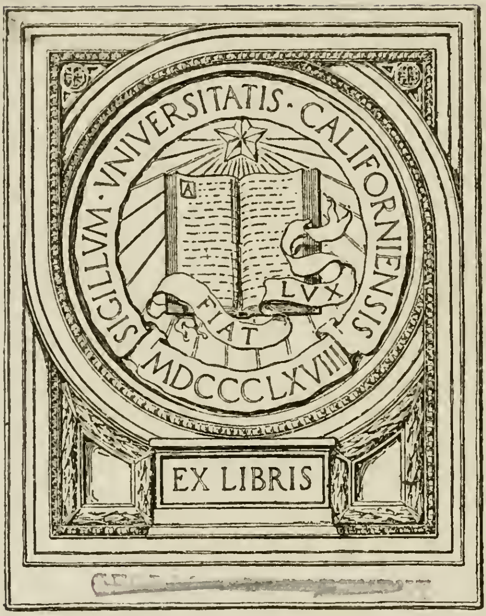
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Miramichi sandstone. Quarry of the Miramichi Quarry Co., Quarryville, N.B.

CANADA

DEPARTMENT OF MINES

HON. W. J. ROCHE, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;

MINES BRANCH

EUGENE HAANEL, PH.D., DIRECTOR.

REPORT

ON THE

Building and Ornamental Stones

OF

CANADA

VOL. II

MARITIME PROVINCES

BY

WM. A. PARKS, B.A., Ph. D.

OTTAWA
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31397—A

No. 203.

LETTER OF TRANSMITTAL

EUGENE HAANEL, Ph.D.,
Director Mines Branch,
Department of Mines,
Canada.

SIR,—I have the honour to submit, herewith, a report on the Building and Ornamental Stones of the Maritime Provinces. The present report forms the third part of the Monograph on the Building and Ornamental Stones of Canada, of which Part I constitutes a general introduction, and Part II deals with the stones of the Province of Ontario.

I have the honour to be,
Sir,
Your obedient servant,

(Signed) **Wm. A. Parks.**

University of Toronto,
March 28, 1912.

AUTHOR'S PREFACE.

The field work in connexion with the present report dealing with the building and ornamental stones of the Maritime Provinces was carried on during the summer of 1911, and occupied a period of two and one-half months. In all, about sixty quarries were visited, as well as a considerable number of abandoned quarries and prospects. Owing to the difficulty of access, and the unsatisfactory outcrop of stone on undeveloped or long abandoned properties, it was found that little additional information was to be gained by an actual visit. In a country where the occurrences of stone, more or less suitable to purposes of construction, are practically innumerable, it was found necessary to use considerable discretion in the selection of localities worthy of close examination. While the present report is by no means confined to quarries in actual operation, it makes no pretense of including every opening that has been made for the production of building stone. It is thought, however, that every important district is represented by a typical example, and that every stone, commercially available at the present time, has received due consideration.

The writer desires to acknowledge the kindness of all the quarry owners and operators throughout the district, whose willingness to impart information has greatly facilitated the preparation of this report.

To Professor Frank D. Adams, Dean of the Faculty of Applied Science, McGill University, the writer is particularly indebted for the opportunity to complete there the series of crushing strength determinations which was begun at the University of Toronto.

Various members of the staff of the University of Toronto have contributed towards the preparation of this report, by affording the writer actual assistance, or by providing him with apparatus and supplies. In this respect he desires to express thanks more particularly to Professors Coleman, Walker, Ellis, McLennan, and Bain.

Mr. A. T. Laing, of the Faculty of Applied Science, has kindly furnished the results of a series of determinations of toughness by the impact method, and, incidentally, has observed the relative ease with which the cylinders of stone required for this test were cut by a diamond drill.

Mr. Alex. McLean, of the Department of Geology, has contributed largely to the accuracy of the physical tests by the careful manner in which he made the large number of weighings in connexion with this work.

Mr. R. Marshall, of the engineering staff, is deserving of thanks for the careful manner in which he made the determination of crushing and transverse strength.

The sketch maps accompanying the report were prepared by Mr. R. R. Rose.

To Mr. Harry Piers, of the Provincial Museum, Halifax, the writer desires to express his thanks for much reliable information as to the occurrences of building material in Nova Scotia.

In compiling the report it was thought advisable to introduce a preliminary chapter, in which the various tests are briefly described. This summary is not intended to replace the account given in the general introduction, but to serve as a guide to those who may not be in possession of the first part.

In the systematic portion, the various stones are treated thus:—

(1) According to the class to which they belong, e.g. granite, sandstone, etc.

(2) According to the more or less definite geographical areas into which the quarries naturally fall.

(3) In order to give prominence to the economic and commercial aspect of the work, the quarries are described under the name of the owner wherever possible.

(4) The general plan of description of individual properties is:—

(a) Quarry observations.

(b) Description of stone, with tests.

(c) Economic remarks and statistics.

(d) Examples of the use of the stone.

(5) Following the description of the various areas, there is inserted a short summary, to which the general reader, not desirous of detailed information, is referred.

The maps accompanying the report are designed to show the general geology of the region, but more particularly to point out the location of the important quarries. Although some quarries not in actual operation are indicated, it has been thought advisable not to complicate the maps by the insertion of too many abandoned quarries. No attempt has been made to indicate the numerous small pits that have been opened for the obtaining of limestone for flux or for lime-burning.

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BUILDING AND ORNAMENTAL STONES

OF CANADA.

VOL. II

MARITIME PROVINCES

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BUILDING AND ORNAMENTAL STONES
OF CANADA.

BY

Wm. A. Parks, B.A., Ph.D.

VOL. II.

MARITIME PROVINCES.

INTRODUCTORY.

CHAPTER I.

General Character of the Building and Ornamental Stones of the Maritime Provinces. Summary of the Method of Testing used for this Report.

Although nearly every kind of rock may be applied to structural purposes, the great majority of ordinary building stones may be classified as sandstone, limestone, or granite. The strata of the Carboniferous, or coal-bearing formation, which are widely developed in the Maritime Provinces, have been quarried for sandstone at various places through a period of time reaching back for a hundred years. Desirable stone of an olive-green, blue, brown, or red colour has been extensively used for public and private structures throughout the Provinces, and has been shipped to distant points in both Canada and the United States.

Limestone suitable for purposes of finer construction is practically absent, although many deposits of this material have been worked for the manufacture of lime. In this respect, the Maritime Provinces differ from Ontario and Quebec, where the great bulk of the stone raised for structural purposes consists of limestone, and where sandstones suitable for building are of very limited extent.

Large areas of both Nova Scotia and New Brunswick consist of granite, which, in many places, is of the requisite grain and colour to render it adaptable to both structural and monumental purposes. In spite of the desirability of these granites, the industry has never reached the proportions it deserves. With the granites proper we may include certain of the basic igneous rocks, such as diabase, diorite, etc., which are commonly known to the trade as "black granites." Stone of this kind has been quarried for monumental purposes at several points, more particularly in New Brunswick.

A type of stone which cannot be included in any of the three classes given is a hard metamorphosed slate: this has been extensively quarried near Halifax, where it has been used in the construction of government buildings as well as in many other structures.

Crystalline limestone or marble occurs at several places in both Provinces and is extensively quarried for the manufacture of lime and for use as flux in the iron furnaces. Incidentally, this stone has been used locally for structural purposes, but its suitability for ornamental work is very doubtful. It must be admitted, however, that some very handsome variegated marbles occur, which, if they could be procured in sufficiently large pieces, would make ornamental material of considerable value.

Fine white gypsum or alabaster, of a character suitable for decorative purposes, occurs in the mines of the Albert Manufacturing Company, at Hillsborough, in New Brunswick. Some of the numerous other gypsum deposits present possibilities in this respect.

Many of the volcanic rocks in both Provinces are of a very handsome appearance when polished and are of undoubted value as decorative material. In this connexion the handsome and vari-coloured felsites and felsite-breccias of Scatari island are worthy of special mention.

Of the rarer decorative substances, chalcedony and agate are the most important.

Slate occurs in both Nova Scotia and New Brunswick, but the attempts that have been made to put this material on the market have not hitherto met with success.

In the general introduction to the report of which the present number forms the third part, a description was given of the properties of building stone and of the various tests which are commonly applied to ascertain those properties. The reader is referred to this introduction for a full account of the operations, but, for the sake of convenience, a brief summary is given herewith.

The physical constants determined were as follows :—

(1) Specific gravity.

(2) Percentage of pore-space.

(3) Ratio of absorption, i. e., the total amount of water absorbed divided by the weight of the specimen and multiplied by 100 in order to express the result as a percentage.

(4) Weight of the stone in pounds per cubic foot.

(5) Coefficient of saturation for one hours' soaking, being the relation between the amount of water absorbed in one hour and the total amount which a stone can be made to absorb by long treatment under reduced pressure.

(6) Coefficient of saturation for two hours' soaking. If neither of these factors exceed 0·8 the stone is in little danger of injury from frost under ordinary conditions.

(7) Dry crushing strength.

(8) Wet crushing strength.

(9) Wet crushing strength after freezing forty times.

A comparison of the dry and wet crushing strengths gives a measure of the softening and weakening effect of water. A comparison of the wet crushing strength of frozen and unfrozen specimens gives a measure of the effect of frost on saturated stone. In the section of this report dealing with Ontario stone, the effect of frost was determined by comparing the dry crushing strength with the crushing strength of the frozen specimen after being dried. As in the case of certain stones, anomalous results were reached owing to the hardening effect of drying, the method herein adopted is considered preferable.

(10) Transverse strength.

(11) Corrosive effect of oxygen and carbonic acid in water. In the case of Ontario stone, carbonic acid only was used: it has seemed advisable, on account of the large percentage of sandstones examined for the present report, to add oxygen in order to duplicate the colour changes which the oxygen of the atmosphere dissolved in the rain water naturally induces in stone exposed to the weather.

(12) The "chiselling factor" is an expression whereby it was intended to express the relative ease with which the different stones could be chiselled. It was determined by moving a plane slab of stone, mounted in a travelling carriage, against the edge of a chisel operated by a pneumatic tool. The tool was inclined at a fixed angle to the face of the stone and was pressed down by a constant weight of $12\frac{1}{2}$ pounds. The tool was operated by air under a pressure of about 60 pounds. After being weighed, the slab of stone was moved against the chisel for a distance of 3 inches in 10 seconds of time: it was then weighed and the loss in grams recorded directly as the "chiselling factor."

In the case of the limestones tested for the Ontario report, fairly good duplicate results were obtained, but with the sandstones of the Maritime Provinces much less satisfactory figures resulted. The reason for the lack of uniformity in duplicate experiments lies in two facts—(1) chips are thrown out from the side of the chisel track in a very irregular manner whereby the factor is rendered extremely variable; (2) in the case of the softer stones, the chisel digs deeply into the stone, and as the slab is forced forward it jumps, leaving hummocks along the track. As it is largely a matter of circumstance whether these hummocks remain or break out, close duplicate results are not to be obtained. The figures herein recorded must, therefore, be allowed a wide latitude, and must be regarded as the results of a fixed experiment which experience has not found to be satisfactory as a general test. I am now convinced that a faster forward motion and a lower angle of inclination are necessary to obtain good duplicate results with the softer stones. Varying the conditions of the experiment would, however, give results of no value for comparative purposes, the figures as obtained are, therefore, recorded directly: while they are of little use for close comparison they represent in a broad way the relative ease of chiselling and are at least indicative of the behaviour of the different stones under this experiment.

(13) The "drilling factor." Owing to the difficulty experienced with the chiselling experiment a second series of experiments was made to determine the ease of cutting by means of a drill. The pneumatic tool was fitted with $\frac{1}{2}''$ + bitted drills which were allowed to penetrate the stone for 30 seconds under a vertical pressure of $12\frac{1}{2}$ pounds. The depth of the hole in millimetres was then measured and recorded directly as the "drilling factor." Duplicate experiments to determine the accuracy of the results were much more satisfactory than in the case of the chiselling test. In many cases the figures were exactly the same, and only in the case of the very soft stones did the variation exceed a fraction of a millimetre. It is believed, therefore, that the depth of the hole as herein recorded gives a far more satisfactory series of results than the amount of material removed by the chisel. How far the drilling factor is indicative of the general ease of working must be left to the reader: I am personally of the opinion that it is a fairly good guide as far as the resistance to *cutting* is concerned. It must be remembered, however, that *chipping* is an important factor in the working of stone. It was largely on this account that I considered the gross loss under the chiselling experiment as the best expression for the general ease of working. The disparity between the two series of results is caused largely by the different degree to which the tendency to chip comes into play in the two experiments.

(14) In some few instances, a third factor bearing on the ease of cutting was obtained by ascertaining the number of revolutions that were required in order to sink a diamond drill to the depth of 1 inch in the stone. In the case of six sandstones, the figures obtained were in exact accord with the results of the drilling test, but with the harder stones the comparison ceased. It was found that the tough "black granites," which gave a very low drilling factor, were more easily bored than the true granites, which gave a higher drilling factor. Mr. A. T. Laing, who kindly made the experiments, found, however, that this result was reversed on operating the diamond drill under a greater pressure. It would appear, therefore, that the speed of cutting by a diamond drill varies greatly, in the different classes of stone, by increase of pressure. In consequence, no deduction can be made as to the *general* ease of cutting by observations on the working of the drill under a fixed and constant pressure. This is but another example of the difficulty which attends any attempt to ascertain this important property by means of fixed experiments.

In the case of the six sandstones, the figures are entered in the description as the "boring factor," which is to be interpreted as the number of revolutions required per inch of bore-hole.

(15) In the examination of stone to ascertain its suitability as a road making material it is customary to subject a specimen to repeated blows of increasing intensity until it finally succumbs. In this manner there is obtained an expression which represents the relative toughness of the specimens. This test is not usually made in the case of building stone, as it deals with a property which is of minor importance in structural material. The test may be of direct value, however, in that it expresses another physical property of the stone, which may assist towards an understanding of its durability and the cost of cutting. The results of this test as recorded herein were not deliberately ascertained for this report, but were obtained through the kindness of Mr. A. T. Laing, who was desirous of making a series of these tests for academic purposes. Mr. Laing consented to operate on typical examples of the specimens from the Maritime Provinces, and has communicated the results as recorded herein.

The experiment was made on cylinders of stone 1″ in diameter and 1″ long. These pieces were prepared by cutting sections from diamond drill cores of the requisite diameter.

The test cylinders were subjected to repeated blows in the Page Impact Machine. This apparatus consists of a rigid anvil on which the specimen rests, a convex-faced plunger above the specimen, and a device whereby a weight of two kilograms is allowed to drop on the plunger. The apparatus is started with a fall of one centimetre, which distance is increased by one centimetre for each successive blow. The number of blows under which the specimen succumbs is recorded as a measure of toughness of the stone.

The general method of procedure for the determination of the above mentioned properties was as follows:—

From each specimen that it was considered advisable to test in full there were prepared three 2″ cubes, and a strip 6″ inches long by 2″ wide by 1″ thick. Both cubes and strip were cut parallel to the bedding of the rock.

The first set of cubes was treated in the following manner:—

(1) Accurately ground so that the two faces representing the bedding planes were as plane and parallel as possible.

(2) Carefully measured to $\frac{1}{100}$ of an inch.

(3) Dried for 24 hours at 110° C.

(4) Weighed.

(5) Soaked for one hour in distilled water and weighed.

(6) Soaked for another hour in distilled water and weighed.

(7) Soaked for 36 hours in warm distilled water under reduced pressure and weighed.

(8) Weighed while suspended in water.

(9) Frozen forty times.

(10) Crushed while still wet in the Riehle testing machine.

The physical constants obtained from these operations are best shown by an example, thus:—

Red Sandstone.

Sackville Freestone Co.

Dry weight	303·834	grams.	A
Weight after one hour's soaking	313·635	"	B
Weight after two hours' soaking	315·680	"	C
Weight when saturated	321·900	"	D
Weight, immersed in water	191·755	"	E
Specific gravity, $\frac{A}{A-E}$	2·711	"	F
Water absorbed in one hour, B—A	9·801	"	G
Water absorbed in two hours, C—A	11·746	"	H
Total water at saturation, D—A	18·066	"	J
Weight of the total water if it were replaced by stone, J×F	48·9769	"	K
Weight of the cube if it were solid stone, A + K	352·8109	"	L
Porosity, per cent, $\frac{K \times 100}{L}$	13·882	"	M
Ratio of absorption, per cent, $\frac{J \times 100}{A}$	5·946		
Coefficient of saturation, one hour, $\frac{G}{J}$	0·54		
Coefficient of saturation, two hours, $\frac{H}{J}$	0·65		
Weight of cubic foot of solid stone, 62·426 × F, lbs.	169·237 lbs.		N
Weight of cubic foot of actual stone N-M % N	145·743 lbs.		
Area of upper bearing face of cube, 2·00 × 1·99 in.	3·98 sq. in.		
Area of lower bearing face of cube, 1·98 × 1·99 in.	3·92 sq. in.		
Average area of bearing faces	3·95 sq. in.		P
Total load at failure in testing machine, lbs.	15·230		Q
Crushing strength of frozen cube, wet, lbs. per sq. in., $\frac{Q}{P}$	3,856·		R

The second set of cubes after being carefully ground and measured were allowed to dry for several weeks at the temperature of the laboratory, after which they were crushed in a Wicksteed machine. The example selected gave the following results:—

Area of upper bearing face 1·985 × 2·00 in.	3·97 sq. in.		
Area of lower bearing face 1·99 × 2·00 in.	3·98	"	
Average area of bearing faces	3·975	"	S
Total load at failure, lbs.	47,300		T
Crushing strength of dry sample, lbs. per sq. in., $\frac{T}{S}$	11,899		

The third set of cubes after being ground and measured were saturated with water by treatment under reduced pressure for 36 hours. While still wet they were crushed in the Riehle machine.

Area, upper bearing face 2·03 × 1·94 in....	3·9382 sq. in.	
Area, lower bearing face 2·03 × 1·95 in....	3·9565 "	
Average area of bearing faces....	3·9483 "	U
Total load, lbs....	21,600	V
Crushing strength of wet sample, lbs. per sq. in., $\frac{V}{U}$....	6,083	W

The strip was ground plane and broken in an Olson machine. The modulus of rupture for transverse strength was calculated by means of the formula:—

$$R = \frac{3}{2b}\frac{1}{d^2}W$$

R = Modulus of rupture.
l = Length in inches.
b = Width in inches.
d = Thickness in inches.
W = Total load at centre in pounds.

For the example selected the figures are as follows:—

Width of strip....	2·07 in.
Thickness of strip....	1·06 in.
Distance between supports....	5 in.
Total load at centre in pounds....	315
Modulus of rupture....	$\frac{3 \times 5}{2 \times 2{\cdot}07 \times 1{\cdot}06^2}$ 1,016 lbs.

The shorter end of the broken strip was utilized for the preparation of the 1″ cubes for the corrosion test and of thin sections for microscopic examination. From this piece also were prepared the specimens shown in the coloured plates, Nos. XLIII, XLIV, and XLV accompanying this report.

The 1″ cubes prepared from the broken strips were soaked in distilled water, and dried at 110° C: they were then weighed and the superficial area measured. The cubes were then suspended in water through which a stream of carbon dioxide gas and a stream of oxygen were conducted. After remaining under this treatment for three weeks they were removed, rubbed gently with the fingers, and then dried and weighed. Colour changes were also carefully observed.

The figures obtained for the selected example were:—

Weight of cube before treatment	37·13 grams
Weight of cube after treatment	37·06 "
Loss on treatment	0·07 "
Superficial area	5·9902 sq.in.
Loss per sq. in	0·01166 grams

The longer end of the broken slab was used for the chiselling and drilling tests. It was fixed firmly into a travelling carriage and moved at the rate of 3″ in 10 seconds against the edge of a chisel. The chisel was inclined at a fixed angle and was actuated by a pneumatic tool under constant air pressure. The loss in weight in grams was recorded directly as the chiselling factor of the stone. This figure is evidently not a scientific constant, and is of use only in comparison with other stones. The drilling test was made on the same slab by measuring the depth to which a $\frac{1}{2}''$+bitted drill sank in 30 seconds.

CHAPTER II.

An Outline of the Geology of the Maritime Provinces.

The geological structure of the Maritime Provinces is much more complicated than that of Ontario, which was described in a former part of this report. This complexity of structure is due to the fact that the present region lies on a line of weakness in the earth's crust, which extends in a general northeast and southwest direction. At several different times in geological history extensive uplifting and folding of the rocks have occurred, whereby the formations have been twisted into ridges with a general northeast direction. The various chains of the Appalachian mountain system are an expression on a grander scale of the same series of disturbances. The intense pressure to which the rocks have been subjected has not only thrown them out of their original position, but has induced changes in their structure and in their mineralogical composition, or, in other words, has altered originally sedimentary rocks into members of the metamorphic series. The complex character of certain areas is further increased by enormous masses of igneous rocks which have invaded or broken through the sedimentary strata of earlier date.

Beginning with the oldest and proceeding to the youngest, the formations exposed in the Provinces are generally classified in the following manner:—

Pre-Cambrian.	
Cambrian	Palæozoic.
Cambro-Silurian	
Silurian	
Devonian	
Carboniferous	
Permian	
Triassic	Mesozoic.

Pre-Cambrian.

The oldest series of rocks, representing the earliest land of which we have any knowledge, is commonly called Pre-Cambrian by Acadian geologists. This term is practically synonymous with Archæan, which is more commonly employed by Ontario investigators. This formation, or rather series of formations, is extremely varied in character, with evidence throughout of having been subjected to intense metamorphism. Repeated disturbances in and near the true Pre-Cambrian areas have so altered the neighbouring rocks of later date, and so pinched them in with the older series, that their separation is a matter of great difficulty. In consequence, geologists are still in doubt whether the rocks of certain areas should be included in the Pre-Cambrian or should be regarded as metamorphic sediments of later age.

The rocks of the Pre-Cambrian comprise gneisses, syenites, felsites, various schists, and bands of crystalline limestone. The chief areas in which they occur are in northern New Brunswick and in the island of Cape Breton, with a less extensive tract near the Bay of Fundy shore of New Brunswick.

The northern New Brunswick area extends across the Province in the form of a lenticular patch with its long diagonal in a northeasterly direction. The western extremity is near the forks of the Main Southwest Miramichi, and the eastern end reaches almost to Chaleur bay, near the mouth of Jaquet river. Parts of this region are occupied by intrusive granites of later date.

Crystalline limestones are not found among the rocks of this northern area, but some of the granites are quite suitable for building purposes, and the rhyolites in the valley of the Tobique river offer possibilities as decorative material.

The southern New Brunswick Pre-Cambrian area is so complicated, and is regarded by different authors in such diverse ways, that any general statement is open to serious objections. Nevertheless, it may be said, that the formation appears in the form of two lenticular patches—one extending from near St. John almost to the Petitcodiac river, and the other, separated by a narrow interval, reaching from Passamaquoddy bay to the vicinity of Longs creek in Queens county. As in the northern area, these belts are invaded by masses of granite and other eruptive rocks. Unlike the northern area, however, they contain bands of crystalline limestone, more particularly near St. John. It should be noted, however, that Dr. Ells, in his most recent report, referred these limestone belts to a later date.

The mainland of Nova Scotia contains no undoubted Pre-Cambrian rocks, but several belts extend in a northeasterly direction across the island of Cape Breton. As several of these contain important bands of crystalline limestone their distribution is more fully indicated on page 172.

The general rocks of the Pre-Cambrian are of little value for purposes of building or decoration, but the handsome felsite-breccias of Scatari island and Louisburg are commonly referred to this age.

Cambrian.

The material derived from the decay of the early *Pre-Cambrian* rocks was deposited in the seas on the flanks of the land areas during a period of time known as the *Cambrian.* The rocks of this age in the Maritime Provinces have suffered severe metamorphism, and have been largely converted into slates and schists. Cambrian rocks are marked off from the earlier series by the presence of fossils. In some cases, numerous fossils are found, indicating beyond doubt the age of the sediments: in most cases, however, the intense metamorphism has destroyed the remains of any organisms that may have existed. In consequence of these changes, much doubt exists as to the proper age of the rocks of many large areas.

In the northern area of New Brunswick, little if any undoubted Cambrian strata is found on the flanks of the Pre-Cambrian rocks. In the southern area the Cambrian rocks form narrow belts in the vicinity of St. John and are pinched in between the belts of Pre-Cambrian rocks. Dr. Ells regards the crystalline limestone of St. John as Cambrian rather than Pre-Cambrian in age.

In Nova Scotia, the great slate and schist formation which occupies the whole of the Atlantic seaboard from Digby to Guysborough has been regarded as of Cambrian origin. This area, although interrupted by large masses of granite, forms the greater part of the mainland of Nova Scotia; from it has been obtained the gold of the Province, on which account the rocks are commonly called the "Gold-bearing series." The metamorphic slate, quarried for structural purposes at Halifax, is obtained from this formation, and some unsuccessful attempts have been made to obtain roofing slate. With these exceptions, no structural material is quarried from the formation proper, but the included granites of later age yield the finest building and ornamental granite, more particularly at Nictaux and at Shelburne. It is worthy of note that, although some undoubted Cambrian rocks occur in the belt, there is a growing tendency to regard the bulk of the gold series as of still later age.

In Cape Breton, narrow belts of true Cambrian rocks occur in several places. The largest of these areas lies along the Mira river, in Cape Breton county, and reaches into Richmond. A second important belt extends along the south shore of St. Andrews channel and reaches almost to the East bay of Great Bras d'Or lake.

Cambro-Silurian.

The series of deposits following the Cambrian are classed by Acadian geologists under the term Cambro-Silurian. The rocks of this age are chiefly sandstones, limestones, and shales, usually showing strong metamorphism with the conversion of the sandstones into quartzite, the shales into slate, and the limestone into crystalline limestone. The formation has been invaded by great masses of granite and other eruptives whereby its extent is materially reduced. From the Cambro-Silurian rocks proper there is no production of building or ornamental stone, but it is possible that some of the bands of crystalline limestone may have a value as marbles.

In northern New Brunswick, the Cambro-Silurian rocks form an ellipse of which the centre is occupied by the Pre-Cambrian rocks. The southeastern border extends across the Province from Vanceboro to Bathurst. Rocks of this age occupy the shore of Chaleur bay for about

15 miles above Bathurst. From this point the northwest boundary sweeps across the Province in a curved line to the vicinity of Woodstock and Canterbury. In Nova Scotia, Cambro-Silurian rocks occur in somewhat irregular but extensive patches along the northern border of the Cambrian from Windsor to Guysborough.

A period of extensive land elevation and deformation, accompanied by the extrusion of great masses of igneous rocks, marked the close of Cambro-Silurian time.

Silurian.

Following the Cambro-Silurian are the deposits of Silurian time, which show less extensive metamorphism, although they are invaded by eruptives of still later age. The rocks consist chiefly of calcareous shales and limestones, the latter of which has been sparingly used for lime-burning. Unlike the formations of similar age in Ontario, the Silurian rocks of the Maritime Provinces are too thin-bedded and too much intermingled with shales to constitute desirable building material.

In New Brunswick are two main areas of Silurian rocks, of which the more important occupies the flat, soil-covered and wooded region, extending from the northern limit of the Cambro-Silurian area to the northern and western boundary of the Province. The second district in New Brunswick is in the form of a narrow band, with an average width of about 10 miles, which reaches from the vicinity of St. Stephen across the St. John river at "the Mistake" into the parish of Studholme in Queens county. Silurian strata in an altered condition also occur south of the granite mass in Charlotte county, and, according to Ells, occur on Frye island, the crystalline limestone of which he refers to this formation.

In Nova Scotia, Silurian rocks are not extensively developed, but they occur as narrow lenticular patches north of the granite area in Annapolis and Kings counties,[1] and in an area of considerable size but irregular form in Pictou and Antigonish[2]. Small areas also occur in Cumberland and Colchester.

Devonian.

Devonian rocks follow the Silurian; they consist chiefly of shales and limestones, with some sandstones and conglomerates.

In New Brunswick, rocks of this age are confined to small areas in the southwest part of the Province. The more southerly of these is near St. John, where the rocks occur on the east side of the harbour; they also lie in narrow depressions in the Pre-Cambrian series west of Musquash. Ells considers that the marbles of Lepreau and Musquash are altered portions of the lower Devonian (Bloomsbury series). A second narrow belt of

[1]Geol. Sur. Can., Rep. 1896, pp 87-123 M.
[2]*Ibid.* Rep. 1900-1901, pp 6, 7, 10-16, 87 P.

Devonian rocks extends along the northern margin of the Silurian area, reaching across Charlotte county into the western side of Queens county.

In Nova Scotia, the Devonian rocks form an interrupted belt reaching from Minas basin to the Straits of Canso. They are developed on the shore of Minas channel west of Parrsboro, and on the south shore of Minas basin in Hants county. A considerable area lies to the eastward of Truro in Colchester county, and extends into Pictou. The formation then narrows, but it expands again in Antigonish and Guysborough, where it forms the whole of the peninsula between Chedabucto and George bays.

In Cape Breton,the formation appears near Hawkesbury in southern Inverness, on Madame island, and at several points in Richmond county.

Towards the close of the Devonian, extensive earth movements again affected the region. The rocks show evidence of uplifting, with much folding and faulting, accompanied by the injection of enormous masses of granite and other igneous rocks.

Carboniferous.

Strata of this age are largely developed in the Maritime Provinces, where they represent a great series of sediments deposited in a sea that gradually encroached on a lowering land surface. Taking the series as a whole and including the upper beds known as Permo-Carboniferous and Permian, the strata fill the large triangular area of 10,000 square miles which lies in New Brunswick between the northern and the southern tracts of earlier rocks. Continuing eastward the formations skirt the coast of the Straits of Northumberland, in Cumberland, Pictou, and Antigonish, and occupy extensive areas between the Pre-Cambrian ridges of Cape Breton. The higher members of the series form the whole of the Province of Prince Edward Island. At the Sydney coal fields the entire series presents a thickness of 13,000 feet, and at the Joggins section the thickness is not less than 14,500 feet.

From the different members of the Carboniferous series is derived all the sandstone, which constitutes the chief building stone produced in the Maritime Provinces.

The rocks of the Carboniferous proper are divided into three series—lower Carboniferous, middle Carboniferous, and upper or Permo-Carboniferous.

The lower Carboniferous consists chiefly of coarse conglomerates and shales, with some bands of limestone. The rocks are not generally suited to structural purposes, but many of the limestone bands have been quarried for lime-burning and for use as flux. To a limited extent also, both the sandstone and the limestone have been employed for building. Some of the limestone bands which have been metamorphosed by contact with later eruptives may have a value as red marbles. The middle

Carboniferous formations include the Millstone Grit and the Coal Measures. The former series produces a large amount of fine building stone as well as practically all the grindstones and pulp stones of the Provinces. The sandstones of the Coal Measures are also used to a limited extent for structural purposes.

Conglomerates and coarse sandstones follow the Coal Measures and pass upwards into the fine sandstones of the Permo-Carboniferous, which furnish the bulk of the building stone now being quarried. The upper beds of all, as exposed in Prince Edward Island, and at points along the mainland, consist of red shales and sandstones, which are less desirable as building stone, although they are used locally to a considerable extent.

The lower Carboniferous rocks occupy a considerable part of the Carboniferous area in New Brunswick, but they are of less relative extent in Nova Scotia. The chief economic importance of this series from the present point of view is that they carry the gypsum beds, some of which possess a distinct value as ornamental material.

The extent of the Millstone Grit and the Permo-Carboniferous sandstones which furnish the bulk of the structural stone will be given in more detail later. For the present, it will suffice to say that the Shepody Bay quarries, the Miramichi quarries, and those of Chaleur bay are in the Millstone Grit, and that the Cape Bald, the Sackville, the Amherst, the Wallace, and the Pictou quarries are in the upper series.

During Carboniferous time, local tilting and disturbance of the strata occurred, so that in some places, the different members of the series are clearly marked off from one another by strong unconformities. For instance, beds of the Millstone Grit in the Shepody Bay district are inclined at a high angle, whereas the overlying strata of the upper Carboniferous are practically horizontal. In some places the strata of the Coal Measures show a distinct disturbance before the deposition of the upper series, but in others the transition is regular and gradual throughout the whole period of deposition.

The close of the Carboniferous ages was marked by a wide-spread elevation of the land, which, in the Maritime Provinces, has not been followed by a subsequent depression, except in one small local area which is referred to below.

Mesozoic.

The only rocks of later date than the Permian occur as a narrow belt along the shore of the Bay of Fundy, in Digby, Annapolis, and Kings counties, with a few minor patches elsewhere in the Fundy basin. These rocks belong to the lowest division of the Mesozoic age (Triassic), and are thought to represent estuarine deposits. They consist of red sandstone and shales, which are overlaid by heavy masses of trap. The sandstones are friable and shattered and have never been successfully quarried as building stone. The trap has yielded agates and minerals of the zeolite family, which have a certain value as semi-precious stones, but which do not appear in sufficient abundance to warrant operations on a commercial scale.

Igneous Rocks.

It has already been pointed out that eruptive rocks are associated with all the members of the sedimentary series mentioned in this sketch. In some cases the igneous rocks form an integral part of the formation in which they occur, i.e., they were extruded during the time that the associated sedimentaries were accumulating. On the other hand, many of the more important igneous masses have invaded the sedimentaries at a time long subsequent to their formation, and consequently can not be said to belong to the strata in which they occur.

The Pre-Cambrian rocks are largely of igneous origin, but they have been converted into gneisses and schists by subsequent agencies of metamorphism. The felsitic and syenitic rocks found within the Pre-Cambrian areas, such as the rhyolites of the Tobique, the felsites of the Craignish hills, and the felsite-breccias of Scatari island, belong, in part at least, to Pre-Cambrian time. It is just as certain, on the other hand, that many of these masses are to be ascribed to a later age.

The black granites of Charlotte county in New Brunswick were formerly regarded as of Pre-Cambrian origin, but Ells has thrown doubt on this view in his recent report. These rocks are undoubtedly older than the red granites of St. George.

