very small quantity—undetermined; alkalies, undetermined; loss on ignition 0·8." An examination for sulphur at the Mines Branch (19) showed only 0·006 per cent, which is about equal to that of the better grades of Coast Range granite; its specific gravity is given as 2·67

The quarry is at the southeastern end of the island, the floor ranging between 10 and 15 feet above water level. Originally the cliffs at this point were at the water's edge, but continuous working of the quarry has enlarged

the opening until there is an excavation 450 feet long (in a northeast-southwest direction) and 200 feet back from the water at the centre of the quarry. The quarry face slopes towards the water at an angle of 55 degrees and has an average height (slope distance) of 125 feet.

The bedding, or sheeting, is highly inclined and seems to vary in both strike and dip in different parts of the quarry. At the northeastern half of the quarry where present operations are centred, the sheets are nearly vertical, strike approximately N50°W, and are commonly spaced 8 to 10 feet apart. Jointing in the quarry is well defined but very irregular, one set being nearly vertical with strikes varying between due north and N45°E. Another prominent set, with joints spaced up to 12 and 15 feet apart, strikes N50°E and dips to the southeast at 54 degrees, paralleling the quarry face. A less marked set with a somewhat similar strike, dips to the northwest at 40 degrees.

As the joints rarely cut the bedding at right angles, there is some waste in obtaining rectangular blocks. This is counteracted to a considerable extent by the wide spacing of the joints, except in certain narrow headings, enabling large blocks to be obtained which can be split into rectangular sizes as required. Due to the wide spacing of the vertical and northwesterly dipping joints (approximately 40 feet, as exposed in the east wall of the quarry), large blocks over 10 feet square and 20 feet in length with their long axis inclining 55 degrees to the southeast, may be obtained at this locality.

Although channelling methods have been used in the past, at present all stone is quarried by drilling and blasting with black powder. In a quarry of this type where the beds and joints are steeply inclined, where the face is over 100 feet in height, and most of the holes have to be drilled at angles of around 45 degrees, it has been found more convenient to quarry the stone by simple drilling and blasting. However, to ensure a clean break in quarrying the stone and in subdividing the large quarried blocks, it is the usual practice to drill all holes on 5 or 6-inch centres to the full depth of the blocks concerned. Approximately 60 per cent of the stone quarried is eventually discarded as waste, with the greater part coming from the upper section of the quarry face near the surface.

The quarry is well equipped to handle large contracts. There are two derricks of 35 tons capacity, both of which have gasoline-operated hoists. Compressed air is supplied by a large diesel-driven compressor, while a small gasoline-operated hoist handles the car on the waste dump. The quarry is ideally situated for disposal of waste.

Scows may be brought to the side of the quarry, and although there is no harbour, the narrow width of the channel between Haddington island and the mainland affords a certain amount of protection. The rough undressed blocks are usually about 180 to 200 cubic feet in size, although

Figure 42 | *J. A. & C. H. McDonald Limited quarry, Haddington Island, B.C. This block measures 15 ft. long, 7½ ft. high and 2 ft. wide and was quarried for the new Bank of Commerce Building, Vancouver, B.C.*

blocks of 250 to 300 cubic feet (20 to 25 tons) are frequently shipped. The scows carry about 6,000 cubic feet of stone on the 200-mile trip from Haddington island to Vancouver.

Haddington island andesite works well under machine and hand tools, dresses easily to fine sharp edges, and is especially good for fine detailed carvings. It is slightly harder to work than some of the standstones found on the coast, but considerably softer than any of the other 'granites' produced in Canada. The machinery employed in dressing the stone, i.e. the swing gang-saw, carborundum saw, planers, etc., are of the type normally employed in a sandstone dressing plant. Polished finish does not fill well nor is there much contrast between it and the hammered and other finishes, and so polished surfaces are rarely used. The stone weathers well and in buildings erected over 50 years ago it shows practically no deterioration.