The great granite masses of both New Brunswick and Nova Scotia are ascribed to the period of intense igneous activity that marked the close of Devonian time. It would be unsafe, however, to include all the granite masses in this statement, for the granites of Halifax and Guysborough are probably, in part at least, older than the post-Devonian granites of Shelburne and Nictaux.

Much of the rhyolite of the Tobique valley undoubtedly represents flows of volcanic matter as young as the lower Carboniferous. The felsites and felsite-breccias of southern New Brunswick, as at Chamcook lake, should probably be ascribed to the same age.

For eastern Nova Scotia, the varied age of the volcanic rocks is summed up by Fletcher in the following way:—

(1) The old crystalline series, containing all the massive rocks and perhaps also the schists described as Pre-Cambrian. (2) Igneous rocks, which, like those of Georgeville, cut the lower Cambro-Silurian conglomerates. (3) Contemporaneous volcanic rocks of the middle and upper Cambro-Silurian, occupying one of the two largest tracts covered by these rocks. (4) Contemporaneous rocks of lower Devonian age, found south of Guysborough river and McPhees millbrook. (5) Dykes cutting Silurian, and

middle and upper Devonian rocks. (6) Contemporaneous volcanic rocks and dykes traversing the Carboniferous conglomerate and lowest bed of limestone at St. Peters and elsewhere.[1]

Finally, there should be mentioned the great masses of trappean rock which cut through and overlie the Triassic sandstones along the shore of Digby and Annapolis counties; and which form the picturesque cliffs of Cape Blomidon and other points along the coast.[2]

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[1] Geol. Sur. Can., Rep. 1886, p. 99 P.

[2] In compiling this brief account of the geology of the Maritime Provinces the writer made free use of the excellent summary by Brock and Young contained in "Geology and Economic Minerals of Canada," being Publication No. 1085 of the Geological Survey of Canada, and of Ells' account of the geology of New Brunswick contained in Publication No. 983 of the same department. For a more complete account of the geology the reader is referred to these works, and to the various reports by Gesner, Bailey, Matthew, and Ells for New Brunswick, and to those of Honeyman, Bailey, and Fletcher for Nova Scotia.

CHAPTER III.

Sandstone.

The various members of the Carboniferous system, which is so extensively developed in the Maritime Provinces, contain numerous beds of sandstone, of which no inconsiderable number are sufficiently homogeneous and of the requisite texture to yield excellent building material. A great system like the Carboniferous is naturally divisible into a number of formations which may represent stones of different physical and chemical character. The rocks of this system as developed in the Maritime Provinces are usually classified as below:—

Upper or Permo-Carboniferous	
Middle Carboniferous	Coal Measures Millstone Grit
Lower Carboniferous.	

While sandstone has been quarried from all the subdivisions, the Permo-Carboniferous and the Millstone Grit have yielded practically all the commercial output. The extended shore-line along which these formations occur, and the deep ravines of innumerable streams, render the stone accessible at many points, in consequence of which a great number of small quarries have been opened from time to time to supply the local demand. These minor openings are so numerous and many of them have been so long abandoned that it is considered advisable to confine the present description to the quarries actually in operation, including with them, however, those quarries or quarry regions which have in the past earned a reputation of commercial importance.

For purposes of description it has been decided to consider the two formations together, using as a basis of classification the geographical areas into which the quarries naturally group themselves. Beginning in northern New Brunswick and continuing south and east to Cape Breton, the following areas are more or less distinctly marked off by the distribution of the important quarries:—

Chaleur Bay area, Gloucester county, N.B.
Miramichi area, Northumberland county, N.B.
Buctouche area, Kent county, N.B.
Shediac area, Westmorland county, N.B.
Fredericton area, Sunbury county, N.B.
Shepody Bay area, Albert and Westmorland counties, N.B.

Cumberland Basin area, Westmorland county, N.B., and Cumberland county, N.S.
Wallace area, Cumberland county, N.S.
John River area, Pictou county, N.S.
Pictou area, Pictou county, N.S.
Monk Head area, Antigonish county, N.S.
Boularderie Island area, Cape Breton, N.S.
Sydney area, Cape Breton county, N.S.
Whycocomagh area, Inverness county, N.S.
Port Hood area, Inverness county, N.S.
Prince Edward Island area.

The sandstones from these various areas, while alike in some respects, show great variations in colour, in texture, and in the character of the cementing material. In a broad way, however, they may be classified into two groups according to colour—olive-green and grey sandstones, and red and brown sandstones. On this basis, the product of the different areas may be arranged in the following manner:—

Areas producing only olive-green or grey stones.

Chaleur bay—chiefly grey.
Miramichi—all olive-green.
Wallace—chiefly grey and yellowish.
Shediac—olive-green.
Pictou—olive and grey.
Boularderie—olive.
Sydney—olive and grey.

Areas producing only red or brown stone.

River John.
Monk Head.
Whycocomagh.
Prince Edward island.

Areas producing both olive-green and red or brown stone.

Buctouche.
Fredericton.
Shepody bay.
Cumberland basin.
Port Hood.

While it is considered advisable to adopt the geographical classification in the systematic portion of this report, it seems better in summarizing the results of the investigations to treat the stone in two classes as above.

Olive-green and grey sandstones.

The great majority of the stones of this class present some shade of olive-green as shown in Plate XLIII. Grey or bluish-grey stone is well seen in the Stonehaven grindstone quarries in the Chaleur Bay area. Light, brown-grey types are seen in some of the quarries of the Pictou area, more particularly at Eightmile creek, and a slightly pink variety occurs at Judique in the Port Hood area.

In texture these stones vary from fine to coarse, the finest grained examples occurring in the Chaleur Bay, the Pictou, and the Port Hood areas. The general average texture of the typical olive-green examples is rather coarse.

The crushing strength ranges from 8,869 lbs. per sq. in. (Buctouche) to 17,893 lbs. per sq. in. (New Glasgow). Three examples only fell below 10,000, the average of 26 tests being 13,000 lbs. per sq. in.

In transverse strength, the modulus of rupture varied from 809 lbs. per sq. in. to a maximum of 1,700 lbs. per sq. in. (Eightmile creek, Pictou county, N.S.). The average modulus of rupture for 21 examples was 1,200 lbs. per sq. in.

In specific gravity there is not much variation as all the samples but one gave results between 2·64 and 2·69.

In none of the specimens tested was the pore-space less than 10 per cent. The highest result was 18·489 per cent, and the average of 21 samples was 13·73 per cent.

The average weight per cubic foot of 21 samples was 143 lbs. The highest figure (148·215) was found in the stone from Forks Bridge in Cape Breton, and the lowest (137·03) in the coarse stone from Buctouche, Kent county, New Brunswick.

All the examples tested were found to suffer considerable loss in strength by being saturated with water. The twenty–one examples tested showed an average strength of 7,185 lbs. per sq. in., which is slightly more than half the average strength of the dry samples.

The probable effect of frost on the stone was determined by means of the "coefficient of saturation," which represents the ratio between the water absorbed in a given time and the total amount of water which the stone can be forced to absorb. It is considered that when this factor is below 0·8 the stone is in little danger of injury by frost under normal conditions. The coefficient of saturation for the one hour test was found to range between 0·46 and 0·68, except for one remarkable exception. The same exception being made, the two hour test gave results ranging from 0·6 to 0·78. In a few examples, the coefficient was determined for a thirty–eight hour period and was found to be but slightly increased. It may be concluded, therefore, that the direct action of frost on these stones is not to be seriously apprehended. It is worthy of note that the two hour soaking caused the absorption of an amount of water which is practically negligible when compared with that taken in during the first hour. The fine grained greyish sandstone from

Judique, in Inverness county, is unique on account of the remarkably low coefficient, which was found to be 0·1 for an hour, and 0·14 for two hours although its percentage of pore space is 12·592. The same feature is still more pronounced in the reddish stone from the same locality, which gave only 0·02 and 0·03 for one and two hours respectively.

The determination of the crushing strength of samples which have been saturated and frozen a number of times is an unsatisfactory test as far as it represents the probable action of frost under normal conditions. This question has been fully discussed in the general introduction. The experiment was performed in the case of most of these sandstones which were found to show, generally, a strength of about one-half of the wet crushing strength. Table III shows that a considerable variation in this respect is shown by the different samples tested. The mechanical and instrumental difficulties of this test are considerable, so that some latitude must be given to the figures as tabulated: they must also be interpreted as representing the relative power of resistance to mechanical agents of disintegration rather than as representing the relative power of resistance to the action of frost under normal conditions.

Nearly all these stones can be carved and drilled with reasonable facility: as these factors evidently depend on the kind of instrument used, the reader must draw his own conclusions from the figures given in Table VII. I believe that the "drilling" factor is a better guide to the relative hardness of the stone than the "chiselling" factor.

The red and brown sandstones.

The stones here included vary from a dirty brown to a very brilliant red. The chief brown stones are quarried at Wood Point and at Cape Bald in New Brunswick: medium toned red stones are quarried at Sackville, New Brunswick, and at Amherst, Nova Scotia. Argillaceous red stones of a brighter hue occur at River John and at many points in Prince Edward Island, while the stone from near Whycocomagh, in Inverness county, Nova Scotia, is decidedly the most brilliant red of any of the examples examined.

In texture, the brown stones are decidedly coarse; the Sackville and Amherst stones are of medium grain, while the River John stone and that from Judique in Inverness county are of fine grain.

The crushing strength ranges from 7,623 to 15,147 lbs. per sq. in., with an average of 11,000 lbs. for 10 samples. It will be observed that this is 2,000 lbs. less than the average of the olive and grey stones.

The average transverse strength of nine samples was 762 lbs. per sq. in., which is considerably less than the average of the olive and grey stones. The extremes were 480 lbs. (Whycocomagh) and 1,532 lbs. (Mary point.)

The specific gravity ranges from 2·65 to 2·72, and, therefore, averages somewhat higher than that of the olive and grey stones.

Contrary to expectation, it was found that the pore space ranges considerably higher than in the case of the olive and grey stones. The lowest figure obtained was 12·962 (River John) and the highest 22·845 (Prince Edward Island.) The average of ten examples was 16·9 per cent.

The high porosity reduces the weight per cubic foot of some of these stones to 131 lbs. The heaviest (River John) weighs 146 lbs. per cubic foot. On the whole, the red stones show a much greater variation in this respect than the olive and grey examples.

As in the case of the other group, saturation with water reduces the strength of the stone about one-half. In the case of the Prince Edward Island stone the softening effect was much more pronounced.

The loss in strength consequent upon freezing was found to be so variable and to extend between such wide limits that an average is of no particular value. The red stones from River John, Monk Head, Prince Edward Island, and Whycocomagh, although they suffered severely from saturation, seem to lose little in strength by freezing. The brown stone from Wood Point, on the other hand, practically crumbled away under the operation. The other examples behaved much like the olive stones, showing a strength after freezing of about one-half the wet strength.

The coefficient of saturation was found to range from 0·42 to 0·63 for one hour's soaking, and from 0·58 to 0·72 for two hours'. These figures do not include the remarkable stone from Judique, which with 16·814 per cent of pore space practically refuses to imbibe water under normal soaking, giving a coefficient of 0·02 and 0·03 for one and two hours respectively.

The softest and most easily cut of these stones is that from Prince Edward Island. The Whycocomagh and River John stones come next, and are followed by a group of medium hardness, including the Sackville, Amherst, and Wood Point stone. The Mary Point stone is distinctly harder and the Judique stone is the hardest of the samples tested.

The method of quarrying sandstones varies somewhat in the different quarries, but the general practice is to use explosives to remove the overburden and to expose the valuable beds. Single holes with a light charge of powder suffice in most cases to break the beds into blocks. It is found that most of the stones break with a remarkably straight fracture under this treatment. Some of the thinner beds are cut directly into blocks by means of wedges. In the heavier layers, the stone is "raised" by means of a series of short wedges of special design "gads" (see page 63), which are inserted into a line of holes made by means of a pick. This same operation serves to break the blocks into the sizes desired. The further dressing and squaring up of the blocks is effected almost entirely by the use of picks. The so-called "scabbled blocks" are thus produced, and it is in this form that most of the larger stone goes on the market. Grindstones are prepared for the lathe in the same manner. Sawing machinery has been introduced by the Sackville Freestone Company at Sackville, and by the Miramichi Quarry Company at Quarryville, N.B.

Chaleur Bay Area.

The sandstones of the Millstone Grit have been quarried for many years along the south side of Chaleur bay, more particularly in the parishes of New Bandon and Caraquet. It is not, however, as producers of building stone that these quarries have gained a reputation, but as the source of a most desirable material for the manufacture of grindstones. Two important quarries are now being operated exclusively for the making of grindstones, but, in the past, small amounts of building stone have been produced at several points along the shore, more particularly at Grande Anse.

The two grindstone quarries now working are situated within 2 miles of each other, at Clifton and at Stonehaven. The very heavy overburden and the consequent expense of quarrying renders the production of building stone economically impossible, except in so far as the waste material may be utilized for this purpose. It seems desirable, however, to give a short description of the formation and of the character of the stone.

The whole mass of the formation as exposed along the coast and as revealed by borings, consists of red and greenish shales, with bands of impure sandstones and occasional thin seams of coal. The thickness of the whole series is at least 700 feet. The formation dips southeast at a low angle— 40 feet to the mile. The valuable layer appears to be lenticular in habit, thinning out and re-appearing in the exposure along the shore, where its maximum thickness is 15 feet. A bore-hole, $1\frac{3}{4}$ miles inland and southeast from Clifton, revealed the bed at a depth of 110 feet with a thickness of 31 feet.

Read Stone Company, Sackville, N.B., Henry C. Read, president; Herbert W. Read, secretary, Sackville, N.B.

The quarries of this company are situated on the shore at Stonehaven, in the parish of New Bandon in Gloucester county. The workings extend almost one-fourth of a mile along the shore. The succession of beds now exposed is as follows:—

40 feet—Shales.
10 feet—Hard, fractured calcareous sandstone.
12 feet—Grindstone beds.

The top of the grindstone beds is almost level with the high water line, and as all the available stone has long since been quarried along the strip of beach, the present practice is to build dams and to quarry the stone behind these protections to a depth of 14 feet below high water level. The construction of these dams and the removal of the large amount of accumulated debris from the earlier workings entails an expenditure which is justified only by the high value of the stone as a grinding material, and which renders impossible the employment of the product for purposes of construction. The valuable stone has a thickness of 8 feet at the western end and increases to 15 feet at the eastern: it occurs in solid layers from 1 to 3 feet thick. The main joints are clear-cut, and vertical in a direction 60° east of north. The other set of joints is not quite at right angles, and is less well defined. The stone is quarried very largely by the use of wedges, explosives being only occasionally used.

The stone : No. 567.—In colour, this stone is the most distinctly blue-grey of any of the examples examined: it is represented in Plate XLIV, No. 5. This colour is unaltered by treatment with carbonic acid and oxygen, under which operation the stone loses very little in weight, as indicated in the table below.

The chief mineral grains are quartz. They are sometimes as great as one-third mm. in diameter, but the average size is much less than this. These grains are, for the most part, of angular outline and they constitute from one-third to one-half the whole rock. Feldspar grains are much less numerous than the quartz fragments and are generally of smaller size: they show much decomposition. Scattered flakes of glistening mica appear and a considerable amount of green-blue chloritic matter which has probably resulted from the decay of some original ferro-magnesian mineral. Open interspaces can not be observed under the microscope, the grains being closely cemented by an argillaceous cement, which constitutes about one-third of the stone.

The physical constants determined are as follows:—

Specific gravity	2·64
Weight per cubic foot, lbs	147·456
Pore space, per cent	10·527
Ratio of absorption, per cent	4·456
Coefficient of saturation, one hour	0·58
" two hours	0·7
Crushing strength, lbs. per sq. in. (Riehle)	14382·
" lbs. per sq. in. (Wicksteed)	11112·
" wet, lbs. per sq. in	6470·
" wet, lbs per sq. in (duplicate)	7667·
" wet, after freezing, lbs. per sq. in	8123·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00278
Transverse strength, lbs. per sq. in	1441·
Chiselling factor, grams	7·3
Drilling factor, mm	20·

It will be observed that the crushing strength after freezing is anomalous: a duplicate wet test was made to correct this but it resulted in confirming it. We may conclude, therefore, that the stone is practically uninjured by this treatment.

Analysis by H. A. Leverin:—

Ferrous oxide, per cent....................	5·14
Ferric oxide, per cent......................	0·14

The Knowles Quarry Company, Limited, W. R. Knowles, president, Clifton.

The property consists of 500 acres in all. The quarry extends along the face of the cliff at Clifton for a distance of about 1,000 feet. At this point the valuable beds ascend to a higher level than at Stonehaven, the succession being as follows:—

30 feet—Shale.
14 feet—Grindstone beds.
60 feet—Shale to level of high water.

As in the case of the Stonehaven quarries, the heavy overburden adds greatly to the cost of production. Further developing can be done only by removing or tunnelling under the overlying shales, which, owing to the dip of the formation, gradually increase in thickness. The fundamental features are the same as in the Read quarries. The output is practically all converted into grindstones and scythestones. A little is used locally for building; an unfinished structure on the property shows a mellow slightly greenish-grey colour which is very attractive.

The stone: No. 568.—This stone is practically identical with No. 567 described under the Read Stone Co.

Lombard and Co., New York, John McGill, manager, New Bandon.

This company has operated at several points along the coast, more particularly at New Bandon 2 miles east of Stonehaven. The product was converted into grindstones and a small amount was used for building. The stone may be seen in the post-office at Bathurst, where it was used for the arches of windows, etc. This stone is less yellowish and more resistant to decay than the Grande Anse stone of which the building is mainly constructed. The company is still producing grindstones at New Bandon.

The Grande Anse Quarries.

Several owners control the exposures in the cliffs at Grande Anse, but no operations have been carried on for a long time. The exposures occur for nearly half a mile along the shore, and show 5 or 6 feet of stripping above the stone which forms the face of the cliff to a height varying from 5 to 25 feet above high water. The rock extends to an undetermined depth.

The stone has a warmer and more yellowish tone than the Clifton and Stonehaven varieties, but it is much lighter and less yellow than the Miramichi stone. In buildings it presents a soft, clean, slightly yellowish-green tint of very pleasing and attractive tone. Soaking in salt water is said to be very destructive of the colour and of the resisting properties of the stone.

The material is fine in grain and is very easily worked, but its resistance to the weather does not seem to be of high order. The post-office and custom house in Bathurst is constructed mainly of this stone: in this structure, erected in 1885, the rock-face work has lost the angularity of the points. Superficial grains are easily removed by rubbing with the tips of the fingers. This deterioration is much more perceptible in some blocks than in others.

The stone: No. 569.—The colour is represented in Plate XLIII, No. 8: it is decidedly less yellow than that of the typical Miramichi stones. Practically no change in colour is effected by treatment with carbonic acid and oxygen. The grains are more rounded, larger, and more diversified than in the Stonehaven example. Mica flakes are more numerous and there is a considerable amount of pinkish feldspar. The binding material is clay. An analysis by H. A. Leverin gave:—

Ferrous oxide, per cent	5·01
Ferric "	trace.

This stone, and No. 567 from Stonehaven, show the greatest amount of ferrous oxide of any of the examples tested: it is surprising, therefore, that the corrosion test showed no discoloration.

The physical tests are listed below:—

Specific gravity	2·67
Weight per cubic foot, lbs	140·075
Pore space, per cent	15·96
Ratio of absorption, per cent	7·083
Coefficient of saturation, one hour	0·67
" " two hours	0·68
Crushing strength, lbs. per sq. in	15577·
" " wet, lbs. per sq. in	7002·
" " wet, after freezing, lbs. per sq. in	3188·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00284
Transverse strength, lbs. per sq. in	856·
Chiselling factor, grams	5·1
Drilling factor, mm	17·6

Under the freezing test, the specimen showed considerable disintegration with a rounding of the angles and the development of cracks.

The post-office in Bathurst (Plate II), as above mentioned, is perhaps the finest building constructed of this stone, but it may also be seen in a fine church in Grande Anse, and in buildings in Caraquet. Near this town also are promising outcrops of sandstone: a fine type of stone is said to occur on the property of C. Hubbert at Caraquet.

Summary—Chaleur Bay Area.

Two types of sandstone have been quarried along the south shore of the bay in Gloucester county. The reputation of the district depends very largely on those of the first type, which consist of even grained bluish stones of fine quality for the manufacture of grindstones. The cost of production is, however, much too high to permit the quarrying of stone for building purposes. The grindstone industry is of considerable magnitude, with companies operating at Clifton, Stonehaven, and New Bandon.

The second type of stone has been quarried farther to the east, more particularly at Grande Anse. At other places along this coast, cliffs of sandstone are available. The stone is of the olive-green class, but it is less yellow than the typical examples of this kind of stone from the Miramichi area.

There is no production at present. The only important buildings of this stone are churches in Caraquet, Grande Anse, and other local towns, and the post-office in Bathurst.

Miramichi Area.

Sandstones of the Millstone Grit are exposed at many points along the lower Miramichi river, as well as in the ravines which have been cut through the strata by tributary streams.

Besides small openings at numerous places there are three important quarries, two of which are now in operation: it is expected that the third will be re-opened on a large scale in the near future. The stone from all the quarries is an olive-coloured freestone varying in tint and in fineness of grain: it has been largely used in New Brunswick and also in Montreal, Toronto, Hamilton, etc., under the name of Miramichi stone.

The Miramichi Quarry Co., Limited, R. Geo. Hood, president, Quarryville, N.B.; W. H. Hood, sec.-treas., Quarryville, N.B.

The property consists of 119 acres, extending $1\frac{3}{8}$ miles from the north shore of the Miramichi river along the west side of Indiantown brook in a direction north 40° west. The quarry is opened in the side of the ravine for a length of 300 feet and has been worked in to a maximum depth of 150

Grande Anse sandstone. Post-office, Bathurst, N.B.

feet. The total height of the escarpment is 90 feet and the face of the quarry shows the following succession:—

6-8 feet—Stripping (occasionally more).
70 feet—Variable layers of sandstone.
10-12 feet—Covered by talus, probably coarser stone.

The 70 feet of sandstone consists of fairly level beds with much less of the lenticular arrangement than is observed in many sandstone deposits. The planes of parting are not continuous, so that the succession of beds in one part is quite different from that in another. On the whole, it may be said that the beds vary in thickness from thin seams up to 12 feet. In some parts the separation planes are quite clean, in others they show a mud parting, and in others they are marked by several inches of plant-laden material which has to be scabbled off the blocks. Some of the beds show the presence of "bulls," which consist of the ordinary stone hardened by local crystallization of carbonate of lime. Surrounding these "bulls" is frequently an aureole of iron stained material, which seems to have resulted from the decay of iron pyrites. The beds vary somewhat in character, and, on the whole, are coarser towards the bottom; they also vary slightly in colour and in the amount of black mica present.

The jointing is not clearly marked: the planes are frequently curved and inclined and are often confined to a single bed. The general direction of the main joints is 20° east of south. This jointing is by no means excessive, and it does not prevent the obtaining of large blocks, although, on account of its curving nature, it occasions a certain amount of waste material. Despite these structural imperfections, the general value of the quarry may be estimated from the fact that about two-thirds of the product is marketable material. The even bedding of the stone is well shown in the accompanying photograph (Frontispiece.)

As already stated, there are differences in the colour and in the texture of different beds, but three general types may be recognized: ordinary building stone (564); fine grained building stone (563); coarse building stone, also employed for pulp stones (565.)

The stone: No. 564.—This example is represented in Plate XLIII, No. 3. On treatment with carbonic acid and oxygen it gains in weight and loses much of the greenish cast, becoming yellow-grey in colour. The quartz grains constitute about one-third of the rock: they are, for the most part, of angular outline, but some rounded grains appear. The average diameter is about $\frac{1}{5}$ mm., but grains up to $\frac{1}{2}$ mm. in diameter are not uncommon. Feldspar grains, in a semi-decomposed condition, are almost as numerous as the quartz grains in some parts of the rock; in other parts they are much less abundant. Flakes of light coloured mica, and some indeterminable grains, also occur. In the more quartzose portions, the grains are fitted close together, with scarcely a film of cementing matter between them. Where

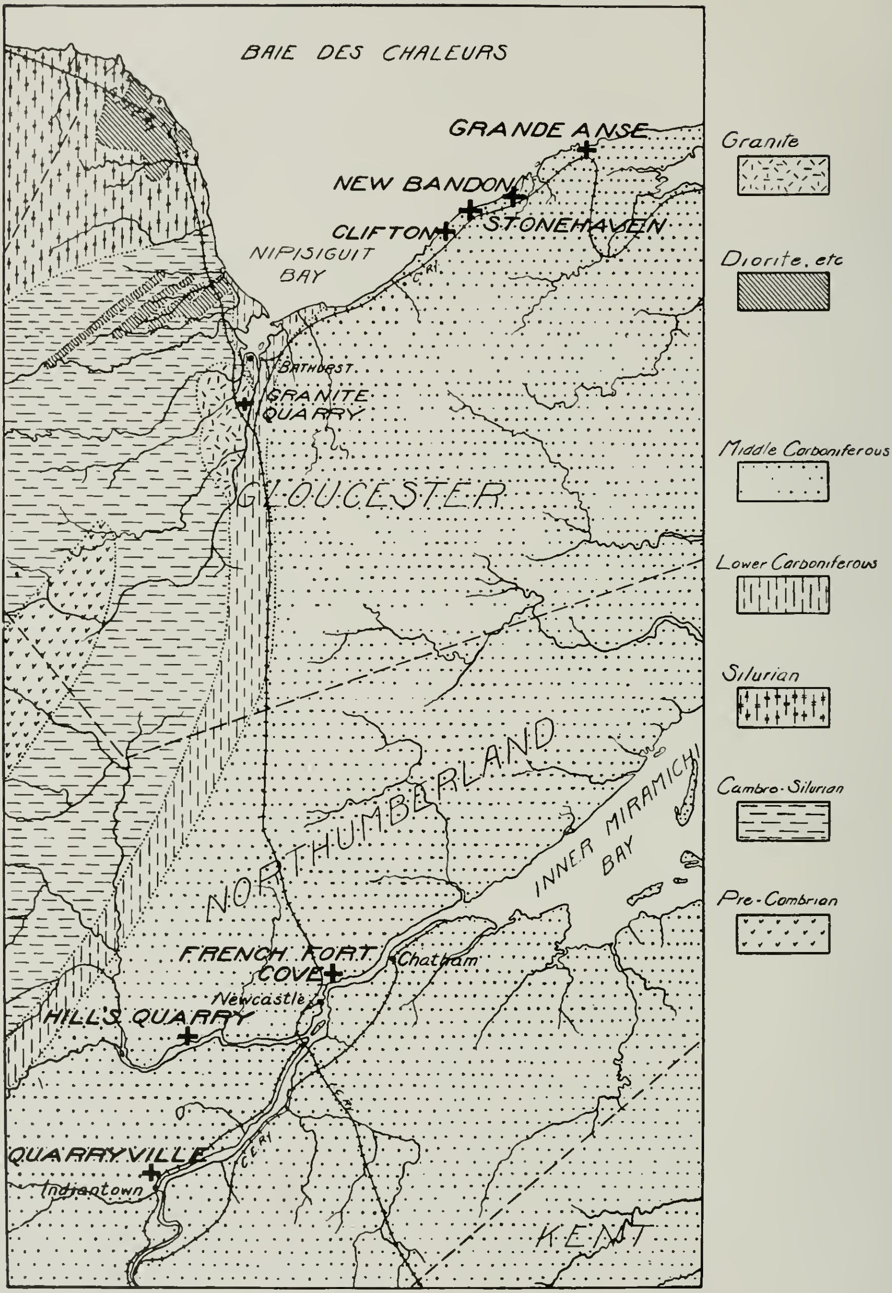

FIG. 1. Sketch map showing the geology and the principal quarries in the Miramichi and Chaleur Bay sandstone areas.

the feldspars are more abundant there is a greater amount ofyellowish-green cement. Occasional grains of quite fresh plagioclase feldspar are present.

The physical characteristics are as below:—

Specific gravity	2·666
Weight per cubic foot, lbs.	147·27
Pore space, per cent	11·51
Ratio of absorption, per cent	5·55
Coefficient of saturation, one hour	0·46
" " two hours	0·61
Crushing strength, lbs. per sq. in. (Wicksteed).	10944·
" " (Riehle)	10832·
" wet, "	8123·
" wet, after freezing, lbs. per sq. in.	6431·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·0045
Transverse strength, lbs. per sq. in.	1330·
Chiselling factor, grams	6·9
Drilling factor, mm.	17·6

The cementing material is argillaceous matter. An analysis shows:—

Ferrous oxide, per cent	2·44
Ferric " "	2·88

Taking this example as typical of the Miramichi stone, it is seen that according to both the chiselling and the drilling tests it is more easily worked than the Wallace stone.

No. 565.—The general appearance of this stone is much like that of No. 564, and is shown in Plate XLIII, No. 2. The tint is, however, slightly less green, and the surface shows minute dark dots which are probably due to the oxidation of particles of iron pyrites. Like No. 464, the present example gains in weight on treatment with oxygen and carbonic acid and assumes a less yellowish-green and more greyish colour. The mineral grains are quite the same as those of No. 464, but they are of greater size, the quartz grains averaging $\frac{1}{3}$ mm. in diameter.

The physical characteristics are given below:—

Specific gravity	2·683
Weight per cubic foot, lbs.	139·183
Pore space, per cent	16·9
Ratio of absorption, per cent	7·57
Coefficient of saturation, one hour	0·63
" " two hours	0·64
Crushing strength, lbs. per sq. in.	9350·

Crushing strength, wet, lbs. per sq. in.......	6029·
" wet, after freezing, lbs per sq. in.	3045·
Gain on treatment with carbonic acid and oxygen, grams per sq. in................	0·00447
Transverse strength, lbs. per sq. in..........	1207·
Chiselling factor, grams....................	9·6
Drilling factor, mm......................	17·2

It is interesting to compare these results with those obtained from No. 564, which is practically the same, except for its finer grain. The increase in the size of the grains, other things being equal, has produced the following effects:—

Increased the pore space.
Lessened the weight per cubic foot.
Increased the coefficient of saturation.
Slightly lowered the dry crushing strength.
Materially lowered the wet crushing strength.
Greatly lowered the crushing strength after freezing.

This difference is also plainly shown by an inspection of the two cubes, as No. 464 shows very little alteration while the present example suffered considerably on the edges and angles.

Both specimens gain nearly the same amount on treatment with carbonic acid and oxygen: this is to be expected as the test is a chemical rather than a physical one. The drilling factor is the same for both varieties, but the chiselling factor is higher for the coarser stone.

No. 563.—This example is very like No. 564, but it is distinctly finer in grain and presents a more yellow and less green colour: in this respect it resembles the Rockport stone (Plate XLIII, No. 4.)

Quarrying is effected by the use of black powder, usually in single, rimmed holes. Remarkably straight breaks result even up to lengths of 8 and 10 feet.

The following list represents roughly the equipment at the quarry:—

Four steam derricks of a maximum capacity of 25 tons, with separate boilers and hoists.

Two hand derricks.

One locomotive crane, capacity eight tons—McMiller Manufacturing Co., Cleveland, Ohio.

One steam drill—Canadian Rand.

One compressor " "

One pneumatic plug drill.

Mill building, 50 feet × 75 feet.

One gang saw—Sector gang, Alston Stone Machine Co., Binghampton, N. Y. (With steel shot this machine cuts 12 inches per hour irrespective of length of stone or number of blades.)

One large planer—W. Collier and Co., Salford, Manchester.

One boiler, 60 H.P.

One engine, 30 H.P.

One band saw.

One lathe, for turning pulp stones.

One half-mile of siding, connecting with the Intercolonial railway and giving good shipping facilities eastward to the main line of the Intercolonial, and westward to the Canadian Pacific at McAdam Junction. A short haul from the quarry enables stone to be loaded into scows on tide water on the Miramichi river.

About 20 men are usually employed.

A large amount of stone has been shipped from this quarry since its opening in 1897: the supply of material is practically inexhaustible. The production in 1910 was 30,000 cubic feet of scabbled blocks, 1,000 cubic feet of stone in the rough, and 100 pulp stones. Mr. Hood quotes the following prices, all f.o.b. at quarry:—

Scabbled blocks, 40-45 cts. per cub. ft.

Dimension stones, 48-54 " "

Random coursing, cut to lay, $3 to $5 per sq. yd., according to quality.

Stone from these quarries may be seen in the following structures, but it is not to be inferred that they are all constructed exclusively of this stone.

Birks building, Montreal (part).

A. Joyce " "

Royal bank, St. John.

R. C. cathedral, Chatham (part).

Postal station F, Toronto (part).

New observatory building, Toronto (part).

Post-office, Campbellton.

Jeffery Hale hospital, Quebec (part), Plate IV.

Post-office, Pointe St. Charles, Montreal.

Post-office, St. Roch, Quebec.

Post-office, Whitby, Ont.

Empire block, Montreal (trimmings).

Adam Hill, Cassilis P. O., N.B. (Rural Route, Box 57).

The quarry is situated on the north side of the Northwest Miramichi, about 9 miles from Newcastle: it was opened about five years ago. The excavation is 180 feet long and has been extended into the bank for 80 feet. The face is about 24 feet high, and, with the exception of 5 or 6 feet of stripping, it consists entirely of sandstone. The beds are not continuous, and they are not all equally desirable owing to the presence of "bulls" and coarser streaks with an excess of black mica. One bed of 16 inches, about two-thirds of the distance from the top, is the worst in this respect: it is, however, not continuous. The beds vary in thickness from 6 inches to 4 feet and are said to extend to a depth of at least 60 feet as determined by boring. The amount of stripping does not materially increase for a considerable distance from the river. The formation strikes about east with a dip of 15° to the south. The major joints are more clearly defined than in the Hood quarries and strike 15° south of east, parallel to the direction of the river. These joints dip 72° to the south and occur at intervals of 10 feet, 8 feet, 6 feet, and 7 feet from south to north. A second less clearly defined set of joints strikes 70° east of north at intervals of 12 feet, with a dip of 70° to the west. It will be observed that the joints are practically at right angles to each other and perpendicular to the planes of bedding whereby the removal of the stone in rectangular blocks is greatly assisted. (Plate III).

The stone: No. 555.—This stone is of a decidedly less yellowish-green colour than the previously described examples from the Miramichi quarries: it is shown in Plate XLIII, No. 11. In conformity with all the other stones from the Miramichi it gains in weight and becomes more greyish in colour on treatment with carbonic acid and oxygen.

The quartz grains are of decidedly angular outline and do not average more than one-tenth mm. in diameter. A small amount of pink and white feldspar and scattered grains of glistening mica make up the rest of the mineral grains. In colour, this specimen approaches the Wallace stone more nearly than any of the other Miramichi stones.

Specific gravity	2·663
Weight per cubic foot, lbs	141·253
Pore space, per cent	15·031
Ratio of absorption, per cent	6·604
Coefficient of saturation, one hour	0·57
" " two hours	0·72
Crushing strength, lbs. per sq. in	11891·
" wet, lbs. per sq. in	7652·
" dry after freezing, lbs. per sq. in	9087·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·00439
Transverse strength, lbs. per sq. in	[1]892·
Chiselling factor	5·8
Drilling factor	18·

[1] The specimen was not cut parallel to the bedding, so that the result is probably too low.

Miramichi sandstone. Adam Hill's quarry, near Newcastle, N.B.

The cementing material is argillaceous. Of the colouring ingredients, the stone contains:—

Ferrous oxide, per cent..................	3·21
Ferric " "	1·28

The equipment consists of two horse derricks, two scows, and a gasoline tug. The stone is loaded directly into the scows and transported to Newcastle where it is transferred for shipment.

The production in 1910 was 2,500 tons, valued at $2.50 per ton for random blocks f. o. b. cars. Dimension stone is quoted at from $3 to $5 per ton, and rubble at from 75 cents to $1 per ton. Nine men are employed.

The stone has been used in the construction of the following buildings:—

R. C. cathedral, Chatham, N.B. (part).
Y. M. C. A. building, St. John, N.B.
R. C. church, Oromocto, N.B.
Public school, Woodstock, N.B.
Hospital, Chatham, N.B.
Harkins academy, Newcastle, N.B. (part). (Plate VI.)

C. E. Fish, Newcastle, N.B.—French Fort Cove quarries.

The quarry lands controlled by Mr. Fish are situated at French Fort cove near Newcastle; in the past, they have furnished a large quantity of stone. The old workings extend for a quarter of a mile along the east side of a deep ravine which has been cut through the strata to a depth of 130 feet: the openings have been made chiefly along the upper part of the hillside and show a face of from 20 to 50 feet. The overburden of soil is not heavy, but as much as 20 feet of this material overlies the good beds in places. The workable layers show the usual lack of continuity and present many variations in both colour and structure. While the section given below is by no means applicable to the whole quarry, it serves to indicate the general character of the beds, which however, may vary greatly in thickness and in order:—

20 feet—Thin stone and stripping.
4 feet—Bed, solid in parts, divided into three layers in others. Has a coarse, pebbly band in middle. The upper and lower stones are like No. 557.
4 feet—Part solid, part divided; stone like No. 557, but the upper part is finer —559.
4 feet—Fairly solid like No. 558.
6 inches—Thin parting.
2 feet —Fine grained stone—557.
4 feet—Coarse feldspathic, weathers spotted.

Towards the north end there is less thin stone at the top, but in places the rock is very coarse and pebbly. At the south end, the thin upper material is from 10 to 20 feet thick; beneath this are variable but heavy beds of finer stone with coarser material below—560.

As already stated, the beds are very irregular, but for the most part they are of sufficient thickness for all ordinary purposes. The main joints strike due east and west and are from 1 to 10 feet apart. Joints at right angles are less well developed. The face of the quarry has a general direction 20° south of east.

The heavy overburden, the variable character of the beds, and the presence of "bulls" and pebbly streaks detract from the general value of the quarry, but notwithstanding these objections, about one-third of the whole is good marketable stone, of the general character of specimen No. 561 described below.

The stone: No. 561.—The colour and grain of this example are shown in Plate XLIII, No. 5: it is slightly less greenish and somewhat finer in grain than No. 464 from the Miramichi quarries. The sample gained in weight and became distinctly less greenish after treatment with oxygen and carbonic acid. Under the microscope, this stone shows much the same structure as No. 564. The mineral grains are the same and the clustering habit of the quartz fragments is equally pronounced. There is, however, a slightly less amount of cement, the grains being more closely apposed. The cement consists of clayey matter, with a very small amount of carbonate of lime. An analysis gave Mr. Leverin:—

Ferrous oxide, per cent	3·21
Ferric oxide, per cent	1·28

The physical properties are as follows:—

Specific gravity	2·684
Weight per cubic foot, lbs.	139·25
Pore space, per cent	16·89
Ratio of absorption, per cent	7·574
Coefficient of saturation, one hour	0·61
" saturation, two hours	0·65
Crushing strength, lbs. per sq. in.	9791·
" wet, lbs. per sq. in.	5863·
" wet after freezing, lbs. per sq in.	3923·
Gain on treatment with carbonic acid and oxygen, grams per sq. in.	0·00221
Transverse strength, lbs. per sq. in.	1361·
Chiselling factor	6·9
Drilling factor	25·2

In comparing this stone with the other examples from the Miramichi area it is to be remembered that the sample was not freshly quarried, and that in consequence its strength and firmness had been reduced by lying

PLATE IV

Miramichi sandstone. Jeffery Hale hospital, Quebec.

Miramichi sandstone. Post-office, Newcastle, N.B.

Miramichi sandstone. Door of Harkins academy, Newcastle, N.B.

exposed to the weather in the quarry. Assuming that its chemical composition is identical with that of the other stones, it will be seen that oxidation had occurred, as the gain under the carbonic acid and oxygen test is only half that of the other specimens.

No. 557—This example presents the same grain and structure as No. 561 but it is slightly less greenish in colour.

No. 558—This stone is of coarser grain and closely resembles the pulp stone from the Miramichi quarries shown in Plate XLIII, No. 2.

No. 559—Not essentially different from No. 561, but seems to contain a greater amount of glistening mica.

No. 560—A rather coarser stone than No. 558: it is of a more friable nature and shows numerous spots and streaks of iron oxide.

It is now five years since this quarry was worked and in consequence it presents the worst possible appearance. I am informed by Mr. Fish that it is proposed to reopen on an extensive scale at a more favourable point farther up the ravine. Mr. Fish states that he will shortly be prepared to furnish stone at the following rates:—

Rubble, 50 cts. per ton, f.o.b. cars.
Random scabbled blocks, 40 cts. per cub. ft., f.o.b. cars.
Dimension stone, 50 cts. per cub. ft., f.o.b. cars.
Random coursing, ready to lay, $1.75 per superficial yard.

French Fort stone may be seen in many important buildings, among which may be mentioned:—

Jeffery Hale hospital, Quebec (part). (Plate IV).
R. C. cathedral, Charlottetown, P.E.I.
Post-office, Newcastle, N.B. (Plate V.)
Post-office, Chatham, N.B.
Post-office, Campbellton, N.B.
City hall, Hamilton, Ont.
Langevin block, Ottawa, Ont.
Birks building, Montreal (part).
St. James Methodist church, Montreal.
Post-office, Fraserville, Que.
Post-office, Rimouski, Que.

The McIntyre residence in Montreal is built of the finest selected stone from this quarry.

Summary--Miramichi Area.

At the present time, this area is to be regarded as the chief producer of the olive-green type of sandstone. The old quarry at French Fort cove has yielded a large amount of stone in the past but it is idle at the present time. The Miramichi Quarry Co. is carrying on extensive operations at Quarryville, near Indiantown, and Adam Hill is raising a considerable amount of stone on the Northwest Miramichi above Newcastle.. Miramichi stone has been used extensively for public buildings in the Maritime Provinces and has been shipped to a distance as well: the City Hall in Hamilton and the Langevin block in Ottawa are good examples of the use of this stone for important public buildings.

In texture, the stone varies from fine to coarse. The different beds in the same quarry show a great diversity in this respect, and many of them, by reason of the coarse grain, are not suited to architectural purposes.

The physical properties of the stone may be judged from the following table, which is compiled from the averages of four samples—two from the Miramichi quarries, one from Adam Hill's quarry, and one from the old quarry at French Fort cove:—

Specific gravity	2·674
Weight per cubic foot, lbs	141·739
Pore space, per cent	15·08
Ratio of absorption, per cent	6·809
Coefficient of saturation, one hour	0·56
" " two hours	0·65
Crushing strength, lbs. per sq. in	10494·
" " wet, lbs. per sq. in	6916·
" " wet, after freezing, lbs. per sq. in	4466·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·0039
Transverse strength, lbs. per sq. in	1299·
Chiselling factor, grams	7·3
Drilling factor, mm	19·5
Boring factor, revolutions per in	130·
Factor of toughness, blows	5·

The ferrous oxide averages 2·95 per cent, and the ferric oxide 1·81 per cent. The percentage of iron in the lower state of oxidation might be expected to cause a darkening of the stone on exposure. It is significant that all of the samples tested gained in weight under the corrosion test.

The considerable loss in strength on soaking may account for the fact that in many buildings the lower stone shows a much greater deterioration than the blocks higher up in the wall. This characteristic is by no means confined to the Miramichi stones, but is more or less observable in most of the sandstones from the Maritime Provinces.

Buctouche Area.

In this area are included three quarries which are separated by a considerable distance, being located respectively at Buctouche, Notre Dame, and Cape Bald.

Miss Deacon, Shediac, N.B., R. Archibald Irving, solicitor, Buctouche.

The quarry is situated about a mile above Buctouche on the north side of the river: it is opened in the side of a bank which rises 30 or 40 feet above the level of the water. The excavation extends 400 feet along the bank, and has been worked back a considerable distance which is now indeterminable. The general section is as follows:—

15 ft.—Stony soil and thin rock.
3 ft.—Solid bed.
2 ft.—Solid bed.
4 ft.—In layers of about a foot each.
3 ft.—Solid stone.

The upper three foot bed appears to be the most continuous: all the other beds are lenticular, so that a section in another part of the quarry would show a somewhat different sequence. The face of the quarry extends in a direction almost north and south. The beds are practically horizontal. Jointing is not very distinct, but appears to occur in two sets striking 75° and 20° east of north. This crossing of the second set at an acute angle is not favourable to the extraction of stone, but fortunately the joints are not too closely spaced. The stone is of fairly uniform colour and grain, but, judging from the material lying in the quarry, it is susceptible to very rapid decay under the action of sea water. The stone is much alike throughout the whole extent of the quarry and is described below.

The stone: No. 468.—The distinctly olive-green colour of this example and its coarse grain are shown in Plate XLIII, No. 1. The mineral grains consist of white and differently tinted quartz fragments, decomposed pink and white feldspars, and pieces of purple and green fine grained volcanic rock. Most of the fragments are of a rounded outline and reach a diameter of $\frac{1}{2}$ mm. The greenish cast of the stone is not as much due to the colour of the cement as to the composite effect of the mixed colours and the greenish volcanic fragments. Treatment with carbonic acid and oxygen only slightly diminishes the greenish cast.

The physical properties are as follows:—

Specific gravity	2·693
Weight per cubic foot, lbs	137·03
Pore space, per cent	18·489
Ratio of absorption, per cent	8·423

Coefficient of saturation, one hour........	0·60
" " two hours.......	0·604
Crushing strength, lbs. per sq. in.........	8869·
" " wet, lbs. per sq. in....	4923·
" " wet, after freezing, lbs. per sq. in..........	2689·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.........	0·00454
Transverse strength, lbs. per sq. in.......	809·
Chiselling factor, grams.................	5·9
Drilling factor, mm.....................	18·

Of all the olive-green stones tested this example is the coarsest, and the weakest: its porosity also is unusually high. The freezing test produced considerable alteration on the edges and angles of the cube. The coarse grains of which the stone is composed are crowded unusually close together, with the minimum of cementing material: this fact, together with the results of the long exposure to which the stone has been subjected in the abandoned quarry, will account for its physical characteristics.

The cementing material is argillaceous. The amount of iron oxides is:—

Ferrous oxide, per cent..................	2·70
Ferric " "	3·43

No stone has been shipped from this quarry for years; there are, however, two derricks which might again be put in order, and a dismantled wharf. Large amounts of stone are available in good sized blocks and the shipping facilities are excellent. The heavy overburden would be a deterrent factor in the further opening up of the quarry.

Hall and Irving, Moncton, N.B., Alfred LeBlanc, manager, Notre Dame. (Formerly the Stevens quarry.)

The quarry is situated near the village of Notre Dame, on the Moncton and Buctouche railway, about half way between the two terminals. The quarry is opened up for a distance of 200 feet along the south bank of the Cocagne river. It is being worked in two banks, a spur from the railway entering the quarry on the floor of the upper bank. The upper excavation shows 12 feet of soil, then 4 feet of thin stone, beneath which heavy layers of good stone, varying from 10 inches to 2 feet in thickness, continue to the level of the track. All of these beds are useful for building purposes, there being very little waste in quarrying. The jointing is but slightly developed, the main fractures running northeast and the minor ones at right angles. The stone is fairly uniform in these upper beds and is represented by No. 469.

The lower bank lies below the level of the track and produces a less desirable stone (470) which is coarser in grain and of unpleasant colour. On exposure, it seems very prone to split along the bedding planes; in consequence of which it is employed for foundations only. In all, about 30 feet of stone is available above the level of the river.

The stone: No. 469.—Like the Buctouche stone this example is of a distinctly green cast and is shown in Plate XLIII, No. 10. On treatment with carbonic acid and oxygen, the green colour is less pronounced and the sample loses slightly in weight.

The grain is much finer than that of the Buctouche stone—about equal to that of the Miramichi building stone (564). Under the microscope the quartz grains are seen to be of very irregular outline and angular and to vary greatly in size. The larger grains are sometimes almost a millimetre in diameter, but most of the fragments are much smaller. Decomposed feldspar is present in some abundance, as well as numerous fragments of a greenish, indeterminable material, which is probably of original volcanic origin. The cementing material is abundant, and is, in some places, converted into bright green chlorite: it is largely of an argillaceous character but contains also a small amount of carbonate of lime.

The physical properties are as follows:—

Specific gravity	2·691
Weight per cubic foot, lbs.	145·621
Pore space, per cent.	13·91
Ratio of absorption, per cent.	6·004
Coefficient of saturation, one hour	0·58
" " two hours	0·68
Crushing strength, lbs. per sq. in.	11240·
" " wet, lbs. per sq. in	4775·[1]
" " wet, after freezing, lbs. per sq. in.	3482·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.	0·0164
Transverse strength, lbs. per sq. in.	1453·
Chiselling factor, grams	7·4
Drilling factor, mm	17·6

A chemical examination by Mr. Leverin shows the stone to contain:—

Ferrous oxide, per cent.	4·24
Ferric oxide, per cent.	1·57

[1] This figure is doubtless too low, as the specimen broke from the side. It should probably be about 6,000 lbs.

No. 470.—This stone is of a decidedly yellow colour and resembles the French Fort stone shown in Plate XLIII, No. 5. The grain is slightly finer and the stone is marred by rather numerous fragments of plants which appear as black marks throughout the rock.

At the present time the property is equipped with one steam drill and one steam derrick and enjoys the advantage of a spur to the railway. Six men are employed. In 1910, 2,000 cubic yards were quarried and it is estimated that this year's production will amount to 3,000 yards. Part of this output was used for foundations and rubble work in Moncton, but a considerable portion was made into cut stone, of which some pieces 11 feet in length were prepared from the upper beds. The following prices are quoted:—

Foundation stone, $2.25 per superficial yard measured in the wall in Moncton.
Foundation stone, $1.75 per yard, f.o.b. Moncton.
Large blocks, $4 per ton, f.o.b. Moncton.
Rubble, 65 cts. per cub. yd., f.o.b. Moncton.

Part of the stone now being supplied to the new general offices of the Intercolonial railway in Moncton is from this quarry. The stone may also be seen in the Young Men's Christian Association building in Moncton (Plate VII.)

Cape Bald Freestone Company, Port Elgin, N.B., H. H. Dupuis, manager, Cape Bald, N.B.

Many years ago, stone was obtained from the shore at Cape Bald for use as a building material in Prince Edward Island. The present company has recently renewed operations and is now actively engaged. The more important workings are towards the northern end of the exposure, where the beds are seen to dip to the northwest at about 8° or one inch to the foot. The average stripping is about 8 feet. Beginning at the north end of the exposure, a bed 4 feet 5 inches thick is first seen and may be traced for 75 yards southward before passing under the next layer, which is 2 feet 4 inches thick. These two beds are the only ones worked. The upper bed shows about a foot of bluish stone at the top, but the lower part (454) is much like the second bed (453). A few yards to the south, still higher beds are encountered in layers of from 2 to 4 feet. For a hundred yards to the southeast of this point the exposure is interrupted by a bay, beyond which are further outcrops, on which little work has been done. The surface is much broken and the stone has a more feldspathic appearance. One good 2 foot bed was observed (455). Where it can be observed, the jointing is due east and west with a vertical dip. The parting planes are from 10 to 12 feet apart so that large stone can undoubtedly be obtained. The company has leased $2\frac{1}{4}$ miles of the shore line, with quarrying rights,

PLATE VII

Notre Dame sandstone. Young Men's Christian Association building, Moncton, N.B.

back to the main road, a distance of a quarter of a mile. That the overburden does not increase inland is shown by the fact that a drill hole, 100 yards inland, showed only 4 feet of soil, beneath which solid beds of 6, 4, and 5 feet in thickness were penetrated. There is no doubt that a large amount of stone is available, and that it can be quarried without undue loss or the removal of an excessive overburden. Where exposed to the action of the sea, the stone has badly crumbled, but it does not follow that it lacks reasonable durability under better conditions. When fresh the stone has a much darker colour and can be cut with great facility: it is said to harden remarkably on seasoning.

The stone: No. 453.—This example is of a rather pleasing light brownish colour, and is represented in Plate XLIV, No. 13: it is decidedly lighter than the brown stone from Wood Point (No. 12). There is very little change in colour by treatment with carbonic acid and oxygen. The grain is decidedly coarse, but the particles are not quite as large as those of the Buctouche stone. Many of the quartz grains are of a pinkish colour, which, with the rather abundant red feldspars, give the characteristic colour to the stone. Indeterminable rock fragments of a greenish colour and a small amount of mica make up the rest of the grains. The clayey cementing material is of small amount in proportion to the mineral fragments.

Specific gravity	2·687
Weight per cubic foot, lbs	135·132
Pore space, per cent	19·434
Ratio of absorption, per cent	8·977
Coefficient of saturation, one hour	0·58
" " two hours	0·59
Crushing strength, lbs. per sq. in	7623·
" " wet, lbs. per sq. in	3691·
" " wet, after freezing, lbs. per sq. in	2656·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·0033
Transverse strength, lbs. per sq. in	539·
Chiselling factor, grams	10·

Under the freezing test the specimen showed serious disintegration.

No. 454.—This example is a coarse grained sandstone of a friable character, presenting a light greenish tint with a cast of pink rather than of yellow as in the typical olive-green stones. The texture is much the same as that of No. 453 and the physical properties are doubtless similar.

No. 455.—This stone is almost identical with No. 453. It is, however, slightly lighter in colour and possibly of a more friable nature.

The only equipment is one derrick. Sixteen men are employed in the quarry, and four are engaged in hauling the stone to the wharf. Black powder is used in quarrying: it is found that a single hole 2 feet deep suffices to break very large pieces from the ledge with a remarkably straight fracture. Scabbled blocks are valued at $5.50 per ton, f.o.b. vessels.

Silas Goodwin, Baie Verte, N. B.

At the time of the construction of the Cape Tormentine railway, stone was obtained from many isolated exposures along the right of way; one of the chief of these was located on the property of Silas Goodwin at Baie Verte, and was known as the Cobourg quarry.

The old workings extend for several hundred feet along the face of an escarpment which rises about 15 feet above the lower land to the north. An enormous mass of debris has been produced in quarrying and the face is now badly shattered by the weather. The soil is scanty, but the upper 4 or 5 feet of stone is so thin that it practically constitutes an overburden. The lower beds are thicker but they are very irregular and present coarse pebbly streaks in many parts. Throughout the whole exposure there is a very large percentage of useless material. The best stone is represented by No. 457, described below. Large blocks are said to have been quarried here about fifteen years ago for the breakwater at Cape Tormentine.

The stone : No. 457.—In colour and texture this stone resembles somewhat that shown in Plate XLIV, No. 14. The stone is, however, distinctly less brownish, and the grain is slightly coarser. The mineral grains consist more of quartz than in the case of the other examples from this area, and there is a greater amount of glistening mica present. On the whole it is a finer grained, less friable, and more desirable stone than the examples from the coast.

Among the other localities from which stone has been obtained in this district may be mentioned the Gaspereau river above Port Elgin. Here, beds of sandstone crop out in layers up to 2 feet thick. The stone is described below as No. 456.

Another abandoned quarry is at Lanes siding near Cape Tormentine. The stone from this locality was found to be thin bedded and to lack durability.

The stone: No. 456.—This stone is coarse grained and friable like the Buctouche or Cape Bald types. The colour is greenish-brown, and may be imagined as intermediate between the green Buctouche (Plate XLIII, No. 1) and the brown Cape Bald (Plate XLIV, No. 13) stone. The mineral constituents are much the same as in all these stones, but there seems to be an unusual amount of the indeterminable grains of volcanic rock. The specimen is dotted all over with small dark specks of about a millimetre in diameter, which probably represent the oxidation of original grains of pyrite.

Summary— Buctouche Area.

The three quarries included in this area are so unlike and so widely separated that any general remarks are not applicable.

The two quarries near the coast, one at Buctouche and one at Cape Bald, are alike in that they yield a very coarse grained stone, but the Buctouche product is olive-green while that from Cape Bald is of a brownish colour. Both of these stones are of a relatively low crushing strength, and they both show serious disintegration under the freezing test. The Buctouche quarry is not now in operation, but a newly formed company is actively engaged at Cape Bald.

The quarry at Notre Dame (Cocagne) has produced considerable stone in the past and has recently been re-opened by Hall and Irving of Moncton. The better grades of stone from this quarry are of a much finer quality and resemble the Miramichi types. The stone contains a rather high percentage of ferrous oxide (2·24 per cent) which cannot be regarded as a favourable indication with respect to permanence of colour.

Stone has also been obtained from other places in this district, more particularly near Baie Verte, and in the Tormentine peninsula, but there are no quarries at present in operation except those at Notre Dame and Cape Bald.

Shediac Area.

Dr. E. G. Smith, Shediac, N.B.

This quarry is situated to the south of the railway, about a mile west of Shediac: it is opened in the side of a bluff facing the river and extending for some distance along the shore. The excavation is 150 feet long and has been carried 100 feet into the hill. The face is about 75 feet high and shows at the top from 10 to 12 feet of soil, beneath which workable stone extends to the bottom of the quarry. The beds are somewhat irregular but they are never thin enough to occasion much waste. Nearly all the output can be worked up into building blocks with a maximum thickness of 3 feet 6 inches. The main joints strike 68° east of north, with a vertical dip: they occur at intervals of 20 feet, and, in some cases, are accompanied by small parallel fracturing. The second series of joints, at right angles to the former, is developed only as insignificant irregular cracks. The stone is of much the same colour throughout, but the upper beds (467) are somewhat coarser than the lower (466). At the time of my visit, the lower beds were being worked and fine blocks 6 feet by 8 feet, with a thickness of more than 3 feet, were being taken out. In such buildings as were observed the stone is seen to present a very uniform colour and to retain that colour remarkably well, e. g., the station at Shediac. I am informed that the stone is susceptible of very fine chiselling, that it cuts readily when green, and that it hardens remarkably with the passage of time.

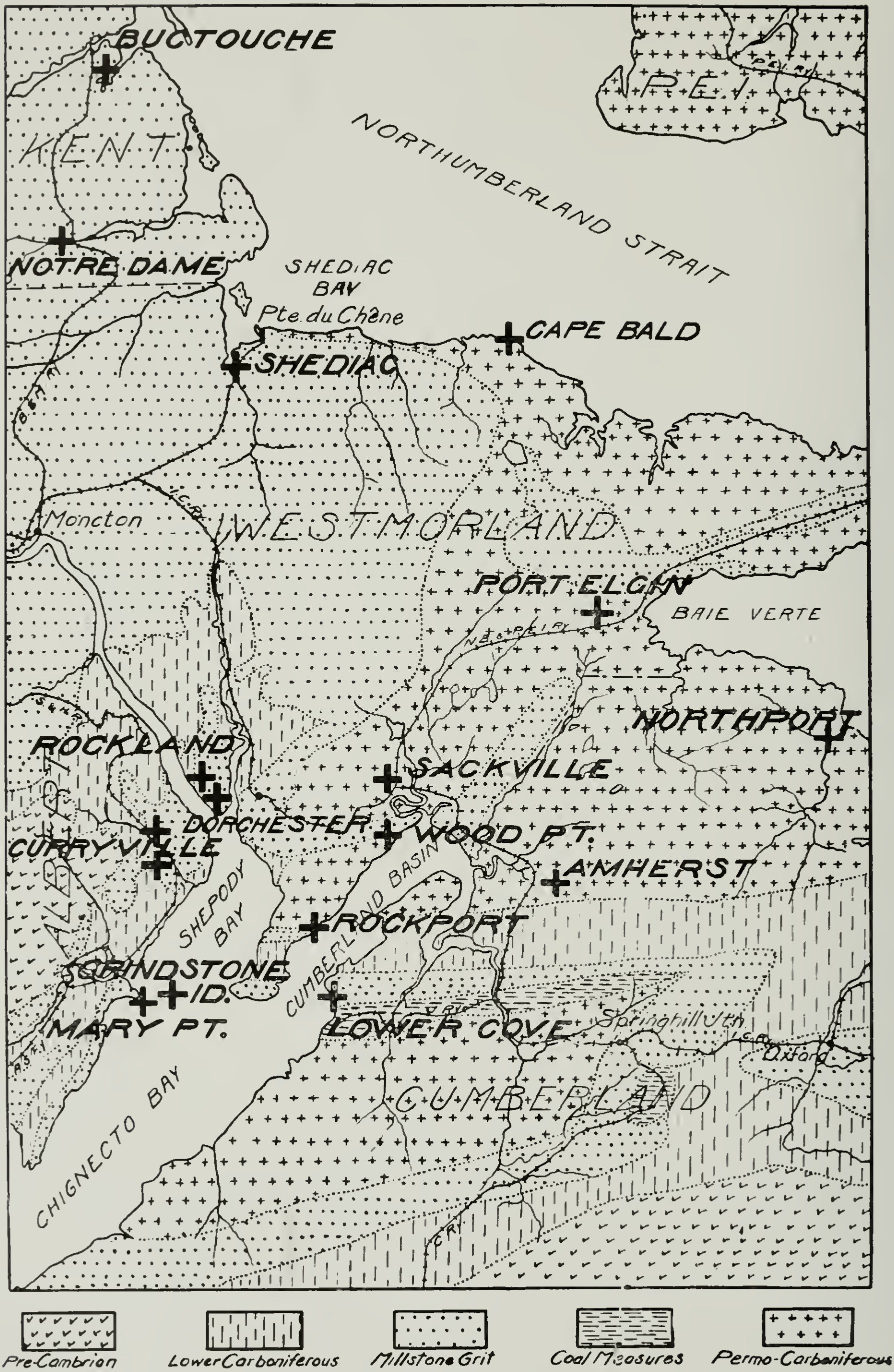

FIG. 2. Sketch map showing the geology and the principal quarries in the Shepody Bay, Cumberland Basin, Shediac, and Buctouche sandstone areas.

The stone : No. 466.—This is one of the distinctly greenish stones from the Millstone Grit, and is represented in Plate XLIII, No. 9. Very little change in colour is produced by treatment with carbonic acid and oxygen but there is a relatively large loss in weight.

The quartz fragments are angular and vary greatly in size: while some of the larger pieces reach a diameter of $\frac{2}{3}$ mm., most of the grains are very much smaller. Decomposed feldspar is present in considerable abundance and is scarcely distinguishable under the microscope from the cementing material into which the feldspar grains fade. Considerable recrystallization has taken place with the production of chlorite.

Specific gravity........................	2·686
Weight per cubic foot, lbs...............	139·898
Pore space, per cent....................	16·572
Ratio of absorption, per cent.............	7·395
Coefficient of saturation, one hour........	0·62
" " " two hours.......	0·64
Crushing strength, lbs. per sq. in..........	12566·
" wet, lbs. per sq. in.........	5337·
" " after freezing, lbs. per sq. in.........................	5148·
Loss on treatment with carbonic acid and oxygen, grams per sq. in................	0·008
Transverse strength, lbs. per sq. in........	955·
Chiselling factor, grams..................	6·7
Drilling factor, mm.	17·
Factor of toughness, blows..............	6·

A slight darkening in colour and some disintegration at the corners were observed under the freezing test.

The cementing material is clay and a very small amount of carbonate of lime. The iron is practically all in the form of ferrous oxide, of which Mr. Leverin found 4·88 per cent.

No. 467.—This is an extremely coarse grained stone, with grains exceeding those of the Buctouche sample. The colour is decidedly green, and is due to the large amount of greenish-grey fragmental material which, in all probability, consists of grains of volcanic rocks, such as andesites and felsites. The average diameter of the grains is fully a millimetre, but many individual fragments are of still greater size. Like all the coarse grained rocks of this formation the present sample shows deficient coherence.

The property is connected by a spur with the Intercolonial railway so that shipment is easily effected. The only equipment is one derrick operated by steam. Five men are employed. The production in 1910 was 590 tons of rough building blocks and 1,000 tons of rubble. Scabbled blocks are valued at 40 cts. per cubic foot, f.o.b. cars, and rubble at $1 per ton. The stone may be seen in the railway station at Shediac, the Bank of New Brunswick in Campbellton, the Bank of New Brunswick in Fredericton, the Bank of New Brunswick in St. John, and in the offices of the Telegraph, Quebec.

Summary—Shediac Area.

Only one quarry is at present in operation in this area. The product is a rather greenish type of olive-coloured stone of medium grain. The percentage of ferrous oxide is high: in consequence, the green colour is lost on exposure to the weather. Where observed in buildings this stone presents a soft, uniform and pleasing colour, e. g., the railway station at Shediac.

Fredericton Area.

At the present time there is no production of sandstone in the region surrounding Fredericton nor has any stone been raised for many years. Concerning this district Professor Bailey remarks: "The sandstones of the coal measures are usually too irregularly bedded and of too coarse a character to yield good building materials. At some points, however, the beds are thicker and more massive, and blocks of large stone are readily removed. This is the case for instance, at Three Tree creek, 4 miles east of Fredericton Junction, and immmediately adjacent to the Fredericton branch railway, also on Salmon river, whence the materials for the construction of several of the public buildings in the city of Fredericton were obtained. They often contain nodules of pyrite, which on exposure, produce by alteration to oxide of iron, rusty brown spots, or even a disintegration of the rock itself; but otherwise they are very durable, and are said to withstand fire much better than granite or marble."[1] Ells also mentions the quarry at Three Tree creek, in these words: "Among these may be mentioned a quarry along the line of the Canadian Pacific railway between Fredericton and Fredericton Junction, where the stone for the provincial parliament buildings was obtained, the output also being in two shades, grey and purple."[2]

In 1909 Professor Bailey refers to these quarries in the following words: "Stone for local consumption has, however, at different times been obtained from other localities, especially along the line of the Fredericton branch of the Canadian Pacific Railway. From quarries opened there was obtained the stone used in the construction of the Fredericton city hall, as well as the large departmental building of the Provincial Government. Besides a grey stone, these quarries yield a rather dark purple rock. When used together, as in the first of the buildings named, the effect is pleasing to the eye; but when employed alone, as in the second, is so dark as to be somewhat sombre."[3]

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[1] Geol. Sur. Can., Rep. 1872-73, p. 229.
[2] Geol. Sur. Can., Rep. No. 893, p. 126.
[3] Geol. Sur. Can., Rep. 1897, p. 114 M.

The long abandoned quarries on the Salmon river were not visited as they are of no present economic importance and are difficult of access. The openings at Three Tree creek are filled with water and debris so that little could be learned except by hearsay. A description of the deposits at this point follows:--

Charles Mott, Fredericton Junction, N.B.

A short distance above the point where the Fredericton branch railway crosses Three Tree creek, exposures of sandstone occur to a height of 10 feet or more in the banks of the stream. The beds dip northward at a low angle, but they are so weathered and shattered along the stream that definite measurements are now impossible. There seems, however, to be a major series of joints striking north and south at reasonable intervals, indicating that large stone could be obtained below the zone of surface weathering and cracking. This conclusion is supported by the evidence of Mr. Mott, who states that blocks 10 feet square were obtained at the time the quarry was in operation.

The actual quarry was not opened in the river bank but was located a short distance away, probably to avoid the broken and weathered material on the exposed cliff. Although little is to be seen at present I am informed that the upper stone was found to be soft and to disintegrate rapidly under the weather. In consequence, it was but little used and recourse was had to the underlying beds. I understand that the upper beds were about 5 feet thick and that the lower stone was worked to a depth of 10 feet in a practically continuous layer. If this is correct, it would appear that a very large body of solid stone is available under a reasonable amount of stripping. The specimens described below were obtained from blocks said by Mr. Mott to represent the lower beds—421. Isolated blocks of this stone, which have been standing near the bridge over Three Tree creek, have altered externally to a brown colour, and, in some cases, have seriously disintegrated. Many of the bridge piers which were constructed of this stone have been replaced by concrete structures.

The dark purple stone referred to by Dr. Bailey was not seen in the quarry described above and I was unable to learn the exact point at which it was obtained.

The stone: No. 421.—The colour of the fresh sample is very like that shown in Plate XLIV, No. 3; the grain, however, is somewhat coarser. The constituent particles are rounded aod consist of quartz and feldspar with a considerable amount of indeterminable rock fragments. The percentage of feldspar fragments in an advanced stage of decomposition is high. Flaky white mica is also a common constituent. These various mineral fragments are embedded in a rather abundant argillaceous cement.

As mentioned above, the stone is very liable to change of colour under the action of the weather and rapidly assumes a dirty yellowish-brown tint.