Many important buildings in British Columbia, either wholly or in part, have been built of stone from Haddington island. Examples are the Parliament Buildings, at Victoria; the Hotel Vancouver, Empress Hotel, court house, and Bank of Montreal, Main Street, in Vancouver; and the Bank of Commerce, at Grand Forks. The stone is being employed in the construction of the new Bank of Commerce, in Vancouver; figure 42 shows a block of stone 15 feet long, 7½ feet high, and 2 feet wide, which will be incorporated in this building. Parks (19) who listed 14 of the more important buildings of Haddington Island stone, including the above examples, made the following comments regarding the stone:—

"An examination of all these structures shows a remarkable uniformity in appearance and a similarity in the effects of weathering. The magnificent buildings of the British Columbia Legislature at Victoria are undoubtedly the finest examples of Haddington Island stone: the following remarks would apply with equal fidelity to any of the structures mentioned above."

"Viewed from a short distance the buildings have a light yellowish-grey appearance very pleasing to the eye. Examined closely the stone shows minute, light brownish grains imbedded in a lighter-coloured matrix. The older parts of the buildings, constructed about 20 years ago, are somewhat darker, more grey, and less yellow, than the part recently built. Rock-face work is darker than work with smooth finish, owing to the imbibition of dirt. A variation in colour is to be observed, but it is not striking; some blocks are decidedly more brownish than others and in a few instances a pinkish cast is shown as in the case of weathered stone in the quarry. Where water has been allowed to run over the masonry, the stone is much darker, doubtless on account of the soaking in of dirt. The buildings show numerous pillars 6 to 8 feet long without any signs of flaws. The suitability of the stone to fine carving is attested by numerous statues and other highly ornamental work. The surface of the stone is hard without any sign of deterioration."

INTERIOR REGION

3. VERNON DISTRICT

For convenience the Vernon district is regarded as comprising that portion of the northern Okanagan valley which Cairnes (5) has included in his geological sketch map. It has a length (north-south) of 25 miles, a width of 17 miles, and centres about 5 miles northwest of Vernon.

Three granite quarries have been opened in this district, two on the east side of Okanagan lake several miles south of Vernon, and the third 2 miles west of Armstrong, close to the C.N.R. right-of-way. The first two quarries are located in a granite intrusive of Tertiary age, which outcrops along the east side of the lake for a distance of 8 miles, the third is opened on a small isolated body of slightly older granite (5).

Quarrying in this district began around 1910 with the opening of a quarry on the east side of Okanagan lake, 4 miles south of Okanagan Landing. The stone was used for building and monumental bases. Between 6,000 and 7,000 cubic feet of stone were quarried before this opening, the Lefroy quarry, was abandoned by the Vernon Granite and Marble Works in 1912 in favour of a new location 2 miles farther south. The latter quarry appears to have operated more or less continuously until some time in the late thirties or early forties. As it was the largest and the last to operate in the district, it will be described briefly below.

About the same time, a quarry 2 miles southwest of Armstrong, the Lumsden quarry, was operated for a short time in an outcrop of fine grained, light grey granite or granodiorite. The stone had a good rift and grain and worked with ease, but contained an undue amount of pyrite. The stone was used for monumental bases and in the Bank of Montreal, at Vernon.

The stone at the Vernon Granite and Marble Works quarry is a medium to coarse grained granite with a slightly pinkish tint, due to the pink colour of the orthoclase feldspar. "The mineral constituents are quartz, orthoclase in crystals up to 10 mm. long, plagioclase in less amount, and black mica or biotite with a little green chloritic matter. The orthoclase crystals show considerable decomposition, but the plagioclase individuals are quite fresh" (19). A little pyrite is also observed but does not appear to have formed any rust spots.

A polished surface in oblique light shows very few incipient cracks and the rock fills well and takes a high gloss. Dressed faces have considerable more 'life' and depth than other stones from this district, and when used in buildings the stone is quite attractive.

The quarry opening extends for 150 feet along the shore of Okanagan lake, and has been worked back for a distance of 50 feet, and the face in places is 30 feet in height. The level of the quarry floor is 10 feet above water. The sheeting is poorly defined but where visible, dips at 30 degrees to the east. The formation is cut by one major set of widely-spaced and steeply-dipping joints, and by two minor sets of vertical joints. The rift is vertical, the grain horizontal, and the stone splits well in all three directions, rift, grain, and hardway. In summing up the formational features here, Parks (19) concluded that "large stone is obtainable only in places of very restricted extent", and that "Large quarries are not likely to prove successful, as a great amount of unmarketable material must be removed to obtain a limited amount of dimension stone".