The stone from this quarry was employed chiefly in the construction of piers along the railway, and in some buildings in Fredericton as stated above in the quotation from Dr. Bailey's report. I am further informed that a similar stone was quarried at the same time from near Waasis by Mr. Charles Hood. A brown sandstone was quarried near the narrows into Washademoak lake in Queens county by Mr. James Robertson, about fifteen years ago. The stone is said to be of even grain and to preserve its brown colour unaltered on exposure.

Summary—Fredericton Area.

This area may be considered as embracing all the quarries in the interior of the Province throughout the district around Fredericton. There has been no production for many years and it seems unlikely that any stone will be raised except perhaps for local work. It cannot be denied, however, that the stone in the parliament buildings in Fredericton is of an attractive colour and that it has shown reasonable durability. I have been unable to ascertain exactly where the stone in the main entrance was obtained: it is said to be of local origin, probably Salmon river (Plate VIII).

CHIGNECTO BAY REGION.

The region around Shepody bay and Cumberland basin, at the head of the Bay of Fundy, has long been known as an important producer of sandstone for building and monumental purposes, as well as for the manufacture of grindstones. While many of the old quarries have been abandoned there is still a considerable output, as the region embraces two of the most important quarries now in operation in the Maritime Provinces. For convenience of description the region may be divided into two areas, within which the quarries fall naturally into groups as below:—

- Shepody Bay area.
    - Mary Point group.
    - Demoiselle Creek group.
    - Rockland group.
- Cumberland Basin area.
    - Sackville group.
    - Amherst group.
    - Lower Cove group.

Shepody Bay Area.

The general manner of occurrence of the sandstones in this area and an interesting historical summary is given by Professor Bailey in his report on the mineral resources of the Province of New Brunswick:—

Salmon River sandstone. Door of Parliament Buildings, Fredericton, N.B.

"For many years, the chief centre of the freestone industry was to be found at the head of the Bay of Fundy, along portions of the Albert county coast, upon that of Westmorland county, and some of the adjacent islands. One of these latter, viz., Grindstone island, emphasizes in its name the nature of the materials of which it is composed, as it was also one of the earliest localities at which grindstones were made. On Mary point, on the mainland near by, similar beds occur, and about forty years ago considerable quantities of stone were quarried and removed from both places. It is said, that, in 1851, as many as 58,949 grindstones were made, mostly from the Bay of Fundy beds. In 1856, more considerable quarries, known as the Budreau quarries, were opened on the left bank of the Petitcodiac river, in Westmorland county, and in 1864, the Caledonia quarries at Rockland in the same county. Still later, a quarry known as the Westmorland Union Freestone quarry, was opened near Cumberland basin, with others in the valley of Demoiselle creek in Albert county.

"At all the above localities, the rocks lie at or near the base of the Millstone Grit, and may often be seen to rest upon and to gradate into the red rocks of the underlying Lower Carboniferous formation. The former are usually grey or olive in colour, but shade on the one hand into chocolate-brown, or on the other into a bluish-grey. At Mary point a portion of the beds were of a pale, purplish-grey colour. The olive grey was generally preferred, and of this, very massive beds, from two to six feet in thickness, were readily obtained, yielding in the case of the Budreau quarries, blocks of any desired size up to a length of thirty feet, and a weight of twenty tons. The fine, even texture of these rocks, the facility with which they could be worked, their durability, combined with their pleasing colour, soon led to their being held in high estimation, and the so-called "brown stone fronts" of some cities of the United States, as well as many public buildings in the United States and in the Maritime Provinces, illustrate the extent to which they were at one time employed."[1]

All the quarries mentioned by Professor Bailey have long since been abandoned: the only one now in operation in the area was opened a short time ago near the old Budreau quarries on the point between the Petitcodiac river and the Memramcook river.

Mary Point Group.

The quarries of this group are situated on the shore of the long point, almost an island, which juts out from the mainland south of Shepody river, and on the adjacent Grindstone island.

Walter Roberts, New York, N.Y.

The rocks which compose Mary point have an average strike of 10° south of east and a dip of about 30° to the south. The major joints cross

[1] Geol. Sur. Can., Rep. 1897, pp. 109-110 M.

the formation at about 35° east of north with a dip of 80° to the southeast. In places these joints are only a foot or two apart, but, on the average, they are much more widely spaced. There is also an irregular fracturing at right angles to the bedding. The whole series consists of sandstones of various colours and variable bedding interlaminated with shales. The steep inclinations of the beds and their variability in thickness and colour must be reckoned with if the further exploitation of these quarries be attempted. For a distance ot about half a mile an almost continuous line of quarries has been opened along the shore. Beginning at the southwest margin of the exposures and proceeding to the northeast angle of the point, the following general sequence is presented. The first opening consists of a V shaped cut, about 200 feet long and 50 feet wide, extending along the strike of the beds. The seaward stone is red but this colour gives place to grey towards the inner side of the belt. Much of the output has been rejected owing to false bedding and the presence of concretions. Proceeding eastwards, the red stone is entirely replaced by the grey, which forms a belt about 200 feet thick resting on an underlying band of shale. The best quality of stone seems to occur near the shale, and has been removed to water level along this stretch. Still farther on, both red and grey stone is met with under the bed of shale referred to above: it has been opened in a line of quarries along the shore facing Grindstone island. On rounding the point to Grindstone island, beds of shale are first encountered, then heavy beds of laminated red sandstone—442. This red series is perhaps 100 feet thick and is succeeded by a narrow belt of grey—443. A considerable mass of shale with thin seams of coal and much iron pyrites follows: this is succeeded, in its turn, by various shades of red, grey, chocolate, and mottled sandstones, which end, towards the northeast angle, in heavier beds of grey like No. 443. Around the point, looking into the mouth of Shepody river, the sandstones are thin bedded and soon disappear beneath the drift. The easily accessible stone along the south shore has been largely removed, but an unlimited quantity of good material is still available by advancing inland along the strike from the old openings facing Grindstone island. The cliff is about 50 feet high and is covered by a moderate amount of soil, so that it should not be difficult to advance the quarries in the direction mentioned.

Many of the blocks exposed along the coast have seriously disintegrated owing to the action of the salt water. Chisel marks have entirely disappeared and some old channeller cuts show rounded and worn edges so that they can scarcely be recognized as such. It does not follow that the stone is of inferior durability, for none but the very hardest sandstones could withstand the combined action of salt water and the continual pounding of the sea.

The stone: The two specimens described below represent the average of the grey and of the red types. Both darker and lighter shades of both colours occur, as well as chocolate tinted and mottled varieties.

No. 443.—This example is referred to in this report as the "grey Mary Point stone" and is represented in Plate XLIII, No. 14. The colour is a brownish rather than a bluish grey and in this respect it differs from the Stonehaven grindstone.

In structure and grain the present example is among the most even and finest grained of the sandstones of the Maritime Provinces. Under the microscope the only recognizable minerals are feldspar and quartz which occur in grains of about $\frac{1}{10}$ mm. in diameter. The cement which is of an argillaceous nature, is fairly abundant, and is frequently arranged in little strings between the mineral grains. By treatment with carbonic acid and oxygen the colour becomes more yellowish and somewhat less pleasing.

The physical properties follow:—

Specific gravity	2·665
Weight per cubic foot, lbs	144·387
Pore space, per cent	13·271
Ratio of absorption, per cent	5·749
Coefficient of saturation, one hour	0·60
" " two hours	0·61
Crushing strength, lbs. per sq. in	17817·
" " wet, lbs. per sq. in	9099·
" " wet after freezing, lbs. per sq. in	5728·
Loss on treatment with carbonic acid and oxygen, grams per sq. n	0·0062
Transverse strength, lbs. per sq. in	1638·
Chiselling factor, grams	5·2
Drilling factor, mm	18·

The specimen was apparently but little affected by the freezing test as the edges and angles remained sharp. Fine black lines parallel to the stratification were rendered more apparent.

In this example the ferric oxide is in excess of the ferrous, as the stone contains:

Ferrous oxide, per cent	2·18
Ferric oxide, per cent	2·71

No. 442.—This stone is referred to as "Mary Point red stone" and is represented in Plate XLIV, No. 14. Compared with the distinctly red stones, this example might more correctly be described as brown. By oxidation, the sample became slightly redder.

The grain is fine but it is slightly coarser than that of the Mary Point grey stone (No. 443). The mineral grains are much the same as in the grey stone, the difference in colour being due to the ferruginous matter in the largely argillaceous cement.

The two stones differ but little in their physical properties, as may be seen by comparing the list below with the figures given for No. 443.

Specific gravity	2·666
Weight per cubic foot, lbs	144·834
Pore space, per cent	12·975
Ratio of absorption, per cent	5·596
Coefficient of saturation, one hour	0·62
" " two hours	0·72
Crushing strength, lbs. per sq. in	14675·
" " wet, lbs. per sq. in	7602·
" " wet after freezing, lbs. per sq. in	4904·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00447
Transverse strength, lbs. per sq. in	1532·
Chiselling factor, grams	3·5
Drilling factor, mm	13·

Under the freezing test, the corners only were slightly affected.

In this red stone the ferric oxide is largely in excess of the ferrous oxide, as below·—

Ferrous oxide, per cent	2·57
Ferric oxide, per cent	4·14

In the cemetery at Hillsborough are to be seen some very interesting old tombstones bearing dates of fully a hundred years ago. Without being guilty of the sacrilege of chipping these old monuments, I am of the opinion that they were made from Mary Point red stone. The fact that the inscriptions are perfectly legible after a hundred years of weather beating speaks well for the durability of this stone. This observation may also be of use, in that it emphasizes the difference between the effect of weather on properly seasoned stone and the action of the elements on a storm beaten coast.

The quarries on Grindstone island are situated along the north shore, on an extension of the same beds which were worked at Mary point. Some of the old derricks are still standing, but operations have been suspended. I am informed that a few grindstones were prepared here at a date subsequent to the general closing down of the quarries.

Demoiselle Creek Group.

On both sides of Demoiselle creek, more particularly in the vicinity of Curryville, quarries were operated in the hillside at a considerable elevation above the bed of the stream. Two of these old openings were visited and samples obtained, which may be regarded as typical of the group.

Levi Downey, Curryville, N.B.

This quarry is situated a short distance south of Curryville and a quarter of a mile to the west of the road to Riverside. The excavation is about 200 feet long and 100 feet wide with a face of 50 feet. The succession of beds is as follows:

20 feet—Mostly thin bedded and shaly but with some thicker beds.
30 feet—Heavily bedded sandstone in somewhat irregular layers with shaly partings. Much of the stone is from 6 to 8 feet thick.

The beds are practically horizontal and are cut by a major series of joints striking 5° east of north, with an undulating but approximately vertical dip. The second series of joints is more irregular, in a direction at right angles to the first, and with an average dip of from 60° to 70° to the north. The cutting of the formation by these joints is not excessive and permits the extraction of very large stone.

The quality of the stone in the heavier beds is by no means uniform, as fine grained and coarse grained bands alternate with one another, and much of the output is rendered of little value by strong lamination in the rock or by the presence of fossil plants. It would be possible however to quarry large amounts of average stone, of which No. 444 described below is a fair example. The property is in bad shape owing to accumulated debris. If the quarry were reopened, the removal of this material would entail considerable expense, and the heavy overburden of thin rock would have to be reckoned with. The quarry is favourably situated for shipping, as a haul of about a quarter of a mile down hill would place the stone at the railway.[1]

The stone: No. 444.—This example is one of the so called olive-green stones in which there is very little green, the colour being distinctly yellow, as shown in Plate XLIII, No. 6. This yellow colour is slightly intensified under the oxidation test. The texture of the stone and the character of the grains are very similar to those of the French Fort stone (No. 561, Plate XLIII, No. 5). It would be described as of medium grain. The cement is argillaceous, with a small admixture of calcium carbonate.

The physical properties follow:—

Specific gravity	2·659
Weight per cubic foot, lbs	147·586
Pore space, per cent	11·686
Ratio of absorption, per cent	4·976
Coefficient of saturation, one hour	0·64
" " two hours	0·73
Crushing strength, lbs. per sq. in	13814·
" " wet, lbs. per sq. in	6586·
" " wet after freezing, lbs. per sq. in	5426·

[1] The Albert railway is not at present in service south of Hillsborough.

Loss on treatment with carbonic acid and oxygen, grams per sq. in.	0·00515
Transverse strength, lbs. per sq. in.	1189·
Chiselling factor, grams	8·4
Drilling factor, mm.	16·4

Under the freezing test the specimen developed iron staining in irregular bands.

The iron is largely in an oxidized condition as shown by Leverin's analysis below:—

Ferrous oxide, per cent	1·80
Ferric oxide, per cent	3·40

Anthony Hawk, owner of property, Curryville, N. B.; Herbert Steeves, owner of quarrying rights, Hillsborough, N.B.

This quarry is situated at the brow of the bluff, on the east side of Demoiselle creek, near Curryville. The excavation extends for some distance along the escarpment and has been worked back about 50 feet. The upper half of the face of 75 feet is thin bedded and useless, but the stone would probably improve if the workings were extended farther in. The lower half of the face shows irregular beds of considerable thickness, from which heavy stone has been obtained. Many of the beds are from 6 to 8 feet thick. One block now lying in the quarry measures 3 feet, by 1 foot 6 inches, by 16 feet 6 inches,. I am informed that slabs 1 foot thick and 10 feet square were obtained. The jointing is clean and vertical, in two sets at right angles to one another. The most pronounced series strikes 5° west of south.

While some of the stone shows the rusty spots so common in the formation, much of it is free from this defect. It is said that the product of this quarry held an enviable reputation in this respect when the stone industry was being actively prosecuted in this area. An average specimen is described below as No. 445.

The stone: No. 445.—This example is very like No. 444 but it is slightly lighter in colour. The physical properties are doubtless quite close to those of No. 444.

The quality of the stone and the certainty that large blocks can be obtained induce the hope that operations may be resumed, either here, or at some more favourable point along the bluff in which the beds are exposed for a distance of two miles. As the escarpment is practically parallel to the railway, and as the valuable beds are at a much higher level, the stone could easily be brought to the rail by gravity trams or aerial lines.

Rockland Group.

The Budreau quarries.

These quarries are situated at a considerable elevation above the water on the east bank of the Petitcodiac river, in Westmorland county. The easiest means of access is by boat from Hillsborough, or by driving from Dorchester. The quarries were opened in 1856, and immense quantities of stone were removed during the period of activity which followed. With the decline of the stone industry in this section of the Province work was suspended, and there has been no production for many years.

Beside scattered workings along the face of the bluff, there are two main excavations in which the beds may be observed. The first of these is 500 feet long and 100 feet wide with a face of 30 feet. It is entered by a narrow portal and the long diameter extends inland. On the present face, the upper 12 feet seems to be made up of thin and shattered stone, which may, in part, be due to the influence of the weather. The succeeding 6 or 8 feet is made up of fairly solid layers of stone, which, however, show considerable shattering in places. The lower 12 feet consists of one solid bed, without stratification planes, but with irregular horizontal cracks in places. The beds are practically horizontal, but they are often broken by lenticular, horizontally disposed cracks, which must have caused the loss of much otherwise desirable stone. The joints are well developed, with a pronounced series striking 3° north of east and dipping vertically or steeply to the south. These joints are from 4 to 20 feet apart and furnish clean vertical walls, which are, however almost universally stained deep brown or black. The second series of joints crosses the former at right angles and is less continous and regular, although fairly well developed.

The stone varies considerably in texture, but much of it is like No. 446, which may be regarded as a good average. On short exposure, the stone loses its brownish cast and turns grey; later, it seems to darken considerably.

The second main opening lies immediately to the south of the one described above and is of even greater extent. The succession of beds varies greatly throughout the quarry; an average section is given below:—

4 feet—Soil.
6 feet—Thin stone.
10 feet—Solid bed.
4 feet—Solid bed.
5 feet—Solid bed.
10 feet—Solid bed.

While the main partings indicated above are continuous, the beds themselves are interrupted locally by minor bedding and lenticular cracks, which must result in a large amount of waste in conducting quarrying operations. This waste is attested by the immense piles of debris now lying in the quarry or on the hillside below the excavations.

As in the other quarry, the stone varies considerably in texture from place to place. A fair average is represented in No. 447. Some of the stone is much lighter in colour (448) and is disposed in lenticular masses enclosed in the darker variety.

The stone: No. 447.—A homogeneous even grained sandstone of medium texture, presenting a colour very similar to Plate XLIII, No. 4. In both colour and texture it very closely resembles the finest grained stone from the Miramichi quarries (No. 563, page 32).

No. 446.—This stone is of a finer grain and presents a lighter and more greenish colour, of the same cast but somewhat lighter than that shown in Plate XLIII, No. 12.

No. 448.—A medium grained stone of more distinctly greenish colour: it resembles Plate XLIII, No.8, but its finer grain gives it a somewhat different appearance.

All three of these examples are good average medium grained stones of the olive-green class.

Both of these quarries are in fairly good shape for re-opening; an unlimited quantity of stone is available; there is a good dump for the waste, and excellent shipping facilities by water could easily be provided.

Dorchester Stone Works, Limited, Dorchester, N. B. Beaumont quarry. F. C. Palmer, president, Dorchester, N. B.

This quarry has been opened to the south of the old Budreau quarries near the extremity of the point between the Petitcodiac and Memramcook rivers. It is situated at a much lower level than the Budreau quarries, the bottom of the excavation being below high water level. The workings are not large but at one point a face of 50 feet is presented. The succession of beds is as follows:—

10–12 feet—Overburden.
5 feet—Badly shattered stone.
12 feet—Indistinctly bedded but furnishes some large blocks. Similar to Budreau stone.
6 feet—Solid bed of blue stone
8 feet— " " "
7 feet— " " " 449.

The jointing is practically north and south and east and west. Both sets are widely spaced, as much as 50 feet intervening between joints.

The stone: The upper stone is comparable with that already described from the Budreau quarries.

No. 449.—All the lower stone is of this quality. The colour, which is represented in Plate XLIV, No. 4, is distinctly blue-grey, and is therefore different from the average stone of the district. Observations in the quarry show that this colour is retained under the action of the weather and the same durability is observed under the oxidation test.

The mineral grains consist very largely of quartz fragments of rounded outline and medium size ($\frac{1}{5}$ to $\frac{1}{2}$ mm. in diameter). The binding material is clay, with a very small amount of calcium carbonate and magnesium carbonate.

The physical properties follow:—

Specific gravity	2·657
Weight per cubic foot, lbs	146·795
Pore space, per cent	10·897
Ratio of absorption, per cent	4·604
Coefficient of saturation, one hour	0·58
" " two hours	0·68
Crushing strength, lbs. per sq. in	17800·
" " wet, lbs. per. sq. in	8418·?[1]
" " wet after freezing, lbs. per sq. in.	5920·?[1]
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00343
Transverse strength, lbs. per sq. in	1447·
Chiselling factor, grams	5·00
Drilling factor, mm	11·

Analysis by Mr. Leverin gave:—

Ferrous oxide, per cent	4·11
Ferric oxide	trace

The equipment consists of a stationary engine and boiler, which operates a lathe for turning pulp stones, a steam hoist, a steam drill, and a steam pump. Fourteen men were employed at the time of my visit. The product is used for pulp stones and large grindstones, and for architectural purposes. This stone is now being used in the construction of the new offices of the Intercolonial railway at Moncton. The following prices were quoted by Mr. Henry Gaudette, the local manager:—

Rubble, 80 cts, per ton, f.o.b. quarry.

Dimension stone rough, $6 per ton, f.o.b. quarry.

Grindstone, $10 to $12 per ton, f.o.b. quarry.

Pulp stones, finished, 50-54 inches diameter, 26-27 inches thick, $40 each, f.o.b. cars, Dorchester.

[1] These tests were not very satisfactory, as the cubes broke at one side before final collapse: they should probably both be higher.

The old Caledonia quarries, etc.

The old Caledonia quarries were opened in 1864, near Rockland in Westmorland county. They are situated on the eastern face of the same ridge which furnishes the Budreau stone on its western flank, and consequently face the Memramcook river. The geological conditions of occurance are much the same in both groups of quarries, and the stone also is very similar in both. It was observed that great variation is presented in texture and some diversity in colour, with a predominance of a dark, greenish-yellow type. The stone from these quarries was largely employed in Dorchester, and may be seen to the best advantage in the Provincial Penitentiary. There has been no production for many years.

Summary—Shepody Bay Area.

As already pointed out, the quarries of this area fall naturally into three groups as follows:

(1) A group at Mary point and Grindstone island which have, in the past, produced a large amount of red and grey sandstones for structural use and for the manufacture of grindstones. Despite an abundant supply of material and excellent shipping facilities, these quarries are all idle at the present time.

(2) A group of quarries centres around Curryville on Demoiselle creek. The openings have been made at some elevation in the high cliffs bordering the stream. The stone is of the olive-green type and resembles the Miramichi product. There is no production at present.

(3) Very extensive quarries of olive-green sandstone were formerly worked on the point between the Memramcook and Petitcodiac rivers. All these old quarries are now out of commission, but a new company is operating, on a small scale, at a point farther to the south. The upper stone is of the same olive-green colour as the product of the old quarries, but the under layers present a distinctly blue-grey colour and thus differ from the general stone of the area.

This stone is described in detail on page 59 : it is of comparatively high crushing strength and low porosity. The ferrous oxide is high, indicating that the colour would change on exposure, but such a discolouration has not taken place in the stone exposed in the quarry. It would appear also that the stone is somewhat hard to work.

Cumberland Basin Area.

While the quarries of the Shepody bay area are situated entirely in the Millstone Grit, those of the present area are for the most part in the upper Carboniferous rocks, the exceptions being the grindstone quarries formerly operated at Lower Cove, and the quarries at Rockport.

Sackville Group.

This group includes the important red stone quarries at Sackville, and the grindstone quarries at Wood point and at Rockport.

Read Stone Co., Limited., H. C. Read, president, Sackville, N. B.

(1) The Wood Point quarry.

This property consists of about 70 acres extending along the water front at Wood point. Numerous quarries have been opened from time to time, but operations are at present confined to one excavation, which may be regarded as typical of all. The quarry is opened on a slight rise of land about 100 yards from the water, and at a moderate elevation only. The total depth is 50 feet, of which the upper 20 feet is stripping. The width of the excavation is 150 feet but it is practically continuous with a line of quarries extending to the eastward. The bedding varies greatly in different parts of the quarry, as the parting planes are disposed in a lenticular manner. A general idea of the succession of beds may however be obtained from the following section at the northwest corner of the quarry:

20 feet—Stripping, clay, etc.
8 feet—Good stone, but interrupted by shaly bands.
4–6 feet—Good stone.
10 feet—Solid bed of good stone.
6 feet—Good stone.

The chief system of joints runs 60° west of north, with a vertical dip. The joint planes are irregular and are sufficiently far apart to permit the quarrying of large blocks. A second set, at right angles to the above, is developed to about the same extent.

All the stone is of a bluish colour when fresh quarried, but it rapidly turns brown and later assumes a greyish brown colour—450. It is found that the stone from the lower beds is harder than that from the upper layers; in consequence, it is preferred for the manufacture of grindstones.

The stone: No. 450.—This stone is of a distinctly purplish brown tint and differs in colour from any of the other specimens examined: it is shown in Plate XLIV, No. 12. The corrosion test appears to effect very little alteration in colour. The grain is distinctly coarse, but the fragments are of fairly uniform size, averaging somewhat less in diameter than those of the somewhat similar Cape Bald stone. The mineral grains are of quartz, feldspar, and a small amount of mica: there is, in addition, a considerable number of greenish and otherwise tinted fragments which have probably been derived from the decay of volcanic rocks. The cementing material is of an argillaceous character and is not present in abundance.

Specific gravity	2·702
Weight per cubic foot, lbs	140·285
Pore space, per cent	16·139
Ratio of absorption, per cent	7·123
Coefficient of saturation, one hour	0·60
" " two hours	0·62
Crushing strength, lbs. per sq. in	10560·
" " wet, lbs. per sq. in	5441·
" " wet, lbs. per sq. in. (duplicate),	5824·
" " wet after freezing, lbs. per sq. in.	445·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00396
Transverse strength, lbs. per sq. in	1037·
Chiselling factor, grams	11·1
Drilling factor, mm	19·
Boring factor, revolutions per in	112·
Factor of toughness, blows	4·

The loss in strength on freezing and the high porosity is doubtless due to the lack of cementing material. This stone showed the most serious breaking down under the freezing test of any of the stones examined.

Mr. Read has kindly communicated the following series of fire tests made on this stone at McGill University, Montreal :—

Sample.	Temperature.	Crushing strength, lbs. per sq. in.		Remarks.
		Cooled in air.	Cooled in water.	
1	500° F.	7,650		Remained brown.
2	500° F.		6,550	"
3	1,000° F.	9,650		"
4	1,000° F.		6,500	"
5	1,200° F.	4,550		Glowing red.
6	1,200° F.		4,700	"
7	1,500° F.	6,330		"
8	1,500° F.		4,130	"

Numbers 3–8 were lighter in colour after heating. At 1,500° F. the samples became almost pink.

An analysis by Leverin shows the iron to be present as follows:—

Ferrous oxide, per cent	1·93
Ferric oxide, per cent	5·28

The equipment consist of two steam drills, three derricks in quarry, one loading derrick on wharf, one 45 H. P. boiler, one lathe for grindstones.

Sixteen men are at present employed. For breaking the stone from the bed, black powder is used in 2 inch holes. The blocks are "raised" and the heavier stone is split parallel to the bedding by "gads". These gads are modified wedges about 5 inches long; they are made from one inch or one and one-eighth inch steel, and are drawn out to a hexagonal point. The cross section of the tool is, however, not a regular hexagon but is much flattened in one direction. In order to split a heavy block parallel to the bedding, holes are made by a pick at intervals of 4 inches: into these holes the gads are driven and they are found to be much more efficacious than ordinary wedges. The smaller blocks are easily split parallel to the bedding by the hammer alone: gads are used across the grain. The pick is practically the only instrument used in dressing the stone to the required shape, whether for the making of grindstones or of "scabbled" blocks for building.

Most of the output is used for grindstones, of which 720 tons were produced in 1910. The building stone industry is less actively prosecuted, as only 100 tons of building blocks were quarried during the year. The above figures include the product of the small quarry at Rockport described below.

Grindstones are valued at $9 per ton, and scabbled blocks at $2 per ton, f.o.b. quarries. The stone may be seen in Mr. Read's residence, and in the H. A. Powell block in Sackville.

(2) The Rockport quarry.

This quarry is quite small and is situated on the shore at Rockport. The formation strikes north and south and dips east at an angle of 45°. The face shows beds up to 5 feet in thickness of a yellowish stone—451, with a smaller amount of stone presenting a greyish colour. Twelve men are employed here; they are operating with the usual equipment, including a small engine and boiler. Most of the product is shipped to Wood point where it is made into grindstones. The ashlar work in the railway station at Sackville is from this quarry; it presents a fairly uniform appearance and gives evidence of a reasonable durability.

The stone: No. 451.—This is a medium to coarse grained example of the olive-green type: it is shown in Plate XLIII, No. 4. In mineral constituents and cement it does not differ materially from the other specimens of this type.

The physical characteristics are as follows:—

Specific gravity	2·688
Weight per cubic foot, lbs	137·409
Pore space, per cent	18·063
Ratio of absorption, per cent	8·203
Coefficient of saturation, one hour	0·60
" " two hours	0·61
Crushing strength, lbs. per sq. in	10585·
" " wet, lbs. per sq. in	6083·
" " wet after freezing, lbs. per sq. in	4824·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00265
Transverse strength, lbs. per sq. in	908·
Chiselling factor, grams	6·3
Drilling factor, mm	18·

Analysis by Leverin:—

Ferrous oxide, per cent	1·41
Ferric oxide, per cent	3·71

Sackville Freestone Co., Limited, Charles Pickard, president, Sackville, N.B.

This quarry, which is situated close to the town of Sackville, must be regarded as one of the most important producers of building stone in the Maritime Provinces. The red Sackville stone is largely used throughout the eastern part of the country, and, notwithstanding freight charges, it is able to compete successfully with other stones for buildings of the best type in Ontario. The quarries at Amherst and those at River John and Charlottetown are the only others now producing red freestone.

The property of the company consists of 50 acres, which, according to Mr. Pickard, is almost entirely underlaid by red sandstone essentially similar to the specimen described below. The quarry is about 200 feet square and 60 feet deep. The upper 20 feet is soil, beneath which is 40 feet of red freestone in beds up to 5 feet thick. The various layers are horizontal and are remarkably continuous, with scarcely any of the lenticular bedding so common in the sandstone quarries of the Maritime Provinces. The major joints strike 5° south of east with a vertical dip. These joints are from 75 to 100 feet apart and are developed with remarkable perfection, forming clean vertical walls of the greatest assistance in quarrying operations. A second series of joints, in a north and south direction, is much less pronounced. In this case the parting planes run for a short distance only and then disappear: they are not too closely spaced for the profitable extraction of the stone. All the beds are of red sandstone and present much the same type throughout, but in places the lower beds are somewhat coarser in grain. Rougher stone, with numerous plant remains, occurs beneath the lowest workings in the present quarry. The rock probably belongs to the Permo-Carboniferous age, and lies at a much higher level geologically than the stone exposed at Wood point.

The stone: No. 452.—The specimen which is described in detail below was selected by Mr. Pickard himself as a good average example of the output of the quarry.

The stone presents the subdued red appearance shown in Plate XLIV, No. 8. Viewed in large pieces, there is evidence of stratification in indistinct bands of slightly different shades. Under the corrosion test there is little if any change in colour and but a slight loss in weight.

Under the microscope the quartz grains are seen to be, for the most part, of sharply angular outline and of variable size. The largest grains measured exceed ½ mm. in their longer diameter, but most of the grains are much smaller. Feldspar grains, mostly in an advanced state of decomposition, are fully as numerous as the quartz fragments. Glistening mica flakes are scattered through the rock and are quite apparent to the naked eye when the stone is split parallel to the bedding. There is a small amount of indeterminable matter mixed with the reddish-coloured cement, which consists of ferruginous clayey material and a slight amount of carbonate of lime.

The physical properties are given below:—

Specific gravity	2·711
Weight per cubic foot, lbs	145·743
Pore space, per cent	13·882
Ratio of absorption, per cent	5·946
Coefficient of saturation, one hour	0·47
" " two hours	0·58
" " thirty-eight hours	0·66
Crushing strength, lbs. per sq. in	11899·
" " wet, lbs. per sq. in	6083·
" " wet after freezing, lbs. per sq. in	3856·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00213
Transverse strength, lbs. per sq. in	1016·[1]
Chiselling factor, grams	5·2
Drilling factor, mm	15·5
Boring factor, revolutions per in	148·
Factor of toughness, blows	7·

[1]Probably low as the specimen was cut across the grain.

Under the freezing test, the laminated structure became more pronounced and there was a slight disintegration on those edges of the cube which were parallel to the stratification planes.

The following determinations as to the condition of the iron content were made by Mr. Leverin:—

Ferrous oxide, per cent	1·93
Ferric oxide, per cent	4·28

The company has installed an up to date plant and is planning for the further extension of the facilities already provided. The equipment may be summarized as follows:—

Four derricks, operated by one large engine and boiler and one small engine and boiler, two steam drills, one pump, two gang saws operated by electricity, which is also used for one of the derricks. Twenty-five men are employed.

The mill is placed close to the quarry and is so arranged that a minimum of handling is necessary. A spur from the Tormentine branch of the Intercolonial railway affords good shipping facilities.

The stone is quarried by the use of black powder where necessary. The blocks are worked up by the use of picks and "gads," or the rough stone is sent directly to the mill where it is sawn to the required size. It is said that a gang, working with five or six blades, will cut through a block 10 feet long and 5 feet thick in a day of ten hours.

The total output of the quarry is from 8,000 to 10,000 tons per annum, all of which is used for building purposes. The following prices, which are to be understood as somewhat variable, were kindly furnished by Mr. Pickard.

Shoddy, hammer-broken, $3 per ton, f.o.b. Sackville.

Scabbled blocks, random sizes, 45 cts. per cubic foot, f.o.b. Sackville.

Sawn blocks, sawn on two sides, random as to length and width, 65 cts. per cubic foot, f.o.b. Sackville.

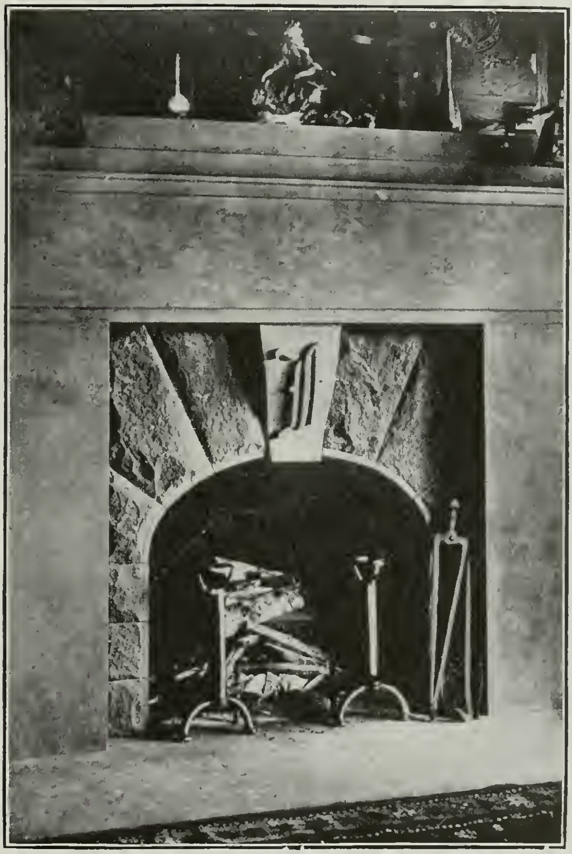
Among the many important structures in which the Sackville stone may be observed, the following may be mentioned:—

Royal bank, Sackville.
Bank of Montreal, Moncton. (Plate IX.)
Observatory, Ottawa.
New wing of parliament buildings, Toronto.
Bank of Nova Scotia, Truro.
Custom house, Waterloo, Ont.

As indicative of the favour with which this stone is being received in Ontario it is worthy of note that it is enjoying an increasing sale in Hamilton, London, Chatham, St. Thomas, and many other towns in the western part of the province of Ontario.

Sackville sandstone. Bank of Montreal, Moncton, N.B.

PLATE X



Sackville sandstone. Fireplace.

Amherst Group.

Red sandstone has been quarried at several points near Amherst, but the only important quarry now in operation is that of the Amherst Red Stone Quarry Co. Edward Curran also produces a small amount of red stone from this area.

Amherst Red Stone Quarry Co., N. W. Black, president, Amherst, N.S.

The property consists of 20 acres situated about a mile to the east of the town. The quarry is at present about 250 feet wide by 100 feet long. The 250 feet represents the actual working face, but the 100 feet is merely the forward end of an excavation of 400 feet, the rest of which has been partially filled with debris. The present face shows 55 feet of stone covered by an average of 15 feet of soil. The main joints strike east and west with a vertical dip: they are well defined at intervals of 20, 20, 20, 40, and 20 feet from north to south. The second series of joints, at right angles to the above, is irregular and ill-defined. The formation strikes east and west with the main joints, and dips northward at from 10° to 20°. The bedding is variable and much of the upper stone is thin and unsuitable for scabbled blocks. The lower stone is thicker and may occasionally be obtained in blocks 4 feet thick, but the average of the heavy stone is not over 2 feet. An irregular bed of shale appears at a depth of 20 feet in the east end of the face, but good stone is encountered beneath it. Of the total face of 55 feet, probably 35 feet would yield building stone of good sizes. The remaining 20 feet is practically all suitable for rubble. (Plate XIII.)

The stone varies somewhat in depth of colour in different parts of the quarry, the lower layers presenting a darker and more desirable tone—459.

The stone: No. 459.—This stone is represented in Plate XLIV, No. 7: it is distinctly brighter in colour and somewhat coarser in grain than the Sackville type. Under the microscope, the same general structure is revealed but the proportion of larger quartz and feldspar grains is greater in this stone. A more distinct film of iron oxide is seen on the exterior of the fragments. The feldspars are rather badly decomposed, and there is present an appreciable amount of dark-coloured fragments of indeterminable character. The cementing material is composed of clay and the oxides of iron.

The physical characteristics as given below accord fairly closely with those of the Sackville stone:—

Specific gravity	2·7
Weight per cubic foot, lbs	142·93
Pore space, per cent	15·20
Ratio of absorption, per cent	6·894

Coefficient of saturation, one hour	0·47
" " two hours	0·59
Crushing strength, lbs. per sq. in	11122·
" wet, lbs. per sq. in	6938·
" wet after freezing, lbs. per sq. in	4000·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00454
Transverse strength, lbs. per sq. in	551·
Chiselling factor, grams	4·8
Drilling factor, mm	19·5

Under the freezing test, the corners and angles were distinctly affected and there was some disintegration on the bedding planes.

As in the case of all the red stones, the ferric oxide is much in excess of the ferrous, as the analysis below indicates:—

Ferrous oxide, per cent	1·80
Ferric oxide, per cent	3·71

The equipment is as follows:—

Four steam derricks, each with separate boiler. One of these boilers is of greater capacity, and operates besides one large pump, two steam drills, one channeller. Fifteen men are employed.

The following prices are quoted:—

Large rough blocks, $1.25 per ton delivered in Amherst.

Random scabbled blocks, 35 cts. per cubic foot, f. o. b. Amherst.

Dimension blocks, 50 cts. per cubic foot, f. o. b. Amherst.

The production for 1910 was 2000 tons, but it is estimated that the output for 1911 will not fall far short of 10,000 tons.

The country immediately adjoining the quarry is well covered with soil, but it appears that a very large amount of stone is available under a stripping of from 15 to 20 feet. The quarry is clean and is easily freed from water. I am informed that, after the winter's water is pumped out, the operation of the pump for three hours a day is sufficient to keep the workings clear. The company labours under the disadvantage of having to haul the stone more than a mile to the rail at Amherst.

Most of the important buildings in Amherst are constructed from the local stone. Among these may be mentioned the Baptist church, the Methodist church, the Bank of Montreal, the Bank of Nova Scotia, (Plate XII), the Telephone building, and the City Hall (Plate XI). The stone has also been used largely in Truro and in Halifax, and has been shipped to Ontario where it may be seen in Toronto, Hamilton, Stratford and other cities.

Amherst red sandstone. City Hall, Amherst, N.S.

Amherst red sandstone. Bank of Nova Scotia, Amherst, N.S.

Amherst red sandstone. Quarry of the Amherst Red Stone Quarry Co., Amherst, N.S.

Edward Curran, Amherst.

This quarry is situated about a half-mile from that of the Amherst Company and at a higher level. The opening of 150 feet by 100 feet is now partially filled with water. The formation dips 10° or 15° to the north, and is intersected by well marked joints striking 5° south of east and dipping vertically. These joints show clear and distinct parting planes at distances of 12, 20, 20, and 10 feet apart. A much less pronounced series of joints crosses at right angles. The opening shows 6 feet of soil, beneath which is thin stone (458) to the water. It is said that below this level the layers are as much as 15 inches thick. There is a dismantled derrick on the property. No present production.

The stone: No. 458—This example is intermediate in colour between the Sackville stone and that from the Amherst red stone quarries; it is highly feldspathic and the grains are rather seriously decayed. On partings parallel to the stratification a great amount of glistening mica is visible. The stone is a little coarser than the other examples and would probable be less durable.

Lower Cove Group.

The quarries at Lower Cove were formerly extensively worked for the manufacture of grindstones, but operations have been discontinued for a long time. Owing to this fact and to the rather inaccessible location of the region, the group was not personally examined. As far as I have been able to learn these quarries were never worked for building stone, the total output being converted into grindstones. The following quotations indicate the general character of the deposits and the former extensive operations. "Grindstones are manufactured in large quantity, principally on the Joggins shore, at the Lower or Seamen's Cove quarries. The cutting and turning machinery here is driven by a steam engine, and the output for the last year was—of grindstones 2,000 tons, and of scythe stones 2,000 boxes, valued at $28,400. Other areas where grindstones are made, are the southern extremity of Cape Maringouin, Port Philip, and several places along the Joggins shore, south of the Joggins mines."[1]

Mr. Hugh Fletcher writes as follows about the Atlantic Stone Company's quarries at Lower Cove, Cumberland, which he visited during the autumn of 1896:—"The product sold is all manufactured; grindstones for all kinds of edge tools (including scythes, &c.) from 84 inches in diameter by 14 inches thick, to 6 inches in diameter and $1\frac{1}{2}$ to 3 inches thick, supplied in dimensions as ordered, not manufactured haphazard; whetstones (for field use for scythes, etc.). These are from the grey sandstones of the quarry at Lower Cove, the fine grained waving stone being best adapted for scythes, the coarser varieties for other purposes.

[1] Geol. Sur. Can., Rep. 1885, p. 70 E.

"A red oil stone, with grey and greenish fine stripes and spots, is made from a quarry near Mill Cove, about five miles higher up the bay, also on the property of the Atlantic Stone Company. The stone used is taken from tide water.

"The quarries of grey stone are near the reefs on the shore, also a short distance inland. The thick fine layers are exposed in a face 30 feet high, and 20 feet of good stone is to be quarried below. A horse winch is used to raise from this upper quarry blocks ten tons in weight, and a stone winch on the ground is capable of lifting sixteen tons. The large blocks are sawn into the required thickness."[1]

"This company exports most of the large grindstones or waterstones as they are called, manufactured by them, to the United States. The stones manufactured by the company vary in size from 6 inches diameter 1 inch breadth to 48 inches diameter 15 inches breadth........ All these are manufactured from a blue grit reef 75 feet thick, composed of layers from 1 inch to 5 feet thick. The quarry is situated about four miles from the Joggins coal mines on the Cumberland Basin, with good shipping facilities."[2]

It is evident from the above quotations that a bluish-grey grit occurs along the shore at Lower Cove, and that it was formerly quarried to a great extent for grindstones. I am informed that the quarries reached for two miles along the shore. I am further informed that the cessation of operations was largely due to increasing difficulties of extraction. In addition to the quarries in the vicinity of Lower Cove, many others were opened at points along the coast—at Ragged Reef, where Mr. H. Reed of Sackville obtained a stone like the Lower Cove stone, and at Apple river where a somewhat similar bluish-grey stone was quarried.

Summary—Cumberland Basin Area.

Formerly this district was best known on account of the great number of grindstones produced from the quarries at Wood point and along the coast from Lower Cove southward. At the present time, the brown sandstones of Wood point are manufactured into grindstones, as is also the olive stone from Rockport. For the purpose of this report, however, the red stone quarries at Amherst and Sackville are worthy of particular consideration. Stone from these quarries has been very extensively used, not only throughout the Maritime Provinces but at many points in Ontario and Quebec.

The general physical properties of the two stones are not essentially different, but the Amherst stone is of a brighter colour (compare Nos. 6 and 7, Plate XLIV). The pore space is less and consequently the weight per cubic foot is higher in the Sackville stone, in which also the transverse strength is much higher.

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[1] Geol. Sur., Can., Rep. 1896, p. 11 S.
[2] Department of Mines, Nova Scotia, Rep., 1897, p. 20.

The product of these quarries is considerable and it is used exclusively for structural work. In 1910, the Sackville quarry yielded about 10,000 tons and the Amherst 2,000. It is estimated, however, that the latter quarry will much exceed this output during 1911.

Wallace Area.

The Upper Carboniferous sandstones near Wallace, in the County of Cumberland, Nova Scotia, have furnished large quantities of excellent stone: the industry dates back more than 100 years. At the present time there is only one large company at work, but new operators are entering the field.

Wallace Stone Company, Thomas Dobson, local manager, Wallace, N.S.

The first excavations were made on a property of five acres, immediately adjoining the present holdings of the company, about 40 years ago, by William McNab. The Batte Brothers, who formerly worked the quarries about four miles to the west on the Wallace river, acquired the present property (200 acres) and later transferred it to a New York syndicate. The Wallace Stone Company, which held the McNab quarry under lease, bought out the New York syndicate and eventually sold to the present company of the same name. The lease on the McNab property has expired, and the quarry, reverting to the McNab estate, is now idle. As the two excavations are continuous it is convenient to include them in one description.

The two quarries taken together form an irregularly shaped excavation covering 5 or 6 acres and extending to a depth of about 40 feet. Towards the southwest corner the stripping is light: it was here that the stone was first discovered in digging post holes, and where some of the thin, upper, yellow layers were obtained for flags. Towards the northeast corner of the excavation, the stripping is fully 20 feet thick. The beds of stone are practically horizontal, and although somewhat variable in thickness, present on the average the following sequence:—

4–5 feet—Thin material, in places less in amount, used for flags. Yellow stone.

2-3 feet—Somewhat variable but usually solid bed. Yellow stone.

15 feet—Solid bed. This is maximum thickness: thinner in places. Yellow stone—461.

20 feet—Grey stone in variable but thick beds—462.

The beds are cut by two very well marked systems of joints, both of which dip vertically and occur at intervals of from 10 to 20 feet on the average, but which are occasionally more closely spaced. The average direction of one set is 13° north of west and of the other 13° west of south. Both sets furnish clean, vertical walls and facilitate quarrying operations.

At the northeast corner of the quarry, where the work is now being carried on, the succession of beds is as follows:—

20 feet—Stripping. Soil and thin hard shaly stone.
6 feet—Heavy yellow bed.
9 feet—Heavy yellow bed.
Thin layer of shale.
6 feet—Bed of grey stone. (Blue).
20 feet—Grey stone in heavy layers.

The depths to which these blue beds extend has not yet been determined: there is no doubt, however, that immense quantities of stone are still available. (Plate XIV.)

The stone: No. 461.—The colour and grain of this example are shown in Plate XLIII, No. 12. The stone is known locally as the "grey stone" but it is rather too yellow in colour to be classified as a grey stone according to the usage of this report. The corrosion test shows that it becomes distinctly more yellowish and loses appreciably in weight.

Under the microscope, the stone is seen to be made up of fairly uniform quartz grains of about $\frac{1}{4}$ mm. in diameter, and feldspars of about the same size in far less abundance. The grains are rather rounded in outline, and are fitted closely together with only a small amount of greenish-yellow cement of an argillaceous character. Although the feldspars show decomposition, there is, on the whole, very little indeterminable material, as little is to be seen except quartz, feldspars, and cement. The greater relative amount of quartz and the absence of "dirty matter" should render this stone more durable than most of the New Brunswick sandstones of the olive-green class. It is interesting to note that this conclusion from the microscopic examination is borne out by the wet and frozen crushing tests as given below:—

Specific gravity	2·687
Weight per cubic foot, lbs	144·808
Pore space, per cent	13·688
Ratio of absorption, per cent	5·902
Coefficient of saturation, one hour	0·61
" " " two hours	0·63
Crushing strength, lbs. per sq. in	13681·
" " wet, lbs. per sq. in	10075·
" " wet after freezing, lbs. per sq. in.	8754·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·0057
Transverse strength, lbs. per sq. in	1838·
Chiselling factor, grams	5·9
Drilling factor, mm	12·

Wallace sandstone. Quarry of the Wallace Quarry Co., Wallace, N.S.

Under the freezing test the stone showed a slight disintegration at the corners only.

An analysis to determine the condition of the iron gives:—

Ferrous oxide, per cent	3·60
Ferric oxide, "	1·14

No. 462.—This stone is of a true grey colour and is known locally as the "blue" stone: it is represented in Plate XLIII, No. 16. The corrosion test shows that it becomes a little more yellowish and that it loses far less in weight than the "grey" stone.

In grain and in structure, the difference from the grey type is scarcely to be noted under the microscope, except for the lighter colour of the cement. The physical characteristics also are very similar as below:—

Specific gravity	2·687
Weight per cubic foot, lbs.	145·869
Pore space, per cent	13·038
Ratio of absorption, per cent	5·58
Coefficient of saturation, one hour	0·62
" " two hours	0·63
Crushing strength, lbs. per sq. in (Wicksteed machine	15633·
" " (Riehle machine)	17680·
" " wet, lbs. per sq. in	12235·
" " wet after freezing, lbs. per sq. in.	7451·[1]
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00164
Transverse strength, lbs. per sq. in	1534·
Chiselling factor, grams	4·6
Drilling factor, mm.	14·
Boring factor, revolutions per in	215·
Factor of toughness, blows	6·

Under the freezing test, the stone stood well but became somewhat darker in colour.

It is interesting to note that a much larger proportion of the iron is in the lower state of oxidation as compared with the "grey stone" (No. 461).

Ferrous oxide, per cent	4·88
Ferric oxide	trace.

The equipment of the company consists of five steam derricks of about 18 tons capacity each, one 65 h.p. engine and boiler, one 25 h.p. engine and boiler, three steam drills, three steam pumps, two miles of track including a double track gravity tramway to wharf, sixteen cars, gasoline engine and derrick on wharf. Thirty men are employed on the average.

[1] This result is doubtless too low as the cube yielded on one side before the final collapse.

In addition to the shipping facilities supplied by the company's own wharf, a spur two miles long connects the property with the Intercolonial railway.

In quarrying, $1\frac{1}{2}$ and $1\frac{1}{4}$ inch holes are used: these are rimmed and charged with black powder. It is found that a single hole, thus prepared, will, when fired, produce a straight break in almost any direction with equal facility. The dressing and cutting of the blocks is performed entirely by the use of gads and picks.

The following prices are quoted:—

Scabbled blocks, either colour, $5 per ton, f.o.b. cars or vessels.
Large dimension, clear, $7 to $8 per ton, f.o.b. cars or vessels.
Rubble, $1 per ton.
It is estimated that the production for 1911 will be 10,000 tons.

Wallace stone has been so largely employed throughout the Maritime Provinces, and in Ontario and Quebec, that it is superfluous to mention individual structures. Among the more recent buildings are the Victoria Memorial Museum in Ottawa, and the new offices of the Dominion Iron and Steel Co. in Sydney. The excellent manner in which this stone withstands the attacks of time and weather may be seen in the Bank of Montreal in Sydney (Plate XV). Large amounts of stone have also been shipped to the United States, more particularly to New York, Boston, and Providence.

Imperial Stone Company, Dr. McKinnon, president, Halifax, N. S.

This property lies about half a mile to the northwest of the Wallace quarry. The excavation is about 50 feet by 35 feet in extent, and is said to be 19 feet deep in part: this cannot be verified as the hole is full of water. The succession of beds is as follows:—

7 feet—Soil.
A small amount of thin yellow stone,
10 feet—Grey stone in thick beds—463·

The stone: No. 463.—This stone is essentially the same as No. 462: the colour is almost identical but the grain is slightly finer.

A derrick is in position, but all operations have been suspended.

E. A. Betts, Wallace, N. S.

This quarry is situated within 100 yards of the one described above, on a property of $17\frac{1}{2}$ acres. Developing work is being done at present and no stone has as yet been shipped. As far as revealed at the time of my visit, the succession of beds is as follows:—

Wallace sandstone. Bank of Montreal, Sydney, N.S.

6–12 feet—Soil.
Thin yellow layers of variable thickness but slight in all.
2 feet—Solid bed of grey (blue) stone.
14 inches—Solid bed as above.
2 feet—Solid bed as above.
$2\frac{1}{4}$ feet—Solid bed as above.
4 feet—Solid bed as above.

The beds are excellently jointed, east and west, and north and south, at intervals of about 20 feet. The stone is practically all of the blue variety and is comparable with the blue stone from the Wallace quarries and identical with No. 463 of the Imperial Stone Company. Seven men are at work, and it is hoped that shipments will soon be made. The haul to tide water is about one-half mile.

The old Batte quarries.

Extensive quarries were formerly worked on the east side of the Wallace river, near the point at which the Intercolonial railway crosses the stream at Wallace Bridge station. The first workings are said to date back more than 100 years, but it is 40 years since any serious work was done. At a later date, however, a company was organized to manufacture brick from the shaly portions of the outcrops: the attempt has been abandoned. Scattered openings extend for some distance along the river, but there are two main quarries—one to the south and one to the north of the railway. The northern opening extends along the strike of the rock for several hundred feet with a width of about 200 feet. The formation strikes 15° north of east and dips 22° to the northwest. In the somewhat V shaped cut along the strike the succession of beds can scarcely be made out owing to accumulated debris. There is, however, about 12 feet of soil, beneath which occur 20 feet of red and green shale. The sandstone beds follow, but they are scarcely perceptible owing to the condition of the quarry. On the south side of the opening, however, as the formation dips northwest, the lower beds can be seen. The stone is much shattered, but it appears to occur in heavy beds, presenting shades of colour from yellow to grey. An average specimen is described below as No. 464.

The quarry above the bridge is of even greater extent and follows the ravine of a small creek, along the northern side of which most of the stone has been obtained. The beds here are of the same yellow-grey colour and are somewhat variable. Farther up the ravine, the formation is better revealed and is seen to strike about northeast and to dip 22° to the northwest. Joints cut the formation vertically along both the strike and the dip. Heavy beds of the yellowish-grey stone (465) are visible here, and a great amount is obtainable under a moderate stripping by continuing the quarry along the strike.

The stone: No. 464.—This example is of a brownish-grey colour which may be considered as intermediate between the two types of Wallace stone: it is shown in Plate XLIV, No. 1. The grain is slightly finer than that of either of the Wallace samples. Uniformly sized quartz grains make up the bulk of the rock, the amount of cement being relatively small. Under the corrosion test the specimen lost in weight and became lighter and slightly more yellow in colour.

The physical properties are as follows:—

Specific gravity	2·678
Weight per cubic foot, lbs	139·84
Pore space, per cent	16·89
Ratio of absorption, per cent	7·32
Coefficient of saturation, one hour	0·59
" " two hours	0·60
" " thirty-eight hours	0·62
Crushing strength, lbs. per sq. in	11775·
" " wet, lbs. per sq. in	5747·(?)
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00213
Transverse strength, lbs. per sq. in	1401·
Chiselling factor, grams	10·
Drilling factor, mm	13·5

No. 465.—A yellowish-grey stone, of coarse grain and less attractive appearance than No. 464.

Owing to the unsatisfactory condition of the quarry, it is difficult to speak of the quality of the stone from different beds. It would appear from the material lying in the quarry that considerable diversity of colour and texture is met with in the different beds. The piers of the railway bridge show a yellowish-grey, rather dirty colour. The old parliament buildings in Halifax are said to be constructed largely of this stone. The effect of the weather has been to strongly emphasize the difference in colour of the laminae composing the beds, so that the various blocks show a markedly streaked appearance. The unfortunate practice of cutting the blocks irrespective of the bedding planes has not added to the present appearance of the building. (Plate XVI.)

In the vicinity of the Batte quarries, other small openings were made in the past and small quantities of stone obtained. Among these may be mentioned a quarry farther up the ravine above the southern opening of Batte. Here a rather coarse grained brown stone was obtained. Another quarry was worked by J. C. Ayre, in the bed of a creek which enters the Wallace river about half way between Wallace River bridge and Wallace River bridge station.

Wallace sandstone. (Batte quarries). Old government buildings, Halifax, N.S

Along the Cumberland shore to the westward of Wallace, several quarries have been opened, but, as far as could be ascertained, they are idle at the present time. The more important openings were made on River Philip, the Pugwash river, and near Northport. Red or reddish stone was procured from nearly all the quarries worked, of which the most important was that at Northport. This latter quarry was operated until quite recently: it is thus described by Mr. Piers—

Northport redstone quarry, Oakley Myers, Northport, N. S.

"The face of this quarry is about 35 feet deep and 100 feet long. The stone is lightered to Pugwash, where Mr. Myers has a stone yard. Average price per ton about $4.50 on board car at Pugwash. The post-office at Springhill is entirely constructed of this freestone, and it is also used in some portions of the Royal Bank at Sydney, and of the new custom house at Halifax."[1]

Summary—Wallace Area.

The region about Wallace harbour has long been an important producer of building stone and it is still to be ranked as one of the chief districts in the Maritime Provinces. The older quarries were situated at several points near the river to the westward of Wallace: it would appear that stone was quarried here as long ago as a hundred years. From this original location, the industry shifted to the vicinity of Wallace village, where a strong company is now working, as well as two minor operators.

The stone occurs in fairly level beds with good jointing, and with only a small amount of inferior or useless material. In the chief quarry, the upper stone is yellow-grey in colour and is known as the "grey" stone. The lower beds are of a true grey colour and are referred to as the "blue" variety. The properties of the two types are very much alike (see page 73) but the blue stone is somewhat stronger and contains a higher percentage of ferrous oxide. It is likely that the upper beds represent an oxidized phase of the lower layers. Contrasted with the Miramichi stone, either of the present examples is much less yellowish-green in colour. They are somewhat stronger and probably more durable, but are considerably harder to work.

The production in 1911 was about 10,000 tons, all of which was used for structural purposes. Many important public buildings are constructed of Wallace stone. A good example is the new Victoria Memorial Museum in Ottawa, which is trimmed with the blue variety. The suitability of the stone for fine carved work is well shown by the main entrance to this building.

[1] Economic Minerals of Nova Scotia, H. Piers, p. 51, King's Printer, Halifax, 1906.

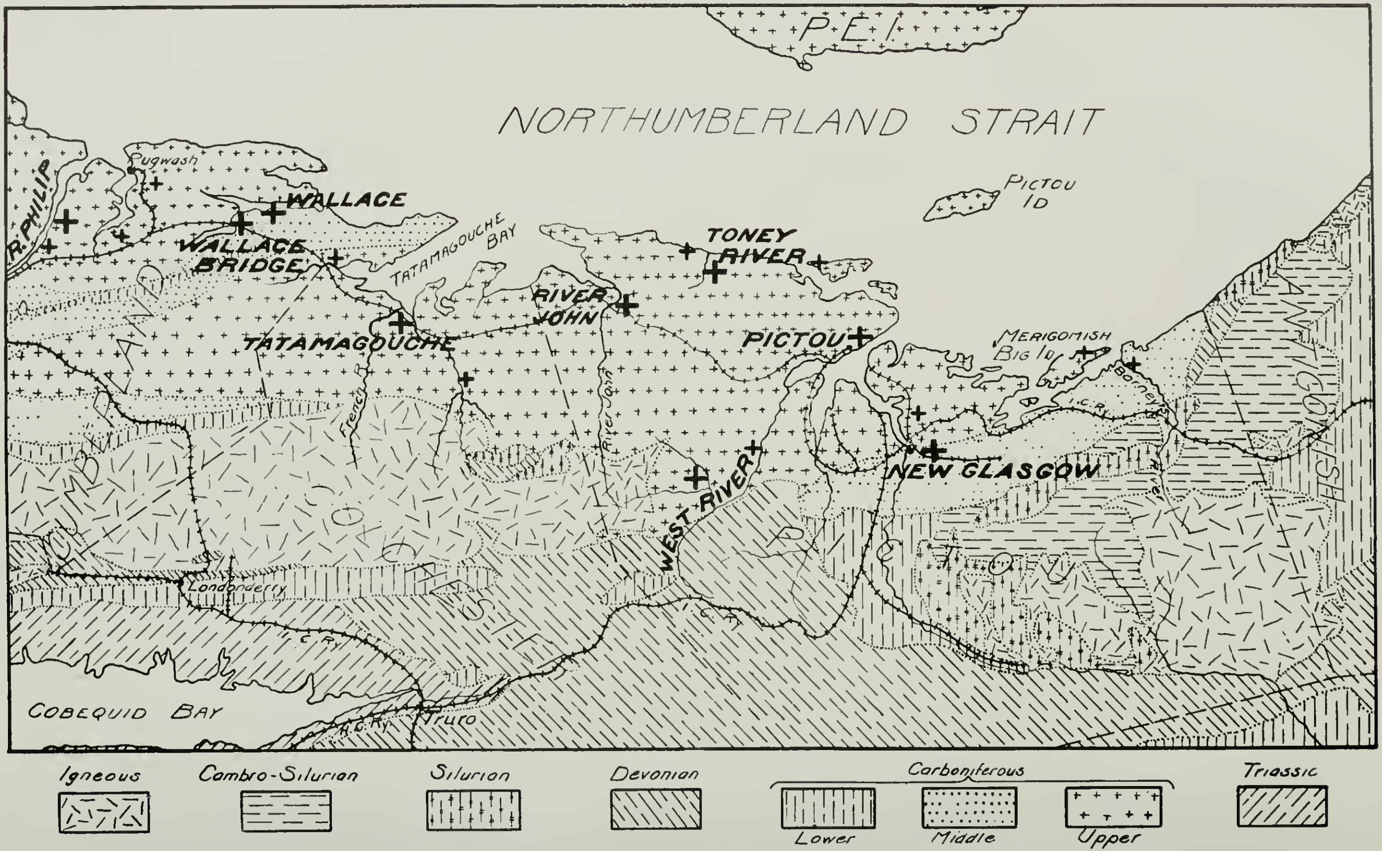


FIG. 3. Sketch map showing the geology and the chief quarries in the Wallace, River John, and Pictou sandstone areas.

River John Area.

In the vicinity of River John, a reddish sandstone has been quarried on the coast, and also on the river a short distance above the village. The quarries at the latter point are situated on the east side, about a quarter of a mile above the line of the Intercolonial railway. The present operators are H. McNab and L. and W. Gammon.

H. McNab, River John, N.S.

The quarry is quite small and represents a new opening in the face of an older working on the bank. The succession is as below:—

20–50 feet—Stripping, soil, broken rock and thin, shaly material.
18 inch—Solid stone, but with white specks.
18 inch—Reddish stone, reedy and easily split.
3 feet—Reddish, mostly solid, but in places showing white blotches and false bedding.
1 foot—Red stone, fairly solid—492.
—Undesirable material.

The formation strikes 15° north of east and dips 15° to the northwestward.

The major joints strike with the formation and are almost 20 feet apart. A second set, at right angles, is fairly well defined. Stone of considerable size can be obtained. Owing to the dip of the formation and the angle at which the river crosses, these beds are lower in the formation than those of the quarry next to be described. The stone varies slightly in colour in the different beds, and is, on the whole, redder than the Gammon stone.

The stone: No. 492.—The colour is brownish red and is shown in Plate XLIV, No. 10. In a large block the stratification planes show distinctly as fine horizontal lines. Old buildings show that the stone wears well and assumes a slightly more brownish and less reddish hue with the passage of time: there is a tendency also for the "reedy" effect to become less distinct. The corrosion test reduced the brilliancy of the red and added a tinge of yellow to the colour.

The grain is exceedingly fine, as many as sixteen grains occurring in the space of one millimetre. The mineral fragments are mostly quartz, with a sprinkling of feldspar grains. The cement is relatively abundant and of a bright red colour: it consists of clay and the oxides of iron.

The statement that this stone is much harder to cut than the Pictou stone is not borne out by the chiselling and drilling tests to which the sample was subjected. The transverse strength and the crushing strength are much higher than one would expect from a stone of the soft appearance of this example, but the chiselling and drilling tests are quite in accord with its general aspect.

The physical properties are as follows:—

Specific gravity	2·688
Weight per cubic foot, lbs	146·041
Pore space, per cent	12·962
Ratio of absorption, per cent	5·54
Coefficient of saturation, one hour	0·42
" " two hours	0·61
Crushing strength, lbs. per sq. in	15147·
" " wet, lbs. per sq. in	8678·
" " wet after freezing, lbs. per sq. in	8717·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·0048
Transverse strength, lbs. per sq. in	1490·
Chiselling factor, grams	19·6
Drilling factor, mm	22·

Under the freezing test, the stone exfoliated slightly on the faces parallel to the stratification. It will be observed that the wet test gave a lower result than that obtained from the frozen sample. The difference is, however, very slight: as both tests seemed to be quite satisfactory we may conclude that the freezing process injured the stone little if any. The same conclusion is arrived at in the case of the similar stones from Prince Edward island and from Stewartdale in Cape Breton. The drilling factor given above is probably too low as the specimen broke under the test.

Mr. Leverin finds the iron oxides to be as follows:—

Ferrous oxide, per cent	2·06
Ferric oxide, per cent	2·14

The equipment consists of one steam derrick and one steam drill. Six men are employed. The haul to the rail is about one-fourth of a mile. The stone is all shipped to Toronto, and is valued at $2 a ton f.o.b. for coursing stone.

Owing to the heavy overburden, the small scale of operations and the variable character of the stone, the production of uniform material is attended with a heavy expense.

L. and W. Gammon, River John.

This quarry adjoins that described above, and, like it, consists of an excavation in the river bank. The actual opening is about 50 feet long and has been extended the same distance into the escarpment. The formation strikes 15° north of east and dips 15° to the northwest. The main joints strike with the formation but have a variable dip, inclining however to the vertical. The partings are from 10 to 20 feet apart. In the opposite direction no pronounced jointing is perceptible. At the higher end the stripping is light, but at the lower end the good stone is covered by from 15 to 20 feet of thin bedded material. The rest of the face presents desirable stone in layers up to two feet thick. The stone here is very similar to that in the adjoining quarry, but it is somewhat bluer in colour and with rather less of the white blotching. The same difficulties of extraction detract from the value of the property.

The stone: No. 493.—In grain and in texture this stone is exactly the same as No. 492. The colour, however, is much lighter and is well described as lying between Nos. 10 and 11 in Plate XLIV.

The equipment consists of one steam derrick and one steam drill. From 6 to 8 men are employed. The product is handled by Britnell of Toronto.

John (?) Chambers, New Glasgow, N.S.

Mr. Chambers quarried a quantity of stone of similar character to the above from the point on the coast east of River John. The long haul of six miles to the railway seems to have put a stop to further work at this point. The locality was not visited.

R. E. Chambers, New Glasgow, N. S.

The Chambers block in New Glasgow is built of stone which was quarried at Toney river. In the building the stone presents a fine brownish-red appearance, but many of the blocks are somewhat marred by a pronounced false bedding in the stone. There is little sign of deterioration in the dressed stone. The quarry is not now in operation and in consequence it was not visited: the general properties of the stone are probably comparable with those of the river John stone.

Summary—River John Area.

From River John, Cape John, Toney river and Tatamagouche small quantities of red stone have been obtained from time to time. The stone is of a soft and argillaceous character, but it stands the weather much better than would have been expected from its appearance. The grain is very fine, and the colour varies from red to brown, but it is not always uniform throughout a given layer. The only present production is from River John whence a small amount is shipped to Toronto.

Pictou Area.

Sandstone has been quarried at numerous localities in the vicinity of Pictou and Merigomish harbours from both the Millstone Grit and Permo-Carboniferous formations. In the whole district there are only two quarries now in operation—one at Pictou and one at New Glasgow. For convenience of description the Pictou area may be divided into four districts:—

Pictou district.
New Glasgow district.
West River of Pictou district.
Merigomish district.

PICTOU DISTRICT.

Pictou stone is well known throughout the Maritime Provinces and has been largely used in many public buildings, churches, and business blocks. At the present time only one company is producing stone from the immediate vicinity of Pictou.

Pictou Quarry Co., Davis Campbell, president, Pictou, N.S., (old McKeen quarry)

The quarry is situated a short distance to the northwest of Pictou and is connected by a siding a mile long with the Intercolonial railway. The excavation is 300 feet by 150 feet, with the longer diagonal extending into the hill. The formation dips eastward at a low angle. The succession presented by the extreme face is as follows:—

18 feet—Overburden.
15 feet—Rather thin bedded above, but with heavier stone towards bottom. This stone is much coarser than in the beds below and represents one type of Pictou stone—471.
15 feet—Finer grained stone, in beds up to four feet in thickness. This is the second type of Pictou stone—472.

The bedding is rather irregular and the jointing also is variable, so that there is a considerable waste in quarrying. The main joints strike 40° east of north, with a vertical dip. A second set strikes 20° north of east and dips 80° to the south. These latter joints are, in places, close set and spoil much stone. There is a practically unlimited amount of stone available, and from the fact that a bore hole of 1000 feet disclosed nothing but sandstone, it is evident that the quarry might advantageously be continued to a greater depth.

The stone: No. 472.—This is known as the "fine" Pictou stone, and is shown in Plate XLIII, No. 15: it is almost a true grey in colour but there is a slight cast of brown. A distinctly fine spotted appearance is presented owing to the presence of relatively large scattered flakes of mica: this effect seems to become more pronounced after the corrosion test.