According to Cole (9) the quarry was equipped with two hand derricks, and compressed air for drilling was supplied by a small gasoline-powered unit. Transportation was by barge on Okanagan lake to different points in the valley.

The best examples of stone from this district may be seen in the court house at Vernon, built in 1914, and in the post office at Vernon, built in 1911, the stone showing a uniform pleasing pinkish tint, without any signs of knots, flaws, or iron stains. It was also used in the railway station and Hudson's Bay store at Vernon, and in the Anglican church and Royal Bank at Kelowna.

4. WEST KOOTENAY DISTRICT

The extensive distribution of granites and other related igneous rocks in this district, many outcrops of which are readily accessible to transportation, affords good opportunity for quarrying, but at present active operations are small and intermittent and confined to an area within short haulage distance of Nelson, and to an area near Sirdar on the east shore of Kootenay lake.

Other localities from which building and monumental stone have been quarried in this district are at Greenwood, Ymir, Rossland and Coryell. None of these furnish stone at present, but a brief description of the stone from the last three mentioned localities will be given in order to draw attention to the wide variety of granites suitable for both building and monumental purposes which occur in the province. The stone from the Greenwood area, a greyish-green granodiorite which Parks (19) concluded was "not to be compared with the better varieties of grey granodiorite", will receive no further mention.

Probably the first quarrying in the West Kootenay district was done by the Canadian Pacific Railway previous to 1900 when the company was constructing the line west from Nelson. A quarry was opened on the right-of-way near a siding, called Granite, from which was obtained a stone for culverts and bridges as well as small amounts for building in Nelson. The Coryell and Rossland monzonites were operated early in the present century, the latter supplying stone for the post office at Rossland, a building bearing the date of 1902. Quarrying in the Ymir and Sirdar areas appears to have started around 1913.

Nelson Area.—For convenience this area is regarded as comprising the Nelson map-area of LeRoy (17), an area of "about 106 square miles, with the city of Nelson lying a little to the north and east of its centre". Rocks of the Nelson batholith occupy about three-fifths of the area and apparently underlie the whole of it at no great depth. LeRoy (17) tentatively referred the intrusion to the Jurassic or post-Jurassic period.

Rocks of the Nelson batholith vary greatly in composition and texture, the most common type being a "grey granodiorite of medium texture, with orthoclase and plagioclase (chiefly andesine) feldspar, biotite or hornblende, and quartz as essential constituents; microcline, titanite, magnetite, apatite, and zircon as accessory constituents; and chlorite, epidote, kaolin, and limonite as alteration products" (14).

According to Parks (19), active quarrying in the Nelson batholith was confined to the immediate vicinity of Nelson. At the time of his visit in 1916, there were two producers, the Canadian Marble and Granite Works, which operated a quarry just west of Nelson, and the Kootenay Granite and Monumental Company, Limited, which operated a quarry at Three-

mile Point, Kootenay lake. The Canadian Pacific Railway Company's quarry at Granite, 3 miles west of Nelson, had been inactive for several years.

Operations in recent years have been confined to the Nelson Granite and Monumental Company, which operates the quarry formerly operated by the Canadian Marble and Granite Works, but activity is intermittent and on a very small scale. The company owns a small cutting shed at Nelson, where one or two men are employed in the production of monuments mainly from imported 'Swedish Black' and 'Beers Red', and from 'Nelson Island Grey'. A small amount of 'Sirdar Grey Royal' and 'Mount Johnson Ebony' is used in addition to stone from their own quarry, although it has been inactive for several years.