Under the microscope the structure is seen to be rather irregular, with quartz fragments of $\frac{1}{4}$ mm. in diameter scattered through a finer matrix of smaller quartz and feldspar grains. The feldspars are badly decomposed and together with the large amount of cementing material make up a considerable part of the rock. In transmitted light the cement is of a brownish green colour and shows evidence of secondary crystallization with the development of chlorite. The large amount of cement accounts for the loss of half the crushing strength on thorough soaking in water. The cement consists of clay, a small amount of carbonate of lime, and the oxides of iron.

The physical properties of the stone are as follows:—

Specific gravity	2·687
Weight per cubic foot, lbs	141·652
Pore space per cent	15·552
Ratio of absorption, per cent	6·853
Coefficient of saturation, one hour	0·65
" " two hours	0·72
Crushing strength, lbs. per sq. in	10348·
" " wet, lbs. per sq. in	5555·
" " wet, after freezing, lbs. per sq. in	3463·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·0148
Transverse strength, lbs. sq. in	869·
Chiselling factor, grams	5·7
Drilling factor, mm	22·

The frozen cube showed very little visible effect of the operation.

The iron is present in the following condition:—

Ferrous oxide, per cent	4·37
Ferric oxide, per cent	1·57

No. 471.—This example is of a lighter and less distinctly grey colour, with a decided cast of green. The grain is very much coarser, with bands of a still coarser structure appearing at irregular intervals. These bands show a red colour owing to the aggregation of fragments of red feldspar. The rock is more friable and much less desirable than the finer variety.

The equipment consists of:—

Siding of one mile to I. C. R., one locomotive and two cars, two steam derricks, two steam drills. Ten men are employed at present. About 3,000 tons a year are quarried.

The following prices are quoted, all f. o. b. quarry siding:—

Rough blocks, 26c. per cubic foot.

Trimmed blocks, 40c. per cubic foot.

Rubble, $1.25 to $1.50 per cubic yard.

This stone was awarded a commemorative medal at the Colonial and Indian exhibition in 1886. Among the many structures in which it has been used may be mentioned the following:—

Presbyterian church, Sydney.
Railway station, Pictou.
Jail, Pictou.
Old Church of Scotland, Pictou.
New jail, Charlottetown, P. E. I.
Post-office, New Glasgow, (Plate XVII).

The stone has also been shipped to Sydney, Charlottetown, Halifax, St. John, etc.

The Pictou stone, as shown by buildings in Pictou and elsewhere, weathers to a fine, soft, uniform buff colour, particularly on dressed surfaces. Where the blocks have been set on edge there is a strong tendency to exfoliation. The effects of the weather are much more apparent in the lower courses, but this feature is by no means peculiar to the Pictou stone.

NEW GLASGOW DISTRICT.

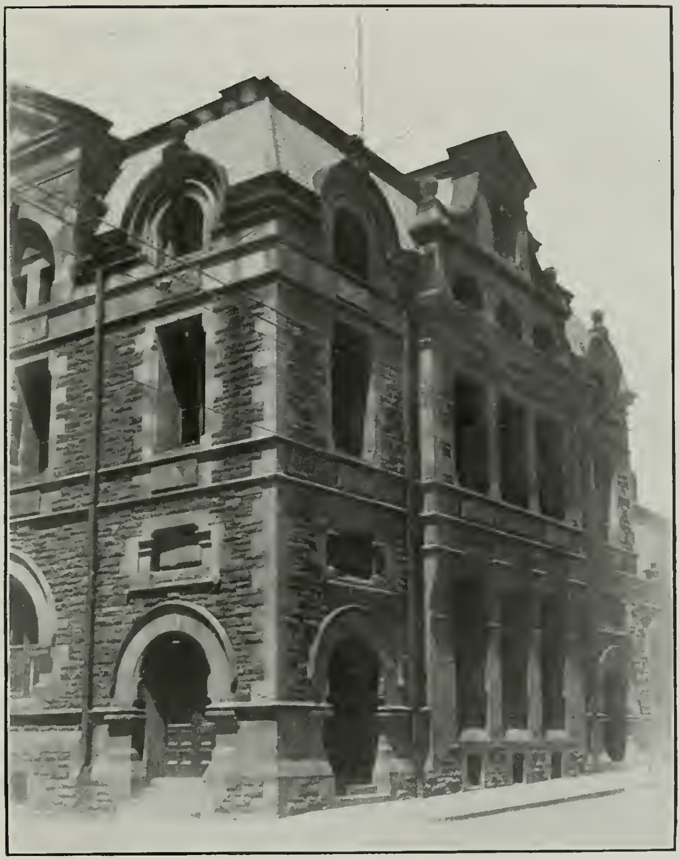
The only quarries now worked in the vicinity of New Glasgow are situated on the Merigomish road about a mile and a quarter from the town. Most of the product is crushed for concrete work, but a small quantity of building stone is produced.

Gammon and Weir, New Glasgow.

The property consists of 23 acres. The quarry is opened for about 200 feet along the face of an escarpment which crosses the property in a southeasterly direction, with an elevation of about 40 feet. The formation strikes 30° south of east and dips 40° to the northeast. The succession of beds is as follows:—

10 feet—Thin bedded stone which is crushed for concrete.
1 foot—Shale.
20 feet—Solid bed of sandstone with no stratification planes.
18 inches—Shale, not continuous.
. . . .—Evenly bedded sandstones, splitting into layers of from 1 to 2 feet thick—498.

The most pronounced joints run north and south with a dip of 85° to the west. The second series runs with the strike of the formation and dips vertically. Neither set of joints is too closely spaced to prevent the obtaining of large stone; in fact, pieces from three to four feet square and from ten to fifteen feet long have been quarried (Plate XVIII).



Pictou sandstone. Post-office, New Glasgow, N.S.

Pictou sandstone. Gammon and Weir's quarry, New Glasgow, N.S.

The stone: No. 498.—In colour, this stone is very like the fine Pictou variety, but its coarser structure gives it a less homogeneous appearance which is represented in Plate XLIV, No. 3. The corrosion test slightly kills the clean grey colour by reducing the greenish element in the colouring matter. Except for the coarser structure, the microscope reveals no essential difference between this stone and the Pictou sample. The cement is largely of an argillaceous character, but it contains considerable ferrous oxide and a small amount of carbonate of lime.

The physical properties are as follows:—

Specific gravity	2·656
Weight per cubic foot, lbs	146·139
Pore space, per cent	11·86
Ratio of absorption, per cent	5·006
Coefficient of saturation, one hour	0·68
" " two hours	0·72
Crushing strength, lbs. per sq. in	16300·
" " wet, lbs. per sq. in	10905·
" " wet after freezing, lbs. per sq. in	8337·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00811
Transverse strength, lbs. per sq. in	1537·
Chiselling factor, grams	5·7
Drilling factor, mm	12·

The iron content is largely in the lower state of oxidation as determined by Mr. Leverin.

Ferrous oxide, per cent	4·11
Ferric oxide, per cent	0·57

It would appear that good coursing stone can be easily and cheaply obtained from this quarry, particularly as a crushing plant is installed to handle the waste. It must not be forgotten, however, that the dip of the formation would carry the beds at present being worked to a much greater depth as operations advance.

The plant consists of one steam derrick and one steam drill. Eight men are at present employed. Most of the output is crushed, but about 300 cubic yards of building stone were produced in 1910. This material is valued at from $3 to $3.50 per yard delivered in New Glasgow.

J. W. Wright, New Glasgow, N.S.

This property adjoins that of Gammon and Weir to the west. The quarry is opened for a distance of 200 feet along the same escarpment.

The general sequence of beds is similar, but local differences in the thickness of the various layers are to be observed. Both the bedding and the jointing are favourable to the obtaining of blocks suitable for building. This quarry was not being worked at the time of my visit.

John McPherson, New Glasgow, N.S.

Mr. McPherson has from time to time quarried a small amount of stone from the ravine of Smelt brook, which crosses the main road between Trenton and New Glasgow. The openings have been made on the property of the Townsend estate and show only thin bedded and shattered stone covered by a heavy layer of soil. A considerable amount of shale is interstratified with the sandstone, which shows much iron staining on the frequent joint planes—499.

The stone: No. 499.—A fine grained greenish-grey stone with a strong tendency to turn yellowish on exposure to the weather. Iron stained spots are common, and there is much shining mica on the planes of stratification. Even if it occurred in beds of sufficient thickness this stone would not make a durable or desirable building material.

In connexion with this area it should be noted that sandstone has been quarried from the strata of the upper series at several points along the road between New Glasgow and Little Harbour. Small quarries in the Millstone Grit have been worked in the more immediate vicinity of New Glasgow: all of these are now idle.

WEST RIVER OF PICTOU SECTION.

Grey sandstone of exceedingly fine grain and excellent quality has been quarried on several of the brooks entering the West River of Pictou. The best stone is found near the confluence of Sixmile brook and Eightmile brook, in which vicinity several quarries were formerly operated. Although this stone is of a highly desirable character there has been no production for many years. The large amount of waste produced in quarrying, and the long haul of eight miles to the railway at Scotsburn, are doubtless responsible for the cessation of operations. As none of these quarries are now being worked only one was visited. The description of this quarry as given below may, however, be regarded as applicable to the other properties in the area.

W. R. McKenzie ? West River, N.S.

This property is situated on Eightmile brook, a short distance above the confluence with Sixmile brook. The ownership of the quarry is somewhat in doubt, but it belongs, in part at least, to Mr. McKenzie.

The stone is exposed in the bed of the stream and in a cliff of about 50 feet in height on the west side. The formation strikes about southwest and dips 25° to the northwest. The stream runs at right angles to the strike of the formation and overcuts the beds. The best stone is said to have been procured from an opening in the bed of the river which is now filled with water and debris. The succession of beds as exposed in the small quarry on the hillside is as follows:—

6–8 feet—Soil.
10 feet—Good grey stone in thin beds. The shattering does not seem to be of a primary nature but to be due to surface effects. It is probable that, farther in, these beds would be more solid.
18 in.—Bed of fine yellowish-grey stone—497.
Thicker beds of greyish stone partially covered by debris.

The joints are variable in both strike and dip; the most pronounced series, however, runs east and west at intervals of about 10 feet. Another set, of less distinct character, cuts the formation in a direction 20° west of south. As far as the present exposure is concerned the extraction of large blocks of stone of good quality would be attended by a practically prohibitive waste. With regard to the deeper opening, now hidden, I am unable to speak, but it would appear that the finest quality of stone was obtained here. A specimen taken from the dump and probably representing the highest grade of stone is described below as No. 495. A somewhat different type likewise obtained from the dump is described as specimen No. 496.

The stone: No. 495.—This stone has a very pleasing brownish-grey colour and is shown in Plate XLIV, No. 2: its appearance is somewhat marred by the occurrence in places of fine, black lines of organic matter.

The grain is very fine and even, as nearly all the quartz grains are from $\frac{1}{8}$ to $\frac{1}{10}$ mm. in diameter: the structure is not quite so fine as that of the River John stone. The quartz grains are imbedded in a matrix of cement and decomposed feldspars, which is relatively abundant and which shows a considerable amount of greenish chloritic matter as the result of secondary crystallization.

The physical properties are as follows:—

Specific gravity	2·69
Weight per cubic foot, lbs	142·418
Pore space, per cent	15·19
Ratio of absorption, per cent	6·66
Coefficient of saturation, one hour	0·58
" " two hours	0·63
" " thirty-eight hours	0·66
Crushing strength, lbs. per sq. in	16888·

No. 496.—This stone is much like No. 495 but it has rather more of the true grey colour. The structure is almost identical. Scattered irregularly throughout the block are fragments of vegetable remains, which appear as black lines when broken across; they are almost imperceptible after chiselling. When the stone is broken parallel to these marks, they appear as distinct black blotches. In some parts the stone

is practically free from these disfigurements, but when they appear, they constitute the only serious objection to the employment of this stone in the finest kind of work. No. 495 is open to the same objection.

The fine grain, uniform grey colour and good weathering properties of the better grades of stone from this quarry as well as from the similar openings in the vicinity cause them to rank among the very best sandstones of the Maritime Provinces. For monumental purposes they are not excelled by any freestone now being produced in the region. The excellence of this stone for monumental purposes is seen in the facility with which it receives and retains the finest kind of chiselling. The application of the stone to architectural work may be observed in the McCulloch building in New Glasgow, and in various structures in New Glasgow, Stellarton, and Pictou.

The difference between this stone and the Pictou variety is clearly to be seen in these buildings, as the West River stone weathers to a uniform grey colour, while the Pictou material always shows a yellowish aspect.

As far as has been observed, the exploitation of this stone is attended with a large amount of waste, which fact, together with the expense of the long haul, is probably responsible for the present abandoned condition of the quarries.

J. McPherson, West River, N.S.

This quarry, which has produced some very fine blocks of grey sandstone of a monumental character, is situated on Eightmile brook, about two miles below that described above. Although the quarry was not visited, I am informed that the general conditions of occurrence are similar to those in the quarry described above. There is no present production.

Havelock Fraser, West River, N.S.

The quarry is opened in the cliff on the eastern side of Eightmile brook, a short distance above the confluence with Sixmile brook. The character of the bedding and the quality of the stone are similar to that of McKenzie's quarry. There is no production at the present time.

MERIGOMISH DISTRICT.

Quarries were formerly worked in the Permo-Carboniferous strata of Merigomish Big island and in the Millstone Grit along French river, Smith brook and Barneys river. All these quarries have been long since abandoned, and in consequence they were not visited. Concerning these sandstones, Fletcher says:—

" In Barneys river, below the confluence of Gordon brook, and in other brooks in the neighbourhood, grey and greenish, brown and reddish sandstone and shale, the former sometimes quarried for building, spheroidal concretions of harder, nodular sandstone and many carbonized plants, are exposed at intervals in the cliffs.

"Near the mouth of French river, a fine grindstone grit has been largely quarried from a bed ten to fifteen feet thick.

"Fine exposures of Millstone Grit occur in picturesque nearly continuous cliffs along French river, between the shore and Glenshee. The first beds seen above the salt marshes are of red green soft marl and fine sandstone, followed up stream by fine grey sandstone, fifteen feet thick, which has been quarried, capped by ten feet of red marl and sandstone."[1]

Summary—Pictou Area.

In the vicinity of Pictou and Merigomish harbours, at points along the shore and for some distance inland, quarries have been opened in both the Permo-Carboniferous and the Millstone Grit. The great majority of these openings were small and unimportant and they have been abandoned long ago. At the present time a yellowish type of stone is being quarried for building purposes at Pictou, and a rather more greyish variety is used for concrete work at New Glasgow.

A very fine grained and highly desirable stone was formerly quarried on some of the brooks entering the West river of Pictou.

Monk Head Area.

Extensive exposures of sandstones and conglomerates occur on the south side of the promontory of Monks Head in the county of Antigonish. Several small quarries were worked in this area at the time of the construction of the Intercolonial railway, and small amounts of stone are from time to time obtained for local building in Pomquet and in other small places in the vicinity.

John Dolores, Monks Head, N.S.—Alex. Baton, Monks Head, N.S.

The whole hill to a height of more than 100 feet is composed of sandstones and conglomerates, mostly of a rough and unsuitable character. Quarries have been opened at three different levels—near the water line, on the road, and on top of the hill. The first of these openings shows a face of from 6 to 8 feet of irregularly bedded, reddish and yellowish sandstone in layers upto 18 inches in thickness—507. Scarcely any work has been done, but it is evident that, for a considerable distance along the shore, a small amount of stripping would reveal workable beds. The overburden however, would rapidly increase as operations progressed. The second series of openings is situated about a quarter of a mile farther west, on the road side at an elevation of about 20 feet above the water. The amount of

[1] Geol. Sur. Can. Rep. 1886, p. 91P.

work done here is too insignificant to warrant definite remarks, but it would appear that fairly thick but extremely irregular beds exist—508. The third set of openings, that on the top of the hill, is more important, but even here only surface stone has been removed, and the quarries are filled with debris and overgrown with vegetation. The stone is of a whitish and yellowish colour and occurs in very irregular beds, which, however, reach a workable thickness in places—509.

The stone: No. 507.—This stone is of an unattractive appearance which would never suggest its use for purposes of fine construction. The colour is dirty yellow and brown arranged in irregular bands. The structure is quite fine, however, and the mineral grains consist for the most part of quartz. (Plate XLIV, No. 15.) The stone is much more durable than might be expected, for although its strength is not high, the loss on soaking and freezing is quite small.

The physical tests resulted as follows:—

Specific gravity	2·65
Weight per cubic foot, lbs	136·002
Pore space, per cent	17·689
Ratio of absorption, per cent	8·11
Coefficient of saturation, one hour	0·58
" " two hours	0·59
Crushing strength, lbs. per sq. in	8185·
" wet, lbs. per sq. in	6459·
" wet, after freezing, lbs. per sq. in	5475·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·00174
Transverse strength (across the grain) lbs. per sq. in	637·
Chiselling factor, grams	7·5
Drilling factor, mm	20·

No. 508.—A fine grained, porous, quartzose sandstone of a light pink colour. The cementing matter is deficient, so that the stone is quite pulverulent to the touch. It is marred by dark brown spots which have resulted from the decay of vegetable matter.

No. 509.—Like No. 508 but of a lighter colour. Iron stained spots are frequent throughout the specimen.

Lacking a good face at any point, it is impossible to speak with accuracy regarding the possibilities of this area. There are doubtless many bands of stone of medium quality, but they are interbeded with much coarse and worthless material. The better beds are extremely irregular so that the quarried stone requires a large amount of work to reduce it to rectangular shape. The possibility of obtaining large blocks in places is attested by the fact that pieces 8 feet long have been observed. On the whole it appears doubtful if this area will ever prove an important producer of building stone.

Boularderie Island Area.

The sandstones, grits, and conglomerates of the Millstone Grit cover a large part of Boularderie island, a strip of land about 15 miles long lying between the two outlets of Bras d'Or lake. The suitability of some of these rocks to structural purposes is thus referred to by Fletcher. "The shores of Boularderie island afford grey sandstone fit for rough work in building." A more specific reference by the same author is as follows: "The Millstone Grit of Boularderie island and New Campbellton furnishes a grey, fine grained, strong, homogeneous, non-calcareous sandstone, well adapted for building material, but sometimes spotted, on exposure to the air, by the oxidation of the iron pyrites which it contains. It is stated that a contract has been entered into for the delivery of 10,000 tons of this stone from the quarries on St. Andrews channel and the Great Bras d'Or, to be used in the enlargement of St. Peters canal.

"Thick-bedded sandstone of a uniform, coherent texture, and suitable for the manufacture of grindstones, might also be obtained from the same strata."[2]

As far as could be learned, none of the quarries on Boularderie island are now in operation. The old quarry opposite Barrachois, however, was visited with the object of securing specimens indicative of the Millstone Grit in this area.

Duncan Grant, Black Brook, N.S.

This property is on Boularderie island on the north shore of St. Andrews channel opposite Barrachois station: it lies in the county of Victoria near the western line of the county of Cape Breton. A small brook has here excavated a channel of considerable depth, in the sides of which the stone is exposed. A short distance farther up the stream, on the property of John McDermott, a better section is exposed which is selected for description.

John McDermott, Black Brook, N.S.

On this property a section of 75 feet has been exposed by quarrying operations, but unfortunately, the lower part is now hidden by a heavy talus. The section is as follows: 1–2 feet—Soil,40–50 feet—Soft, in places

[1] Geol. Sur. Can., Rep. 1876–77, p. 456.
[2] Geol. Sur. Can., Rep. 1875–76, p. 416.

pebbly, yellowish-brown sandstone, showing much iron staining by oxidation—531. 25 feet—Hidden by debris; a finer stone of grey colour and the only desirable material in the quarry—530.

The upper stone is much shattered and shows strong jointing at 50° west of north, and also at right angles to that direction. Both sets have an approximately vertical dip. The beds are irregular and variable. Much of the stone is soft, friable, and badly stained. The lower beds of more desirable stone cannot now be seen: their further exploitation could be effected only by removing the heavy talus and the overlying inferior beds. This lower stone, when fresh, is of a pleasing grey colour, but specimens obtained from the old workings show an external zone of yellowish brown discoloration extending to the depth of an inch or more.

The stone: No. 530.—A medium grained, greyish sandstone of pleasing colour when fresh, but which alters rapidly under the action of the weather to a dirty yellowish-brown hue. The structure is not very homogeneous, as some of the quartz fragments are much larger than others: the grains are distinctly rounded for the most part. The physical characteristics are given below. It will be observed that the crushing strength is unusually high.

Specific gravity	2·591
Weight per cubic foot, lbs	143·972
Pore space, per cent	10·989
Ratio of absorption, per cent.	4·765
Coefficient of saturation, one hour	0·60
" " two hours	0·78
Crushing strength, lbs. per sq. in	16894·
" " after freezing, dry, lbs. per sq. in	11143·

No. 531—A very coarse grained, yellowish-green stone, with fragments as great as five mm. in diameter arranged in bands throughout a somewhat finer matrix. This stone is of no possible use as a building material except for rough foundations, etc.

It is now 21 years since this quarry was operated to obtain stone for construction work on the Intercolonial railway. For a period of five months work was actively carried on. I am informed that the pay roll amounted to $1,300 a month during this period, and that solid blocks of stone as much as 16 feet long were obtained. It would appear, therefore, that large quantities of a fairly desirable stone are available at this point, if the difficulties of extraction do not render quarrying operations economically impossible. Stone from these quarries may be seen in the old Court House at Sydney.

Quarries on Black Brook.

About four miles to the eastward of the properties described above, at points along the shore and in the ravine of Black brook, stone was obtained for the construction of St. Peters canal. The present condition of these old openings does not warrant critical remarks. As far as could be seen in a short examination, the bedding is thin and variable and the stone of a heterogeneous character with a predominating coarse type—532. An old building in the ravine of Black brook presents a very rusty exterior. The blocks are of various kinds of stone but most of them are similar to specimen 532. It is worthy of remark that this stone is quite hard and solid in the building, while along the cliffs it is very friable, almost pulverulent, in character.

The stone: No. 532.—This example is a grit rather than a sandstone. The fragments consist of white quartz and pink feldspar, which are, on the average, two or three mm. in diameter with much larger pieces in places. There is a relatively small amount of cement, so that the stone is almost pulverulent in character.

Summary—Boularderie Island Area.

At the time of the construction of canals in Cape Breton, and the building of the Intercolonial railway, several quarries were opened on the north shore of St. Andrews channel on Boularderie island. The stone, for the most part, is of an exceedingly coarse character, but some beds of finer texture were quarried. As far as could be seen, the better quality of stone is covered by a heavy overburden which would render its further exploitation rather difficult. When freshly quarried, this better stone is of medium grain and clean grey colour but it assumes a dirty, yellow appearance on exposure. There has been no production for many years and it seems unlikely that the quality of the product will justify the reopening of the quarries.

Sydney Area.

There are many exposures of sandstone in the vicinity of Sydney which, at various places, have been worked for the production of building stone. At the present time, however, these quarries are all abandoned, as local contractors prefer to use better grades of stone brought from a distance, more particularly from Pictou.

The Carboniferous strata near Sydney are usually too thin bedded to yield stone of a desirable quality: on the same account the expense attending quarrying operations is excessive. The best known local quarries are situated at Hardwood hill near the city, at Forks bridge, at Black brook, and at North Sydney.

Local stone may be seen in some of the old buildings in Sydney: a good example is the old Church of England, which shows that the stone has turned very yellow and brown with the lapse of time but that it has resisted disintegrating agencies in a satisfactory manner. (Plate XIX.)

John E. Burchel, Hardwood Hill, Sydney, N. S.

The quarry is situated in the ravine of Wentworth creek near Hardwood hill to the south of Sydney. The stream runs about north and occupies a valley 40 feet deep, which it has cut through the sandstone formation. The stone is exposed for about 200 yards along the side of this ravine. The formation strikes 10° south of east and dips 35° to the south. The whole face presents thin and irregularly bedded stone, with occasional lenticular beds of thicker material. The jointing is very irregular so that distinct systems of joints can scarcely be made out. As only a small fraction of the material which must be quarried is suitable for structural purposes, and as much of the heavier stone is very coarse, even pebbly, in character, there seems to be little hope of this property proving an important producer. Most of the product was formerly used for foundations, but some coursing stone and sills have been cut from it. The best type is described below as No. 526.

The stone: No. 526.—In colour this stone very closely resembles that from Grande Anse in New Brunswick (Plate XLIII, No. 8) or the finer type from Smith's quarry, at Shediac (Plate XLIII, No. 9). In grain and in structure also the difference from these stones is not material, except for a more pronounced lamination, which induces a tendency to split parallel to the bedding. While this specimen was not examined in detail, it is a fair assumption that it is a reasonably strong and durable stone, but that it would be rather hard to work.

There is no equipment on this property, and there has been no production for some time. The product was formerly sold in Sydney for $3.50 per cubic yard. Probably the best example of this stone may be seen in the Conway building, on the corner of Bentic and Prince streets, Sydney.

Dr. Arthur S. Kendall, Sydney, N. S.

This property is situated near Forks bridge on the Sydney river, about seven miles from the city. Very little work has been done and a quarry can scarcely be said to exist. Small openings were made at two points—the first at a low level above the bridge and the second on top of the hill below the bridge. The stone from the first opening was used in the construction of the piers for the Forks bridge. The excavation is now flooded by the construction of a dam, so that further operations would be difficult. As seen in the bridge, this stone has a uniform and pleasing grey

Sydney sandstone. Old Church of England, Sydney, N.S.

colour, which it has acquired since being placed in the structure. Its weather-resisting properties seem to be good as no evidence of wear or chipping is to be seen. The beds must be of considerable thickness, as heavy blocks were used in the construction of these piers. The opening below the bridge is a mere pit now overgrown with vegetation. There is evidence, however, of the presence of at least one bed of stone fully 2 feet thick which could be reached by a reasonable amount of stripping. The material from both quarries is almost identical, and is described in detail below as representing the best type of stone in the vicinity of Sydney, N. S.

The stone: No. 527.—This stone approaches more nearly to the olive-green type than the other examples from eastern Nova Scotia: it is shown in Plate XLIII, No. 7. It is characterized by a profusion of small dark brown spots, which are scattered uniformly through it. There is little change in colour produced by the corrosion test, but, like the Miramichi stones, this operation results in an increased weight. The grains are of irregular size and sharply angular outline: some of the quartz fragments are ½ mm. long but the average is much less. The feldspar fragments are present in considerable abundance, but, although badly decomposed, they are clearly separable from the yellowish-green cementing material, which consists of clay, iron oxide, and a small amount of carbonate of lime.

The physical properties are as follows:—

Specific gravity	2·657
Weight per cubic foot, lbs	148·215
Pore space, per cent	10·642
Ratio of absorption, per cent	4·485
Coefficient of saturation, one hour	0·50
" " two hours	0·63
Crushing strength, lbs. per sq. in	12208·
" " wet, lbs. per sq. in	5796·
" " wet, after freezing, lbs. per sq. in	4829·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·00367
Transverse strength, lbs. per sq. in	1609·
Chiselling factor, grams	6·8
Drilling factor, mm	15·

An analysis by Leverin gave:—

Ferrous oxide, per cent	3·34
Ferric oxide, "	1·00

Angus and Donald Morrison.

This quarry is situated near Black brook, about eight miles from Sydney, on the road to Mira bay. The stone is said to be similar to that from Kendall's quarry. There is no present production. The property was not visited.

A. C. Thompson, North Sydney, N. S.

A small quarry was opened at Lockman's cove, opposite the Roman Catholic church, by Mr. Thompson and associates. The product was a light grey sandstone, which may be seen in the trimmings of Voogt Bros'. store in North Sydney. There is no production at present.

Summary—Sydney Area.

There is no regular production of stone in this district. The best known quarry is at Hardwood hill near the city, from which a rough thin bedded stone has been procured for foundations. Quarries at Forks bridge and Black brook have yielded a better quality of stone, but the operations were on the smallest scale. A small opening near North Sydney supplied material for some local structures in that town.

Whycocomagh Area.

Red sandstone has been quarried on a small scale to the northward of Whycocomagh, at the head of St. Patrick channel in Inverness county, Cape Breton. The stone appears to occur in large quantity and it is exposed more particularly on two farms as described below.

John H. R. McDonald, Stewartdale, N.S.

This property is situated four miles north of Whycocomagh. The exposures occur towards the summit of a hill which rises 200 feet above the level of the road. The formation strikes 35° east of north and dips southeast at a low angle. This dip corresponds approximately with the slant of the hill towards the road. About one acre of stone is exposed, but it is a reasonable assumption that a much greater acreage occurs under the drift. Only the upper bed has been quarried, and that to such a small extent and so long ago that little is revealed as to the character of the formation. This upper bed, however, is about 3 feet thick and shows very little jointing. Large blocks could certainly be obtained without undue waste. Most of the stone is red, but some portions show scattered white blotches—522.

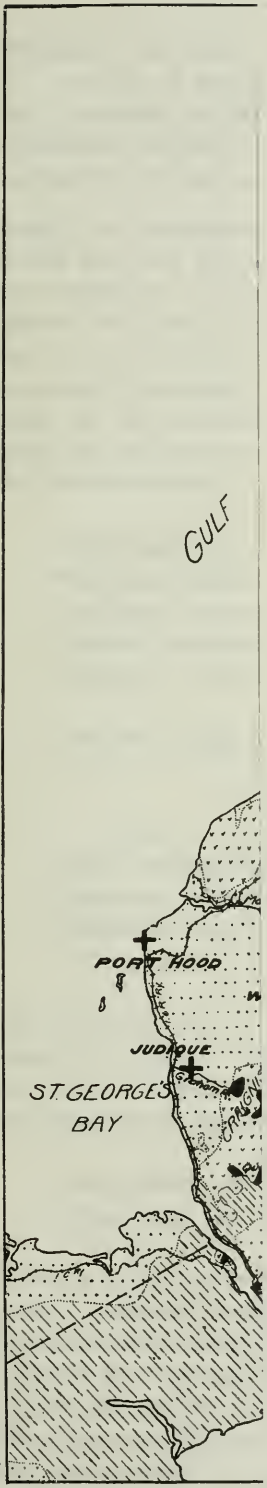


FIG. 4. Sketch m

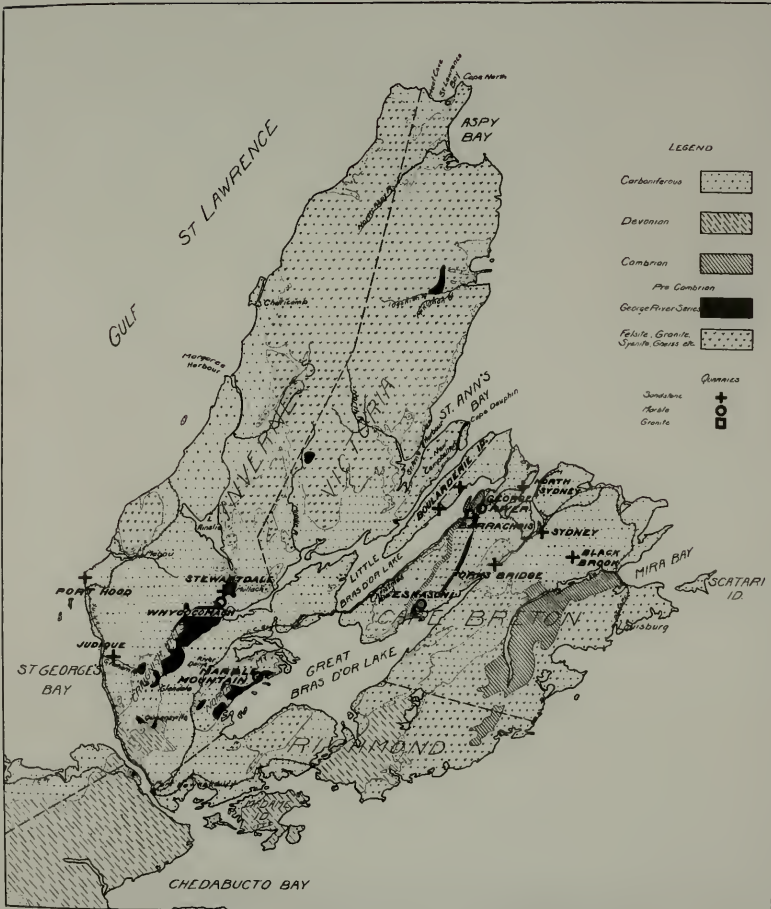


FIG. 4. Sketch map showing the general geology and the chief quarries of sandstone, marble, limestone, and granite in Cape Breton.

The stone: No. 522.—The colour of this stone is seen in Plate XLIV, No. 6. It is about equal to the Amherst stone in the intensity of the red, but the shade is different as it lacks the slightly rose-coloured tint of the Amherst variety. There is no change in either colour or weight by treatment with carbonic acid and oxygen.

Under the microscope the stone is seen to be particularly clean. Practically the only grains present are those of quartz, which occur in angular fragments of fairly constant size (about $\frac{1}{6}$ mm. in diameter). The grains are closely aggregated together, each fragment being surrounded by a film of oxide of iron which serves as cement. Judging from the microscopic examination, this stone should be a fairly durable material. Although the softening effect of water is pronounced it will be seen by examining the table given below that the mechanical disruption by severe freezing is insignificant.

Specific gravity	2·659
Weight per cubic foot, lbs	131·86
Pore space, per cent	20·562
Ratio of absorption, per cent	9·735
Coefficient of saturation, one hour	0·56
" " two hours	0·57
Crushing strength, lbs. per sq. in	9056·
" " wet, lbs. per sq. in	5362·
" " wet after freezing, lbs. per sq. in	4834·
Loss on treatment with carbonic acid and oxygen	0·0
Transverse strength, lbs. per sq. in	480·
Chiselling factor, grams	14·6
Drilling factor, mm	25·5

The small amount of ferric oxide is remarkable in view of the bright red colour of the stone. It may be concluded that less than one per cent of ferric oxide is sufficient to impart this colour when the intensity is not reduced by other substances.