Stone from the Nelson Granite and Monumental Company quarry is a fine to medium grained light grey granodiorite of fair to uneven mixture. A number of black knots and blind seams are visible and the stone is also, in places, impregnated with iron bearing minerals which rust on exposure, the knots occasionally running up to 1 inch in diameter. Nevertheless blocks of good size may be obtained that are very uniform in mixture and entirely free from any of these blemishes. Under the microscope the feldspars are shown to be in a semi-decomposed condition. Quartz is present in some abundance and the dark minerals are chiefly biotite and hornblende. The rock takes a high gloss, fills well, and shows very few incipient cracks under oblique light.

The quarry is on the south side of the highway about 1¼ miles west of Nelson. It has been opened up for a length of 50 feet, a width of 40 feet, and has a face 30 feet high. The quarry is roughly V-shaped, the east and west walls being marked by well-developed joint planes nearly vertical and at right angles to one another. Other steeply-dipping joints occur, but they do not hinder quarrying, rather they facilitate the quarrying of small blocks such as are required for a small operation of this type. The sheets slope gently and vary from 3 inches up to 3 feet in width, with an average of over 1 foot. A few small black knots were noticed, also small dark grey seams which more or less parallel the sheets. The rift and grain are well developed, the rift being parallel to one of the minor sets of joints, and the grain horizontal.

The quarry is equipped with a two-ton, stiff-leg, hand powered derrick and apparently all drilling is done by hand.

The stone from this quarry is being used solely for monumental dies and bases at present, although in the past it was also used in several buildings in Nelson and elsewhere. A number of handsome war memorials for several of the towns in the Kootenays have been prepared by this firm. A good example of its use for building purposes may be seen in the main building and stone fence of the S. G. Blaylock estate 3 miles from Nelson, and in the addition to the Church of England, at Nelson.

Stone from the old Canadian Pacific Railway quarry, 3 miles west of Nelson, was "used for culverts, bridge piers, etc., along the line of railway, also to a limited extent for building purposes in Nelson" (19). The quarry at Three-mile Point supplied stone for the Church of Jesus Christ of Latter Day Saints at Cardston, Alberta, for the Houston monument in Nelson, for the courthouse in Revelstoke, and for the post office in Grand Forks (part) (19).

Sirdar Area.—In the vicinity of Sirdar, about 35 miles southeast of Nelson, granite quarrying has been carried on more or less continuously since 1913. This district is on and near the southern extremity of the Bayonne batholith, a large granite batholith of post-Triassic age (20) which covers an area of some 350 square miles in the Kootenay lake area. The stone is produced by James S. Wilson and Company, Limited, of Sirdar, from a quarry on the east side of the main highway a few miles north of Sirdar. Operations are on a very small scale, not more than 2 or 3 individuals being employed by the industry.

The stone, which is sold under the trade name of 'Grey Royal', is a medium grained, light-coloured, grey granodiorite with rather more quartz than is usually found in similar rock to the west. The feldspars are white to opaque, the biotite black, and the quartz glossy to translucent, giving the stone a 'live' appearance. The stone differs from that of the Nelson area in that it is coarser grained and has a very slight pinkish tinge.

The quarry, which is known as the Atbara quarry, is near the Canadian Pacific Railway bridge which crosses the Kootenay river. It is located at the foot of a granite ridge some 300 feet in height, and is being worked in steps. The deposit is a sheet formation and the joints are well defined. The formation is said to be free of knots or segregations and large blocks can be obtained here. Apparently the rift and grain are not as well developed here as in the granite of the Nelson area.

The stone has been used chiefly for monumental work, the Creston, B.C. war memorial being one of the largest jobs turned out and completed here. Some building stone has also been prepared and shipped to Alberta. At present, apparently, its use is mainly confined to the production of monumental bases, which are sold locally or shipped to Alberta, mainly the Calgary and Lethbridge areas. When visited by Cole (9) in 1931, the plant equipment included a crusher which was used in the production of stucco dash and poultry grit.

In dealing with the economic geology of the district, Rice (20) refers to the Bayonne batholith as follows:

"At the Atbara Quarries, Sirdar, B.C., phases of the Bayonne granodiorite are being successfully used for building and monumental stone. Much of the batholith, however, is unsuitable as it is uneven in texture, contains objectionable inclusions, and has other disadvantages".

Carr, G.F. The granite ind. of Canada. 1955.
176 p.

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