Ferrous oxide, per cent	1·41
Ferric oxide, per cent	0·71

There is undoubtedly a large quantity of red sandstone available at this point. Although little work has been done, the general contour of the country shows that a considerable acreage must be accessible with a reasonable amount of stripping. I am informed that a bore-hole sunk at the foot of the hill, and about 200 yards from the quarry, showed this red sandstone continuously for 100 feet. The haul to tide water at Whycocomagh is four miles.

Mrs. James MacDonald, Stewartdale, N.S.

This property adjoins that described above, and, like it, shows about one acre of visible stone. The upper bed only has been worked, and that to a very small extent. There is no present production.

Port Hood Area.

Although sandstones are known to occur at many points along the west shore of the island of Cape Breton, and although they have been worked for local building, I am unaware of any extensive operations ever having been conducted. Fletcher was not enthusiastic as to the possibilities of this region, as may be seen from the following remark: "No large and good deposit of building stone is known among all the sandstones of the region, which are usually too highly tilted and broken to be available. At several places, however, stone has been found to serve local purposes; the best of which is perhaps found in Graham river, near Judique. Some of the sandstones of Inhabitants river and West bay break into large blocks which are used for rough work in building."[1]

At a later date the same writer observes: "Sandstones fit for building are confined chiefly to the Coal Measures and Lower Carboniferous. They are quarried for local use at Southwest Margaree, Broad cove, Cheticamp, Whycocomagh, Southwest Mabou, and Pleasant bay."[2]

The sandstone from Whycocomagh is described under another area in this report. Of the other localities mentioned above, that near Judique was the only one visited, as the rest of them are difficult of access and apparently of little economic importance.

Angus McMillan, Judique (Campbell office), N.S.

This property is situated a mile and a half above the steel bridge over the Graham river west of Judique The ravine here is about 75 feet deep and shows beds of sandstone for the greater part of that depth. Along the left side, where the old quarries are situated, these exposures may be seen for a half mile: on the opposite side the outcrops are less distinct and continuous. Near the point at which the most work has been done, the ravine runs about east and west and crosses the formation which strikes 30° south of west. The beds are highly inclined with a dip of 80° to the northwest. On advancing up stream, therefore, successively lower beds are encountered and altogether a great thickness of stone is revealed. Much of this series is thin and friable, but at many places thick beds occur between the thinner material. Up stream the stone is all grey, but towards the west end of the exposure good brownish red stone is exposed both in the cliff and in the bed of the stream. This red stone

[1] Geol. Sur. Can., Rep. 1878-80, p. 125 F.
[2] Geol. Sur. Can., Rep. 1882-84, p. 98 H.

appears to be interbanded with grey and not to occur in large amount without this objectionable feature. Nevertheless a very great quantity of good red stone could be obtained by separating it from the intermixed grey. On the hillside the stone is overgrown with vegetation and shattered by the weather, but in the bed of the stream it appears to be fairly solid and quite capable of yielding large blocks. The most pronounced system of joints crosses the formation vertically at right angles to the strike.

No real quarry exists, as the only work done has been to detach a few blocks from the hillside. Both the red (547) and the grey (550) stone has been used locally with every evidence of success. A good example may be seen in the presbytery in Judique, where the red stone cut 32 years ago has preserved all the marks of the chisel and has suffered no deterioration except that it has assumed a more mellow colour. The grey stone also has worn well and appears to be particularly free from injury by abrasion, as doorsteps after many years of use show little or no deterioration.

Besides in the ravine at McMillan's, both the grey and the red stone are known to occur in accessible position along the ridge behind Judique, where they have been quarried at several points.

The stone: No. 547.—This sample represents the average red stone from McMillan's: some examples are of a deeper red while many are much lighter; in fact, all gradations of colour are found, from a fairly intense red to the slightly pinkish type described below as No. 550.

The colour of the present specimen is shown in Plate XLIV, No. 11: it should perhaps be described as a brown rather than as a red. The red cast is intensified and the weight is increased by treatment with carbonic acid and oxygen. The mineral grains are nearly all quartz fragments of about $\frac{1}{6}$ mm. diameter, as in the case of the Stewartdale stone. The grains are fitted closely together with only a small amount of cement. By reference to the table given below it will be seen that the physical properties of this stone are of a high order. The low coefficient of saturation is remarkable: with the exception of the grey stone from the same locality there is no other sandstone from the Maritime Provinces which approaches it in this respect. If the coefficient of saturation is a reliable means of determining the frost-resisting properties of a stone, this Judique material should be extremely durable. As far as could be observed, the stone which has been used in buildings justifies the above conclusion. The microscopic examination does not reveal any explanation for this low coefficient, unless the occurrence of a few visible pore spaces, which are seldom to be seen in the other stones, may be interpreted as meaning that the porosity is due to the presence of interspaces of more than capillary size. Such an explanation would be in accord with the theory. It is significant also that both the chiselling and the drilling factors are high in the present example.

Specific gravity	2·659
Weight per cubic foot, lbs	137·98
Pore space, per cent	16·814
Ratio of saturation, per cent	7·598
Coefficient of saturation, one hour	0·02
" " two hours	0·03
Crushing strength, lbs. per sq. in	14744·
" " wet, lbs. per sq. in	8536·
" " dry, after freezing, lbs. per sq. in	10129·
Loss on tıeatment with carbonic acid and oxygen, grams per sq. in	0·0016
Transverse strength, lbs. per sq. in	1249·
Chiselling factor, grams	3·6
Drilling factor, mm	11·2

The durability of colour in this stone is attested by the very low percentage of ferrous oxide as follows:—

Ferrous oxide, per cent	0·90
Ferric oxide, "	2·71

No. 550.—This stone is quite similar in structure and grain to No. 547. The colour is a very light shade of the same brownish-red tone: it might be described as pinkish-grey (Plate XLIII, No. 11). The specimen exhibited the same peculiarity of increasing in weight under the corrosion test.

The coefficient of saturation, in this case also, is remarkably low. It will be observed, by reference to the two tables of physical properties, that the red stone is more porous and that the grey stone is harder.

The physical properties are as follows:—

Specific gravity	2·654
Weight per cubic foot, lbs	144·816
Pore space, per cent	12·592
Ratio of absorption, per cent	5·428
Coefficient of saturation, one hour	0·10
" " two hours	0·14
Crushing strength, lbs. per sq. in. (Riehle machine)	15670·
" " wet after freezing	11418·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·00248
Transverse strength, lbs. per sq. in	1542·
Chiselling factor, grams	1·9
Drilling factor, mm	9·6

As in the case of No. 547, the percentage of ferrous oxide is very low.

Ferrous oxide, per cent..................	0·77
Ferric oxide "	1·43

From observations on buildings, from the results of the physical and chemical tests, and from the general appearance of the samples, I cannot but regard these Judique stones as among the very finest in the Maritime Provinces. The greater hardness of these stones is not to be denied, but I believe their attractive and uniform colour, and their promise of great durability, will more than offset this disadvantage.

Little prospecting has been done in this district, but stones of a similar kind are known to occur on the ridge behind Judique, as well as in the gorge at McMillan's: it is a reasonable assumption that a suitable location for the profitable quarrying of these desirable stones could be found in the vicinity.

Ridge east of Port Hood.

The ridge inland from Port Hood is probably a continuation of that at Judique and has yielded a small amount of stone for local construction. Most of the output has been obtained from boulders which are strewn over the hill, but ledges are said to be exposed in places. Two specimens were obtained from this locality, and are described below as Nos. 552 and 553. The former appears to be much more abundant and was employed for the construction of a house in Port Hood 50 years ago. This building shows well the effect of the weather which has brought out green and black stains along the bedding planes of the stone, and, in many places, has produced unsightly stains by the oxidation of included iron pyrites. The general durability of the stone, however, is good, as angles and chisel marks are well preserved. It is noteworthy also that some of the blocks in this building present an attractive, soft, reddish-buff colour without the slightest sign of staining or other deterioration. As far as can be learned, these blocks were obtained locally and must be taken as evidence that a highly desirable stone exists somewhere in the vicinity.

The ridge referred to above stretches to the northward towards Little Mabou, where a church has been constructed from stone quarried locally.

The stone: No. 552.—A medium grained rather feldspathic sandstone of a light yellowish colour: it is rather lighter in colour than any of the samples shown in Plate XLIII. Minute brown specks are to be seen throughout the stone, but they are not of sufficient size to detract from the rather pleasing soft yellowish colour of the sample.

No. 553.—A fine grained, uniform brownish sandstone of excellent appearance and desirable texture: it very closely resembles No. 547 from Judique.

R. McDougall, Port Hood, N.S.

About a mile north of Port Hood, Mr. McDougall has quarried stone from the cliff facing the sea for use in the cribwork of the new bridge being built at Port Hood. Immense quantities of stone can easily be procured along this coast from the sandstones of the Coal Measures, which are disposed in undulating beds interstratified with thin layers of coal. At the point in question the beds dip 20° W.S.W. and are jointed parallel to both strike and dip. Large stone can certainly be obtained, but the exposed coast is not favourable to the erection of a quarrying plant or the construction of a wharf.

The stone: No. 554.—This stone is of medium grain and yellowish colour like No. 552. It appears to contain a large amount of decomposed feldspar, and it is much stained by scattered spots of iron oxide. The specimen was not examined in detail, but I think it would not prove a durable stone either in colour or in resistance to mechanical abrasion.

Summary— Port Hood Area.

In this region a small amount of stone has been obtained for local building: no regular quarry has ever been opened. A stone of yellowish colour and rather variable texture, with a tendency to develop dark stains, is obtained from the Coal Measures near Port Hood. At Judique, however, undeveloped beds of remarkably fine, grey and red stones are met with in the valley of Graham river and on the ridge behind the village. See pages 99, 101.

Prince Edward Island Area.

This province has never played an important role as a producer of building stone, although red sandstones associated with shales have been quarried at several points for local use. Throughout the island, the rock formations belong to the upper Carboniferous age and consist of characteristically red beds. The sandstones are, for the most part, of coarse grain and inferior durability. Further, they frequently occur in thin layers interstratified with shales, which materially increases the cost of extraction. Owing to the slight economic importance of Prince Edward Island stone, it was not thought advisable to visit more than one quarry, although several others, now abandoned, are known to have been opened. The account given below may therefore be considered typical of these red sandstones.

Henry Swan, Charlottetown, P.E.I.

The quarry is situated about two and a half miles from Charlottetown and one quarter of a mile north of the railway: it is opened in the side of a hill which rises about 50 feet above the general level. Stone has been obtained from this quarry for 40 years, but the excavation does not exceed a quarter of an acre in extent. The present face is 50 feet high and presents the following succession of beds:—

10 feet—Soil.
10 feet—Thin and broken stone with some shale and with a rather pronounced band of shale at the bottom.
1 foot—Bed of solid stone.
2 feet, 6 inches—Bed of solid stone.
4 feet—Bed of solid stone.
To bottom—Fairly heavy, but irregular beds.

Many of the thicker beds are divided in places, by minor, horizontal partings, and all of the stone is very readily split into thinner material parallel to the bedding. Blocks from 4 to 5 feet thick, however, can be obtained. The formation is cut by a major series of joints, which occur at intervals of from 4 to 20 feet and strike 20° south of east with a vertical dip. A second, less pronounced and more irregular series crosses the former at right angles. The stone is easily worked by picks and wedges, and it is quarried almost entirely without the use of explosives. Little difference in colour or texture is apparent in the various beds, but the lower stone is said to be harder and more durable. A typical example is described in detail below.

The stone: No. 494.—This stone presents a red colour which is of a different tone from any of the red or brown stones previously described. It might be described as red with a cast of yellow. (Plate XLIV, No. 9).

Under the microscope the mineral grains are seen to consist of quartz and feldspar in the proportion of about two of the former to one of the latter. Some flakes of mica are also present. The grains average about $\frac{1}{6}$ mm. in diameter and are cemented by a considerable amount of reddish, clayey and ferruginous cement, with a small admixture of carbonate of lime.

The pore space is the highest of any of the stones tested; the crushing strength is very low, and the loss of strength on soaking is remarkable. On the other hand, the reduction in the strength of the wet sample by freezing is insignificant. The physical properties are given below: they may be considered typical of a fine grained, highly argillaceous sandstone.

The physical properties are:—

Specific gravity	2·72
Weight per cubic foot, lbs	131·009
Pore space, per cent	22·845
Ratio of absorption, per cent	10·886
Coefficient of saturation, one hour	0·63
" " two hours	0·64

Crushing strength, lbs. per sq. in.........	8126·
" " wet, lbs. per sq. in....	1962·
" " wet after freezing, lbs. per sq. in.........................	1903·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.............	0·0133
Tranverse strength, lbs. per sq. in........	865·
Chiselling factor, grams..................	15·2
Drilling factor, mm....................	41·1

Mr. Leverin found the iron content to be as follows:—

Ferrous oxide, per cent..................	2·06
Ferric oxide "	3·57

The only equipment in the quarry is one horse derrick. Five men are employed. Stone is sold at $1.80 per perch in the quarry, or at $2 per perch delivered in Charlottetown. Examples may be seen in Zion Presbyterian church, in Mr. Beal's residence, in the Connor building, and in the Church of England (Plate XX) in Charlottetown. In all these structures, certain of the blocks are very much more decayed than others. In many cases the deterioration is serious and is due to the presence of soft spots in the stone, which, owing to their clayey nature, are rapidly eaten into by the weather. A carefully selected sample of this stone is to be used for the coat of arms in the monument at Halifax.

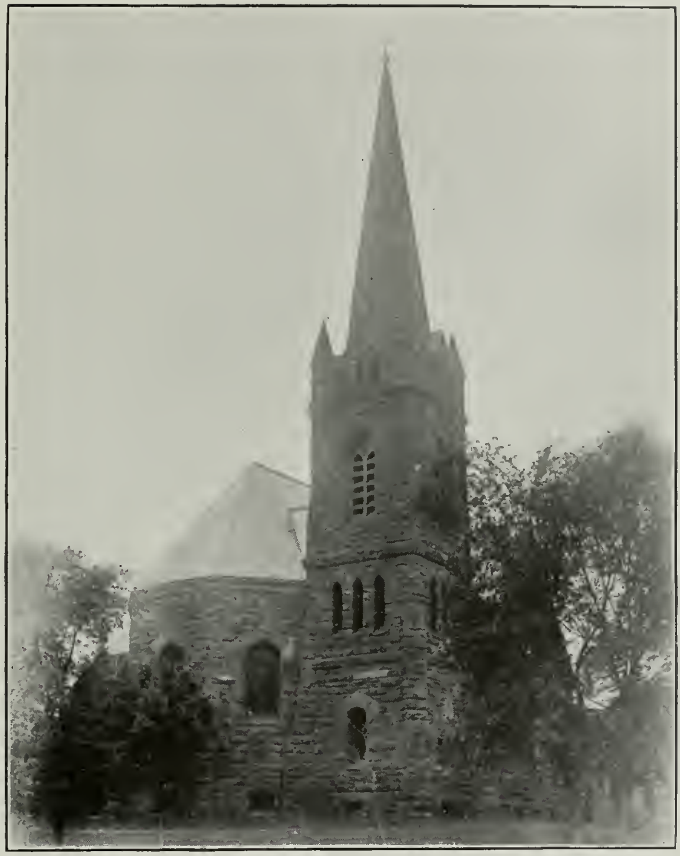
Exposures of stone, somewhat similar to the above, are by no means infrequent in the island, and they have been exploited for local use at many points. The more important quarries of which I have been able to learn are summarized below. None of these are at present producing stone.

(1.) Quarry near Fredericton, 14 miles northward from Charlottetown. The stone is similar to Swan's but it is apparently of better quality. The Bank of Montreal (Plate XXI) is constructed of this stone and shows little deterioration in the four years since it was erected. Perhaps with longer exposure it will not prove more resistant than the Swan stone.

(2.) Stone for the construction of the market house was obtained by Thomas McLean from near the block house at the mouth of the harbour. A regular quarry was not opened and much of the stone had been subjected to the action of the sea. The building presents a very unfortunate appearance, but occasional blocks have well withstood the action of the weather. The serious deterioration in most of the stone may be due, in part at least, to the soaking by salt water.

(3.) Quarry at Cardigan bridge, six miles from Georgetown. The product was a fine grained, red stone, which was used for building and even monumental purposes. It is said that very large blocks were obtained, some of them 12 feet in length. (Lewis quarry).

PLATE XX



Prince Edward Island sandstone. Church of England, Charlottetown, P.E.I.

Prince Edward Island sandstone. Bank of Montreal, Charlottetown, P.E.I.

(4.) Quarry at Glen cove, two miles from Vernon River station. The product was a fine grained, red stone, said to be of a flinty nature: it was employed in railway construction along the Murray Harbour line. (McDonald quarry.)

(5.) Quarry seven miles from Cape Traverse. The product was a fine grained, red sandstone which may be seen in Bell's bridge in the vicinity. This stone is said to be easily cut and to be suitable for fine carving.

(6.) Stone for foundations and rough use has been obtained in many of the ravines in the district around Hunter River station.

Summary—Prince Edward Island Area.

All the stone on the island belongs to the Permo-Carboniferous system: it all presents a red colour and is much interstratified with red shales. Numerous small openings have been made for local buildings, but the only quarry now working is at Charlottetown. The product is a bright red argillaceous sandstone of inferior durability. Most of the stone used on the island is imported.

CHAPTER IV.

Granites.

Extensive masses of granite, more or less suitable for purposes of construction, occur in several areas in both Nova Scotia and New Brunswick. In texture, these granites vary from extremely coarse to very fine grained and in colour from bright red to light grey. Notwithstanding the wide extent of the exposures and the undoubted value of many of the granites, there are only five locations in which stone is being continuously quarried. It must be remembered, however, that there are several other districts in which quarrying operations are carried on from time to time. The important areas in which stone is being quarried at the present time, and the character of the product are briefly indicated below:—

St. George, N.B. Red, pink and light grey, coarse grained, monumental stone.

McAdam Junction, N.B. Coarse, grey stone for building only.

Spoon island, N.B. Pinkish and greyish, medium grained, monumental and building stone.

Nictaux, N.S. Fine grained, grey monumental, and building stone.

Halifax, N.S. Coarse grained to porphyritic, greyish building stone.

For purposes of description it is proposed to treat the subject in the following way:—

New Brunswick:—Bathurst area.
McAdam area.
St. George area.
Spoon Island area.
St. Stephen area.

Nova Scotia:—Nictaux area.
New Germany area.
Shelburne area.
Halifax area.
Guysborough area.
Cape Breton area.

NEW BRUNSWICK.

Several large masses of granite occur along the southwestern boundary of New Brunswick, in Charlotte, York, and Carleton counties: thence they extend north and east and appear as isolated patches on the shore of Chaleur bay. Roughly speaking, we have three more or less distinc belts, of which the more northerly is quarried near Bathurst and constitutes the Bathurst area. The second, or York county belt, is of the greatest extent, but it is not quarried except for the production of building stone, which is broken from the scattered boulders to the northward of McAdam Junction and in the vicinity of Southampton: this constitutes the McAdam area. The more southerly belt, that of Charlotte county, extends across the country to the westward from St. Stephen, and appears in the form of an isolated outcrop on the St. John river near Spoon island. Most of the important quarries are situated on this belt, which may be conveniently divided into three areas—the St. George, the Spoon island, and the St. Stephen.

Bathurst Area.

Granite is exposed at many points a short distance inland from Chaleur bay near Bathurst. This stone was exploited for the construction of bridges and other works along the line of the Intercolonial and the Caraquette and Gulf Shore railways: it has also been employed locally for building purposes. While the stone varies in colour at different points and has been worked in several localities, the only important quarry is that described below, which may be regarded as typical of the area.

Edward Connolly, Bathurst, N.B.

The quarry is situated about one quarter of a mile east of the line of the Intercolonial railway near Nipisiguit junction, four and a half miles south of Bathurst (Fig. 1). About three acres of stone are exposed, on which several shallow openings have been made from time to time. Insufficient work has been done to determine the character of the sheeting, but it appears to be practically horizontal, with an upper layer 8 feet thick in places. The rift is horizontal and the general trend of the major joints is 30° west of south, with a vertical dip: these joints are from 1 to 10 feet apart and are for the most part clean and not accompanied by minor fractures. Cross joints at 30° south of east divide the formation at irregular but usually wide intervals. Large amounts of stone, in any desired size, can be easily quarried with very little waste.

The stone: No. 566.—This granite is of a reddish colour, which is due to the presence of porphyritic crystals of red feldspar. The general mass of the rock is of medium grain, in which the red colour is less pronounced, as shown in Plate XLV, No. 4. On larger surfaces, however, pinkish feldspar crystals from 5 to 15 mm. in length occur at intervals of an inch or less.

Under the microscope, it is seen that this stone is a true granite, as it consists of quartz, orthoclase, and black mica. The orthoclase only shows incipient decay, so that the stone may be regarded as comparatively fresh. The physical properties are as follows:—

Bathurst granite. Roman Catholic church buildings, Bathurst, N.B.

Specific gravity	2·654
Weight per cubic foot, lbs	163·9
Pore space, per cent	0·711
Ratio of absorption, per cent	0·27
Coefficient of saturation, one hour	0·47
" " two hours	0·63
Crushing strength, lbs. per sq. in	28446·
" wet, lbs. per sq. in	27014·
" wet, after freezing, lbs. per sq. in	25005·
Gain on treatment with carbonic acid and oxygen, grams per sq. in	0·00133
Transverse strength, lbs. per sq. in	2149·
Drilling factor, mm	3·3

The more important structures of this stone are the court house and the Roman Catholic church, convent, school and presbytery in Bathurst, and the Victoria bridge over the Nipisiguit river. The appearance of some of these buildings is much injured by the partial use of a differently coloured granite from other sources.

There is no regular production, as stone is quarried only on the receipt of orders. Besides the local consumption, a small amount has been shipped to Chatham and Campbellton.

Mr. Connolly is prepared to furnish rough drilled shoddy at 45 cts. per cubic foot at the quarry.

McAdam Area.

The large area of granite which extends in a northeasterly direction across York county is not worked to any great extent, but a considerable amount of building stone is produced from the boulders scattered over the country, particularly along the line of railway reaching from McAdam Junction northward to Deer lake. Many of the boulders are of large size and yield solid pieces of stone 20 feet in length. The practice of the operators is to select boulders at various places, pay the owners of the land a royalty, cut the stone into blocks, and haul it to the nearest railway siding. The stone is a coarse, grey granite described below as No. 420. In the region immediately north of McAdam, it contains considerable pyrite, the decomposition of which produces unsightly stains, as may be observed in the station building at McAdam. Farther north this objectionable feature is said to be less apparent. Among the more important producers are:—

Joseph Oldham, Southampton.
W. R. Oldham, Southampton.
Joseph McVey, St. Stephen.
Powers and Brewer, Woodstock.

Most of the output is used for building in Woodstock, Canterbury, etc., and a small amount is manufactured into monuments. Statistics are difficult to obtain, as the stone is produced by contractors as occasion demands, rather than by persons devoting their time to the quarrying industry. Joseph McVey has eight stone cutters employed in dressing stone at McAdam Junction. This material may be seen in the Fredericton bridge, the bridge at Pokiok, McAdam Junction station, Woodstock high school, and in banks in St. Stephen.

Charles Perkins, of Woodstock, is holding as quarry land an exposure of granite about twenty-five miles from Woodstock on the line to Fredericton: no work has been done on the outcrop, which is stated to be of the same coarse granite described above.

The stone: No. 420.—This example is a coarse grained, grey granite with white feldspar crystals as great as 25 mm. in length in some instances, although the general grain is somewhat less coarse. The quartz is less abundant than the feldspar and appears dark in contrast to the opaque white of the former mineral. Black mica in much smaller crystals and in relatively small amount makes up the rest of the stone. In general appearance this stone resembles that from Halifax, which is figured in Plate XLV, No. 10.

St. George Area.

The town of St. George, situated at the mouth of the Magaguadavic river, in Charlotte county, must be regarded as the centre of the granite industry in the province of New Brunswick. In the town are several granite mills, and, within a few miles, are the principal quarries in the Province. These quarries are opened on a belt of red granite, not more than a mile wide and generally much narrower, which marks the southern limit of the great granite mass. The quarries are situated along this belt from Lake Utopia westward across the Magaguadavic river for a distance of about six miles: red granite is also quarried about four miles farther west near Bocabec.

While the typical St. George granite is bright red in colour, many different shades are presented by different parts of the belt. Thus, dark red, medium red, light red and salmon coloured varieties are recognized. Passing northward from the red belt, the colour gradually fades to a grey or very lightly tinted pink rock, as exhibited at Bonny river or at Upper Mills.

Red granite was first quarried in this locality in 1872, by a New York company. The quarry was opened on the shore of Lake Utopia, and the first monument consisted of a large cross which may yet be seen in the cemetery at St. George. Although much granite has been produced since the first attempt to work the stone was made, no very extensive opening has ever been formed and no complete quarrying plant installed.

The practice has usually been to quarry from one spot, until some change in colour, the presence of flaws, or the occurrence of excessive fracturing rendered it advisable to open a new hole in some other locality. In this way, a great many small quarries have been developed most of which are now idle. Although steam drills have been employed in the past, the present operations are carried on without the aid of machinery of any kind. The usual practice is as follows:—A hole is sunk by a 2 or $2\frac{1}{2}$ inch bit to a depth of 5 or 6 feet at a convenient distance from the working face; it is then rimmed and is fired with a small charge of powder sufficient to form a crack only. The crevice thus made is charged with a greater amount of powder and the block is driven out. The subsequent squaring and cutting is effected by the ordinary plug and feathers method. It is found that 3 inch plug-holes, placed $4\frac{1}{2}$ inches apart, suffice to break stone of 2 feet or more in thickness.

Throughout the red granite area the stone is much fractured; this is particularly true of the dark red type, in which it is universally found that the difficulty of obtaining large pieces is much greater than in the case of the lighter tinted varieties. It is not to be inferred that no large stone is obtainable in the dark red, but there is so much waste entailed in quarrying suitable blocks that the companies hesitate to accept contracts for large work in the dark red stone.

It cannot be denied that there is a regrettable falling off in the production of stone from this region. In considering this question, it must be noted that it has never been the practice of the owners to ship rough stone, but to employ practically all the product in the mills at St. George. The decrease in production, therefore, is not due to a lessened market for rough stone but to a decline in the demand for finished monuments. This decline is chiefly owing to the birth of manufacturing plants at other centres where other stone is more easily obtained. As there is no outlet for St. George rough stone, the *quarrying* industry has declined with the lessened demand for finished work. It would appear, therefore, that increased activity in quarrying could be obtained by stimulating the trade in rough stone. To this end, the cost of quarrying must be greatly reduced and the facilities for transportation increased. The enormous piles of waste now lying in the old quarries would furnish building stone of the first quality, and a similar use should be made of the smaller and less perfect part of the stone to be quarried in the future. Under the present system, the cost of quarrying, of haulage, and of transportation is quite prohibitive. By a combination of interests, the installation of a modern quarrying plant and the construction of suitable means of transportation to the railways or to tide-water, a new lease of life might be given to the industry. It is encouraging to note that a proposition is on foot to combine the various interests in one company, and that options have been obtained from most of the companies now operating on the belt.

Six granite mills have been erected at St. George, but one of these is now idle. The falls on the Magaguadavic river furnish ample power, which is converted into electrical energy by the St. George Pulp and Paper Co.

In return for the surrender of their water-rights, four of the companies are entitled, under an agreement with the pulp company, to 100 horse power continuously. The equipment of the mills will be briefly described under the individual owners. Rough stone, delivered at the mills, is valued at from $1 to $1.25 per cubic foot. The average value of finished material is about $5 per cubic foot.

The amount of red stone cut in these mills in 1910 was about 9,000 cubic feet, of which rather less than half was of the dark red type. The product was worth approximately $45,000. The amount of New Brunswick "black granite" cut was 1,400 cubic feet, and of grey, about 3,000 cubic feet, having an approximate value of $22,000. To this must be added a considerable amount of imported stone, which would raise the total output to about $75,000 in 1910.

The firms or individuals at present quarrying red granite are as below:—

Milne, Coutts and Co.
Epps, Dodds and Co.
H. McGrattan and Sons.
John Maxwell.
Tayte and Meating.
O'Brien and Baldwin.

Milne, Coutts and Co., St. George, N.B., Charles Johnston, manager.

The quarry property of this company consists of about 1,700 acres, situated between the west shore of Lake Utopia and the road between St. George and Upper Mills on the east side of the Magaguadavic. On Lake Utopia and along the southern and western flanks of the granite, numerous quarries have been opened from time to time. From the quarry on the lake, the stone can be taken by water to St. George; from the other quarries it is hauled by teams a distance of 2 or $2\frac{1}{2}$ miles.

The main ridges of granite run northwest and southeast, but along the southern flank the minor ridges extend about east and west. The opening a little west of the one on the lake shows two sets of joints in an east and west direction, one dipping 60° north and the other 40° south. A set of vertical joints crosses these at right angles. The stone is quarried out in the Vs between the inclined east and west jointing, with the vertical north and south joints for a working face. The stone is of the dark red type and the blocks are mostly small. Larger pieces are occasionally obtained, but the production of large stone cannot be relied on. Two derricks are installed, and four men are now working at this point which is the only location being exploited at present.

A short distance farther to the west, a larger quarry was formerly operated in dark red stone: it was sunk to a depth of 60 feet, but was finally abandoned owing to excessive fracturing, although the sheeting in horizontal layers was favourable to the extraction of good blocks. A hoisting engine and a steam drill were used here: this machinery as well as a derrick and a section of track are still on the property.

The opening next to the west is situated at a higher level and shows four good floors at intervals of about 6 feet. The formation is crossed by a strong series of vertical joints which strike east and west. Much good stone is still available at this point: the opening was abandoned on account of the occurrence of thinner material towards the bottom of the quarry.

Just east of the above is the old Bay of Fundy quarry, and next to that, at a higher level, is a quarry in a light, pinkish grey stone which was quarried for fifteen years. Horizontal sheeting, at intervals of from 2 to 8 feet, divides the stone into convenient thicknesses. The joints are far apart and irregular. Much good stone is still available, but the demand for this colour has fallen off. The stone (410) may be seen in monuments in the Montreal cemeteries.

Between this point and the road are several small quarries: at the angle of the road and at a lower level, is a larger quarry in dark red stone, which was abandoned on account of the flinty nature of the lower stone.

On the easterly aspect of the granite mass and only a short distance from the quarry described above, a quarry of 150 feet by 80 feet, with a face of 20 feet, was formerly worked by steam power in good, red stone. Near here a large quarry in medium red shows good horizontal sheeting and irregular jointing. Large blocks were obtained here and much is still available.

A little farther north is an old quarry 200 feet by 100 feet and 50 feet deep, from which much good stone was obtained. The main joints strike 20° south of east and dip 60° to the north. These main joints are 20 feet apart. A second set runs north and south with a dip of 80° to the east. A third set strikes 60° east of north with a vertical dip. This series is apparently of later origin than the others and it is the most troublesome, as, in places, it cuts the blocks formed by the primary jointing into small and useless pieces. The sheeting is irregular and wavy, at intervals of from 4 to 12 feet. (Plates XXIII and XXIV.).

It will be seen from the above description that a belt of bright red granite extends across the property in an east and west direction, that many openings have been made, and that they have from time to time been abandoned, chiefly on account of excessive fracturing. It will also be noted that at higher levels the stone passes into a lighter red and eventually into a pinkish-grey. It is worthy of remark that here, as elsewhere, the lighter coloured varieties may be obtained in larger pieces than the red.

The stone: Three varieties are recognized, the bright red which is the same as No. 403, page 115, a medium red not essentially different from No. 400, page 120, and a pinkish grey stone described below as No. 410.

No. 410.—This rock is a coarse grained example with feldspar crystals as great as 10 or 12 mm. in diameter: these crystals have a slightly pinkish colour which becomes the characteristic tint of the rock as a whole (Plate XLV, No. 3).

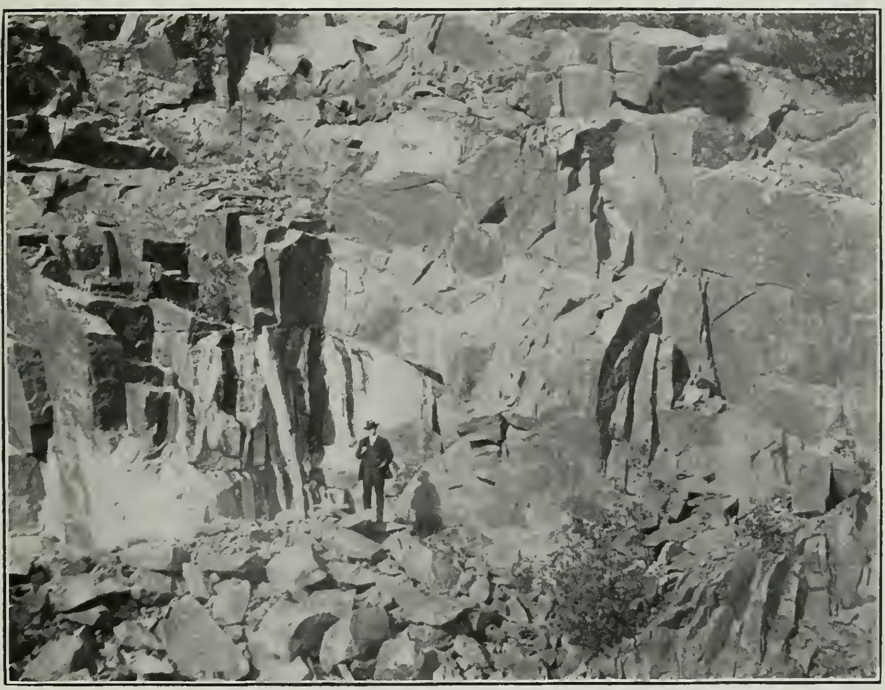
Under the microscope, the feldspar crystals are seen to be rather badly decomposed and to present both varieties—orthoclase as the chief constitutent but with more plagioclase than is usually seen in typical granites. The plagioclase is much less altered than the orthoclase, many of the crystals appearing to be quite fresh. Quartz crystals are rather less abundant than the feldspars and of somewhat smaller size. Small crystals of dark mica (biotite) appear in quite insignificant amount. Owing to the relatively large amount of plagioclase present, the rock is more properly to be classified as a granodiorite than as a granite.

The physical properties are as follows:—

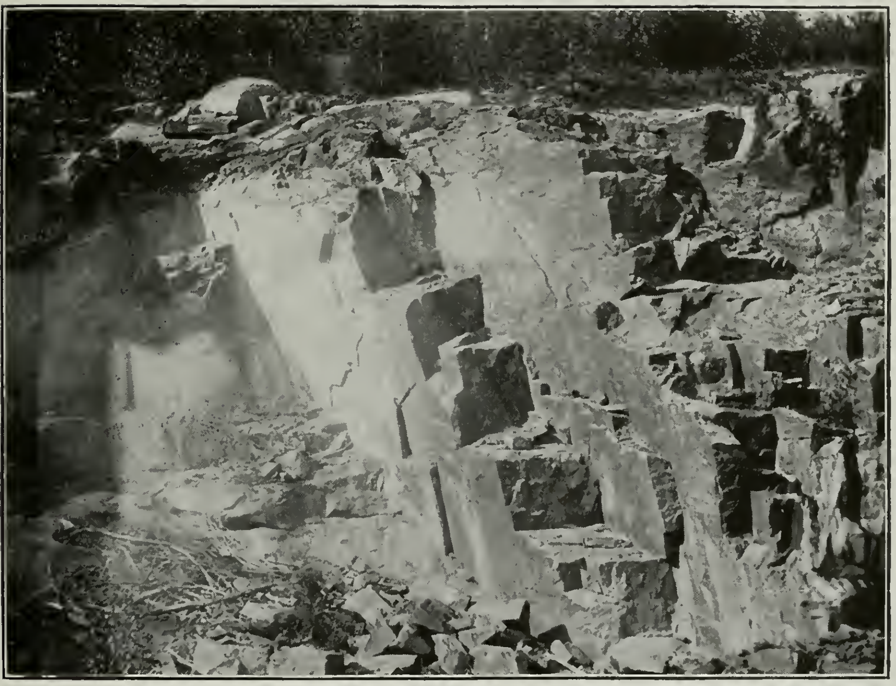
Specific gravity	2·621
Weight per cubic foot, lbs	162·444
Porosity, per cent	0·719
Ratio of absorption, per cent	0·298
Coefficient of saturation, one hour	0·58
" " two hours	0·59
Crushing strength, lbs. per sq. in	31863·
" " wet, lbs. per sq. in	29450·
" " wet after freezing, lbs. per sq. in	24974·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00087
Transverse strength, lbs. per sq. in	2309·
Drilling factor, mm	3·9

The light red stone may be seen in the Banque des Peuples, Montreal, and in the columns of the John Macdonald memorial in the same city. The dark red stone has been largely used for monumental purposes throughout the country.

The mill consists of two buildings, one 275 × 40 feet, and the other 260 × 22 feet, with a yard 40 feet wide between. The yard and one of the mills are equipped with travelling cranes.



St. George granite. Milne and Coutts' quarries, St. George, N.B.



St. George granite. Milne and Coutts' quarries, St. George. N.B.

Electric power, of which about 75 horse power is used, is obtained from the St. George Pulp and Paper Co. under the agreement already referred to. The plant consists of: One compressor delivering air at 80 lbs., Can. Rand Co.,one pneumatic surfacing machine, Trow and Holden, eight polishing machines (Jenny Linds), Union Foundry Co., St. John, N.B. ten stations for pneumatic tools, two plug drills, one cutting lathe, six polishing lathes, one pendulum polisher, five vertical polishers. Twenty-two men are at present employed: stone cutters receive from $2 to $2.75 per day of eight hours and polishers from $1.50 to $1.80 per day.

In 1910, 720 feet of red stone, 300–400 feet of Spoon island grey, and a small amount of black Bocabec stone was cut. This is exclusive of imported stone.

The company pays $1 per cubic foot for red stone, quarried from their own property and delivered at the mill.

Epps, Dodds and Co., St. George.

The quarries of this company are situated between the Magaguadavic river and the road, and consequently lie immediately to the west of the property of Milne, Coutts and Co., and at a lower level. The stone is all dark red and has been quarried from two large and from several small quarries. The larger openings are 150 × 150 feet and are now idle. Derricks and an engine and boiler are on the property.

The stone: No. 403.—All the product of these quarries is dark red, and consists of the dark red stone which is usually regarded as the typical St. George granite. The rock face is shown in Plate XLV, No. 1 , and a polished surface in Plate XXVI.

A microscopic examination shows that this stone does not differ greatly from No. 410 already described. The grain is about the same and the mineral constituents identical; there is, however, a relatively smaller amount of plagioclase. The decomposition is somewhat more advanced than in No. 410, and the stone shows evidence of strain after its formation, for some of the feldspar crystals have been broken across and recemented by deposits of secondary quartz. The mica crystals are small and are frequently aggregated into clusters which are surrounded by chlorite: this is to be interpreted as a further evidence of advancing decay. The pore space is high for a granite and may be regarded as another evidence of the extent to which decomposition has advanced.

The physical properties are as follows:—

Specific gravity	2·614
Weight per cubic foot, lbs	161·51
Pore space, per cent	1·024
Ratio of absorption, per cent	0·396
Coefficient of saturation, one hour	0·46
" " two hours	0·48

Crushing strength, lbs. per sq. in.	27266·
" wet, lbs. per sq. in.	26660·
" wet after freezing, lbs. per sq. in.	19845·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.	0·00083
Transverse strength, lbs. per sq. in.	2479·
Drilling factor, mm.	4·6
Factor of toughness, blows.	8·

As compared with No. 410, it will be noticed that this stone is softer, that it has a lower crushing strength and a higher porosity, but that its coefficient of saturation is lower. We may conclude, therefore, that it is less liable to injury by frost under normal conditions, but that it would disintegrate more easily under mechanical strains as indicated by the severe loss in strength after being frozen. The figures representing the wet and the frozen crushing strengths must not be too literally interpreted either here or in the case of any of the strong stones, for, under the heavy pressure to which they were subjected, the slightest imperfection in bearing produces a result which is much too low. It is always to be remembered that these tests were made on a single specimen, which is in itself unsatisfactory: to prepare a sufficient number of cubes in order to secure a proper average would entail an expenditure of time and money quite out of proportion to the importance of the results, and indeed impossible under the conditions governing the preparation of this report.

The mill is 110 feet by 70 feet and is equipped with the following machinery: one pneumatic surfacer, Trow and Holden, Barre, Vt., one gang-saw, eight stations for pneumatic tools, one compressor, five polishing machines, Union Foundry Co., St. John, N.B., vertical polishers and polishing lathes. About 40 horse power of electrical energy from the pulp company is used. Twenty men are employed.

The company is now purchasing its red stone from individual operators, paying $1.10 per cubic foot for monumental stone up to $2\frac{1}{2}$ tons delivered at the mill. Large stone is delivered at $2, and building stone at 75 cts. per cubic foot.

In this mill the Canadian stone cut in 1910 was as follows:—

Red granite, 792 cubic feet.
Dark grey (Glenley), 592 feet.
Black (Townsend Mt.), 350 feet.
Blue-grey (Spoon island), 109 feet.
Pink (Spoon island), 183 feet.
Dark grey (Quebec), 44 feet.

The management expects a 40 per cent greater output for the present year.

H. McGrattan and Sons, St. George, N.B., J. S. Murray, manager.

The red granite quarries of this firm are situated at two different points, one property adjoining that of Milne and Coutts on the east side of the Magaguadavic, and the other being opened in the parish of St. Patrick, to the eastward of the Digdequash river near its mouth.

The first-mentioned quarry has been extensively worked in the past but it is now idle. The structural features are the same as in the quarries of Milne and Coutts and in those of Epps and Dodds in the same locality. Two types of stone are produced, a light (408) and a dark (407) red variety.

The western quarry produces the light red variety only, in blocks of considerable size. The opening is 75 feet by 50 feet and is 25 feet deep. No stone has been quarried for two years, but it is proposed to resume operations at this point, where the haul to tidewater is short.

The stone: No. 407.—Almost identical with the dark red type described as No. 403: it is possibly of a slightly brighter red.

No. 408.—This example presents a colour intermediate between those shown by Nos. 2 and 3 of Plate XLV. The feldspars are less yellow than those of No. 3 (410) and less red than those of No. 2 (400).

The mill is about 100 feet by 50 feet. The machinery is operated by 30 horse power of electrical energy, at a cost of $20 per horse power per year. The plant comprises: two compressors, delivering air at 80 lbs. pressure, one surfacing machine, five polishing machines (Jenny Linds), one polishing lathe, ten stations for pneumatic tools, one plug drill. From 25 to 50 men are at present employed.

In 1910 the amount of New Brunswick stone cut was as follows:—

Red granite, 2,000 cubic feet.
Grey granite (Spoon island), 800 cubic feet.
"Black" granite, 350 cubic feet.

Charles Young, owner, St. George, N.B., John Maxwell, operator, St. George, N.B.

This property, which consists of about 2,000 acres, is situated near the railway on the west side of the Magaguadavic opposite the quarries of Epps and Dodds. On the west side of the ridge is the old St. John quarry, long since abandoned, and on the east side, facing the river, are several openings at different levels. The upper quarries are in dark red stone, but those opened farther down show lighter red passing into salmon coloured and greyish stone.

In the main upper quarry, which is of crescentic shape and about 100 feet by 100 feet in size with a face of 25 feet, the sheeting is irregularly horizontal and thick. The sheeting planes are as much as 20 feet apart, but limited intervening partings occur. The main joints are north and south with a dip of 75° to the east. A second set strikes east and west with a dip of 80° to the south. Inclined fracturing cuts up the blocks resulting from the major systems of joints. As a result of this shattering, a great amount of waste attends the quarrying of blocks suitable for monumental purposes. The stone is dark red—401.

Below this dark red stone, lighter varieties occur in which quarries have been opened. The sheeting here is domelike in character and the parting planes are more regular, although closer together. The chief opening is 100 feet by 100 feet with a face of about 20 feet. Light red, salmon-coloured and greyish stone is obtained here: it can be quarried in longer pieces than the dark red of the upper quarries. The major joints strike east and west and dip north at an angle of 45°. The other joints are very irregular. Specimen 402 is of average colour: both darker and lighter types occur in this quarry.

The stone : No. 401.—Dark red stone, scarcely to be distinguished from No. 403.

No. 402.—Almost the same as No. 400 (Plate XLV, No. 2): it would be described as a coarse grained pink granite.

The output of this property is about 1,500 cubic feet a year: for average sizes, it is valued at $1 per cubic foot at the quarry.

Tayte, Meating and Co., St. George, N.B., A. R. Tayte, manager, St. George, N.B.

This company owns two properties on the red granite belt. The first consists of 45 acres to the southward of Young's quarry described above, and separated from that property by a strip belonging to Milne and Coutts. The second property is a few miles farther west and adjoins the quarries of O'Brien and Baldwin near Lily lake. The first quarry presents structural features identical with those of Young's, and produces a medium red stone—412. The Lily lake property of 945 acres has been opened in several small quarries which produce a light red stone in large blocks. This stone is identical with No. 400 from the adjoining property of O'Brien and Baldwin described on page 120. A large amount of this stone was used in the Museum of Natural History in New York.

The stone: No. 412.—This example would be described as a light red type intermediate in colour between Nos. 403 and 400 (Plate XLV, Nos. 1 and 2).

The mill consists of one building 115 feet by 40 feet, and of two 23 feet by 60 feet each. The power is obtained from the pulp company as in the case of the other mills: about 40 horse power are used. The equipment consists of the following apparatus: two compressors (one auxiliary), one pneumatic surfacing machine, one column cutter, two polishing lathes, four polishing machines (Jenny Linds), one vertical polishing machine, one pendulum polisher, nine stations for pneumatic tools, one plug drill. Seventeen men are at present employed.

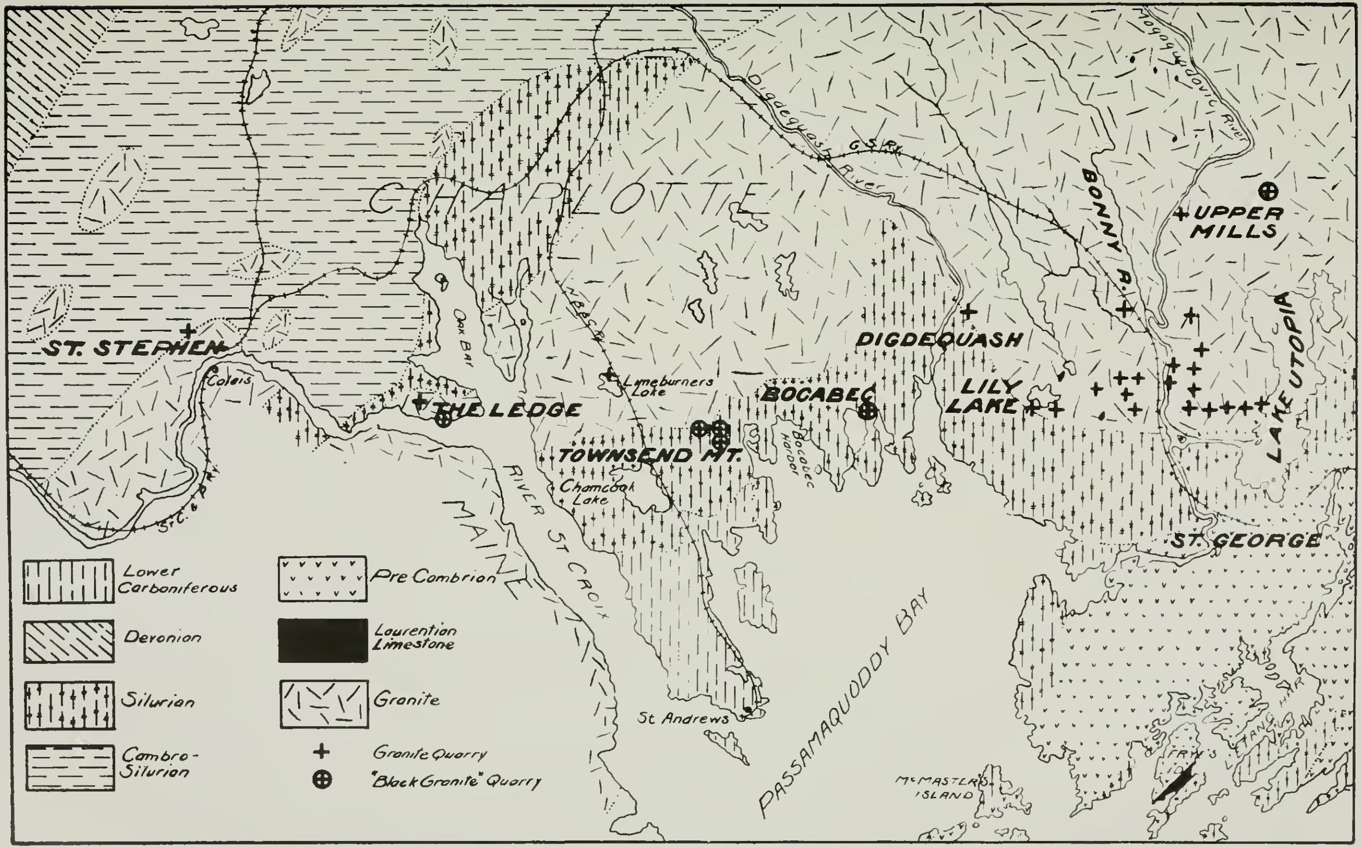


FIG. 5. Sketch map showing the geology and the location of the chief quarries of granite and black granite in Charlotte county, N.B.

Of New Brunswick stone, the following amounts were cut in 1910:—

Bright red	1,600 cubic feet.
Light red	500 "
"Black" granite	100 "
Spoon Island granite	350 "

The undressed dark red stone is valued at $1 per cubic foot at the mill, and the light red at 65 cts. per cubic foot at the mill, or f.o.b. St. George.

O'Brien and Baldwin, St. George, N.B.

The quarry property of 350 acres is situated about four miles west of St. George, to the southward of Lily lake. The opening is 200 feet by 100 feet, with a face of 30 feet. The sheeting is pronounced, with an inclination of 30° to the northwest. The main joints run northeast with a vertical dip, and are of irregular nature with fractured zones at intervals. In a direction at right angles to the major joints very irregular joints with varying inclination are found. Large stone can be obtained from this quarry; pieces were observed 20 feet long by 2 feet by 3 feet. Blocks 5 feet square are frequently quarried. A horizontal rift and vertical grain are feebly developed, whereas, in most of the quarries, the stone does not present any preferential direction of parting. The stone is all of the light red type and is described below as No. 400.

The quarry is equipped with a derrick, track and cars. The long haul to St. George adds considerably to the cost of production, particularly in the case of large stone.

The stone: No. 400.—This example is to be regarded as a light red type: it is shown in Plate XLV, No. 2. The grain is not essestially different from that of the specimens already described in detail. The crystals are perhaps a little smaller and the mica flakes rather larger and more abundant. The decomposition of the feldspar has advanced to a degree comparable with that shown by No. 410.

A comparison of the physical properties with those of the examples previously described shows no remarkable differences. This specimen is more nearly comparable with No. 410 than with the dark red type, No. 403.

Specific gravity	2·626
Weight per cubic foot, lbs	163·086
Pore space, per cent	0·515
Ratio of absorption, per cent	0·197
Coefficient of saturation, one hour	0·58
" " two hours	0·69

Crushing strength, lbs. per sq. in.	30702·
" " wet, lbs. per sq. in.	28068·
" " wet after freezing, lbs. per sq. in.	22582·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.	0·00123
Tranverse strength, lbs. per sq. in.	1910·
Drilling factor, mm	3·
Factor of toughness	8·

The mill is 150 feet by 45 feet and is equipped with the following machinery: three polishing machines (Jenny Linds), two vertical polishers, one cutting lathe, two polishing lathes. About 40 horse power of electrical energy is obtained from the pulp company. There is no pneumatic plant. Twenty men are employed in the mill and six in the quarry.

This mill is engaged chiefly in cutting large work from the light red stone: it is said that from 2,000 to 3,000 cubic feet per year is used. This stone is valued at $1 per cubic foot f.o.b. St. George for blocks up to 15 cubic feet, and at $1.50 per cubic foot for blocks up to 24 cubic feet.

In addition to the light red stone, 200 cubic feet of bright red and 400 cubic feet of Spoon Island stone are used. It is the practice of this company to import its dark stone.

The light red granite may be seen in the columns of the post-office in Owen Sound, Ont. (11 feet by 12 inches), and in the Infant Jesus church in Montreal (16 feet long). The Montcalm monument for Quebec is now being cut from this stone.

Craig and Gilmour, Bonny River, N.B.

This property is situated close to the line of the railway near Bonny River station. The stone is a light grey granite of rather coarse grain: it was formerly extensively quarried for the construction of bridge piers along the Shore Line railway but the quarry has not been worked since the road was built. An unlimited amount of stone is available and the facilities for shipment are excellent.

Thomas McKay, Upper Mills, N.B.

This property is east of the Magaguadavic and south of the road from Upper Mills to Red Rock. The stone is a light grey granite and has been worked to a very slight extent.

Summary—St. George Area.

The region surrounding the town of St. George, in Charlotte county, New Brunswick, must be regarded as the most important producer of granite in the Maritime Provinces. The red granite, for which the region is particularly known, is quarried from a narrow belt which reaches for several miles in an east and west direction to the northward of the town. This red belt forms the southern edge of a much greater mass of granite, from which pink, salmon coloured and grey types of stone are obtained.

The stone is of coarse grain and usually shows considerable decay, particularly in the feldspar crystals. Three general types may be recognized—the bright red, the pink, and the light. Each of these is described in detail in the preceding pages as follows:

Bright red granite, No. 403, page 115.
Pinkish granite, No. 400, page 120.
Light granite, No. 410, page 114.

Numerous quarries have been opened but none of them have reached large dimensions, as they have been abandoned from time to time in favour of new locations. This practice has resulted either from the failure of the red stone or from the occurrence of excessive fracturing.

Nearly all the output is used in the mills in St. George, either for monuments or for decorative architectural purposes. There has been little or no attempt to extend the industry to the quarrying and shipping of stone in the rough.

Five firms operate mills in St. George and cut about 9,000 cubic feet of the local granite per annum. In addition to this, there is consumed a considerable amount of Spoon Island granite, and of the black and grey stone from Bocabec as well as imported material.

Spoon Island Area.

Granite quarrries have been worked for many years on the west side of the St. John river about two miles south of Hampstead (Fig. 6). The granite mass in which the quarries are located is an easterly outlier of the greater area in which the St. George quarries are worked. At the present time only one company is producing stone, but other properties have been worked in the past. Two types of stone are produced—a pinkish variety known as ''Gypsy Mountain stone,"and a grey variety known as ''blue monumental". Both of these stones are commonly referred to as ''Spoon Island stone", although the quarries are not on Spoon island but on the hillside to the west of the island.

D. Mooney and Sons, St. John, N.B., F. E. Walton, manager, Hampstead, N.B.

The property consists of 900 acres situated about two miles south of Hampstead on the St. John river. Two quarries are worked: one producing the so-called ''Gypsy Mountain'' stone and the other the "blue monumental."

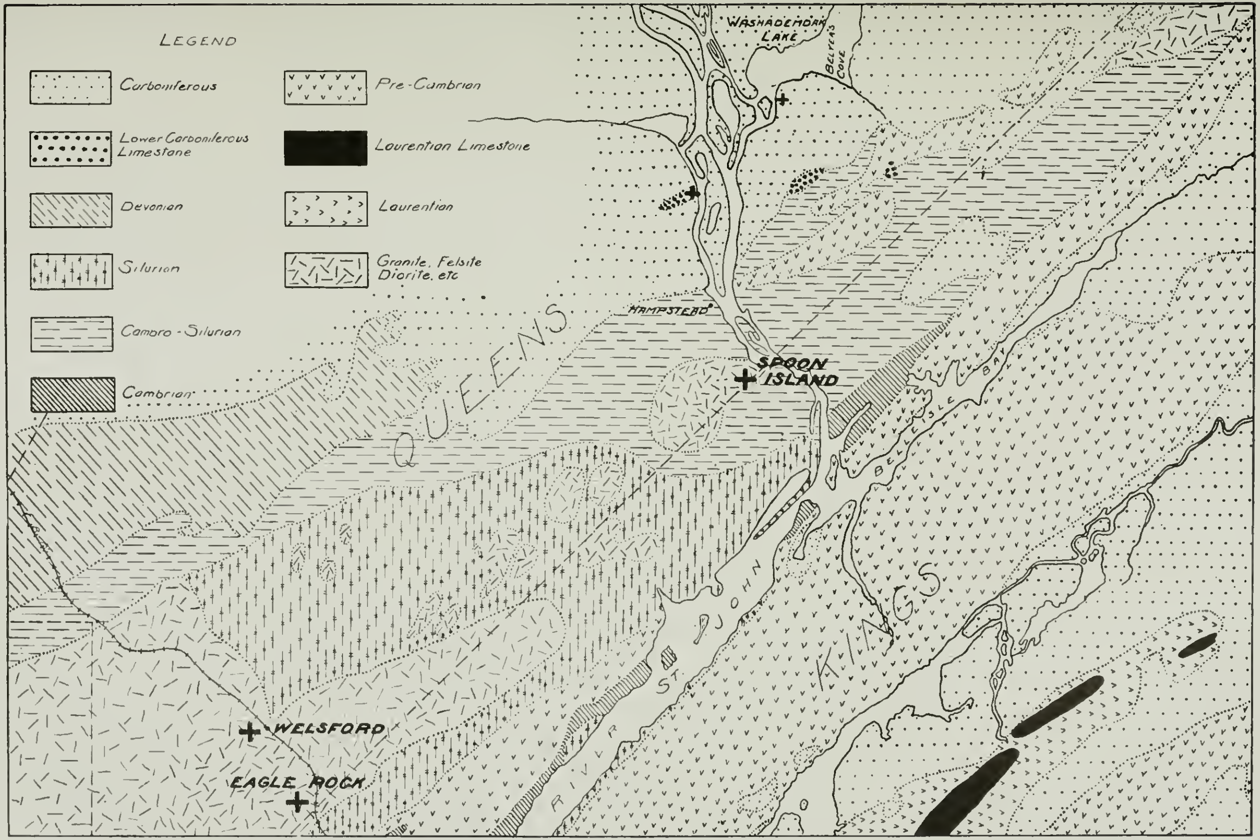


Fig. 6. Sketch map showing the geology and the location of granite quarries in the region about Spoon island, in the St. John river, New Brunswick.

The first quarry is opened in the side of the hill near the top for a distance of 300 feet: it presents a width of 50 feet and a face of 50 feet in height. The sheeting is horizontal and discontinuous, the planes of parting being, in some places, 20 feet apart. The main joints run with the ridge in a northeast and southwest direction, with a dip of 80° to the southeast: these partings are from 10 to 20 feet apart. A minor set of joints strikes east and west with a dip of 80° to the north, and a third set cuts the formation 40° west of north with a vertical dip. These two latter sets are variable and are irregularly developed. The rift is horizontal and the grain vertical in a northeast direction. Some black knots are present but much of the stone is free from these blemishes—430. (Plate XXV.)

The second quarry is about a quarter of a mile from the above, in a southeast direction, and has been worked over a space 300 by 400 feet in extent to an average depth of 25 feet. Indiscriminate use of explosives by former operatives have left an uneven and much shattered floor, but Mr. Mooney is now engaged in operations which will remove the waste material, clean up the quarry, establish an even floor at a lower level, and increase the height of the working face. The sheeting is wavy-horizontal and discontinuous, with the planes from 2 to 8 feet apart.

The major set of joints strikes 12° west of north with a vertical dip: they are from 8 to 20 feet apart. The second set of joints runs at 60° east of north and the partings are very irregularly spaced. The rift is horizontal and the grain vertical, in an east and west direction. Neither the rift nor the grain is very pronounced, but the stone splits smooth with facility —431.

Quarrying is effected by single holes, usually at an average distance of 10 feet back from the face. These holes are drilled with $2\frac{1}{2}$ inch bits for starters and are finished with $2\frac{1}{8}$ inch bits. After rimming, they are fired with about a pound of black powder, to produce a crack. The crack is then charged with several pounds of powder and the loosened block driven from the face.

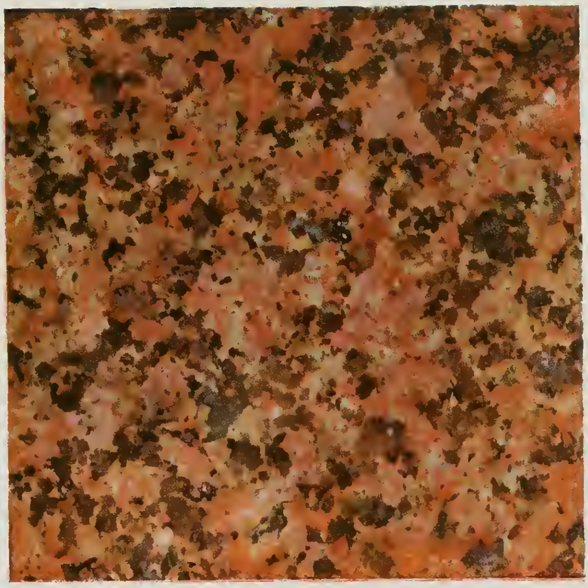
The stone: No. 430.—This stone is represented in Plate XLV, No. 5, and in Plate XXX[1]. It is a medium grained granite, with the feldspar crystals averaging about 4 mm. in diameter. These crystals are of two colours, pink and white, which give a unique appearance to the specimen, and renders the stone easy of indentification. Quartz is present in less amount than the feldspar and occurs in much smaller crystals. Black mica and some hornblende make up the rest of the stone: these dark minerals are present in greater relative abundance than in the case of the St. George granite.

The physical characteristics as given below are strikingly similar to those of No. 431 in most respects, although the grain of the two stones is different:—

[1]The considerable difference in the two plates is due to the effect of polishing, as all the figures of Plate XLV are rock face, while Plate XXX is from the polished surface.

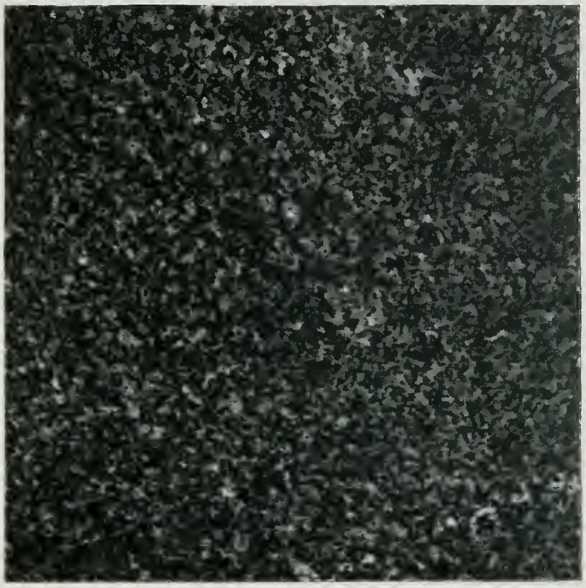
Spoon Island granite. Gypsy Mountain quarry, near Hampstead, N.B.

PLATE XXVI



ST. GEORGE RED GRANITE.

Plate XXVII.



BOCABEC BLACK GRANITE.

Specific gravity	2·698
Weight per cubic foot, lbs	167·642
Pore space, per cent	0·466
Ratio of absorption, per cent	0·173
Coefficient of saturation, one hour	0·71
" " two hours	0·71
Crushing strength, lbs. per sq. in	35063·
" " wet, lbs. per sq. in	32082·
" " wet after freezing, lbs. per sq. in	28614·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00161
Transverse strength, lbs. per sq. in	2331·
Drilling factor, mm	3·1

No. 431.—This stone resembles No. 430 in a general way, but the grain is much finer and there is less of the red feldspar present: it is shown in Plate XLV, No. 6. This figure is too small to convey a strict impression of the stone, as there are scattered throughout the mass a considerable number of much larger feldspar crystals, which give a different general effect to the surface.

Under the microscope the grains of feldspar do not exceed 2 mm. in diameter, always excepting the large scattered crystals referred to above. The feldspars are in an advanced state of decay and the whole section has a dirty appearance indicative of decomposition. The quartz crystals are less abundant than the feldspars and of smaller size. The rather abundant black mica also shows considerable decomposition. The high drilling factor of this stone is to be accounted for by its fine grain and the decomposed condition of the feldspar crystals.

Specific gravity	2·699
Weight per cubic foot, lbs	167·786
Pore space, per cent	6·435
Ratio of absorption, per cent	0·128
Coefficient of saturation, one hour	0·67
" " two hours	0·71
Crushing strength, lbs. per cubic foot	34993·
" " dry after freezing	30700·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00225
Transverse strength, lbs. per sq. in	2655·
Drilling factor, mm	5·0
Factor of toughness, blows	12·

The equipment consists of the following appliances: six derricks—five in quarries and one at wharf, one 30 horse power engine and boiler, one 40 horse power engine and boiler, one steam drill, two compressors, six pneumatic plug drills, a quantity of rails and a number of cars, two blacksmith shops, a boarding house and other buildings. Thirty men are at present employed.

The stone is hauled to the wharf, a distance of about a quarter of a mile.

The output is used for monuments, for monument bases, for building, and for paving blocks.

Last year's production was about 600 tons, but it is estimated that 6,000 tons will be handled during 1911, of which about 400 tons will be of monumental character. Prices kindly furnished by the management are as below:—

Monumental, 75 cts. per cubic foot, f.o.b. scows.

Rough shoddy, $8 per cubic yard "

Rubble, $5 per cubic yard "

Pavement blocks (6 × 4 × 9—12 inches), $78 per thousand delivered in St. John.

Pavement blocks (4 × 10 × 4), $68 per thousand delivered in St. John.

Spoon Island stone has been largely used throughout New Brunswick: good examples may be seen in the Tilley and in the Champlain monuments in St. John.

Appleby quarry.

This property adjoins that just described: at one time, it was extensively worked. The main opening is 200 by 100 feet and shows excellent horizontal sheeting with the parting planes from 4 to 6 feet apart. The major jointing is 20° west of north with a dip of 85° to the west: these joints are as much as 20 feet apart in most parts of the quarry. A second series of joints is less regularly developed in an east and west direction. Stone 20 feet in length can be readily obtained.

The stone: No. 432.—This example is almost identical with No. 431 described above: it is perhaps a little more uniform in structure but the difference is so slight as to be negligible.

An old derrick is still standing and the rails remain of a gravity tramway, by means of which the stone was conveyed to the wharf.

The lower beds show excellent dark-coloured stone which could be easily worked without undue expense.

Summary—Spoon Island Area.

Granite has been quarried for many years on the hillside to the west of the St. John river opposite Spoon island. The product is of two kinds —a medium grained pink and grey stone, and a darker greyish type. The former of these is known as "Gypsy Mountain stone," and the latter as "blue monumental." D. Mooney and Sons of St. John are at present quarrying both types of stone for use as building and monumental material.

They are also creating a paving stone industry in order to utilize the waste material. These quarries are very favourably situated, as the stone can be readily loaded into scows on the river. The company expects to quarry 6,000 tons of stone during 1911.

St. Stephen Area.

Three quarries of grey granite are from time to time worked in the vicinity of St. Stephen, in Charlotte county. Two of these quarries are situated at the Ledge near Oak point, about four miles east of the town. The second locality is at the Little Ridge, which lies to the northwest of St. Stephen, at a distance of about two miles.

Alfred Price, St. Stephen, N.B.

The more important quarry at the Ledge and the one at the Little Ridge are worked under lease by Mr. Price.

The former quarry is situated at Browns mountain on the property of William Avery. The sheeting is pronounced and conforms to the dome-like shape of the hill. At the quarry, the inclination is 15° towards the river, the upper sheet is 8 feet thick and the lower one 2 feet thick. The main joints are vertical and strike northwest at intervals of from 10 to 25 feet. Joints in the opposite direction are so few and so far apart as to be negligible. In other parts of the property the joints run 10° west of north and are somewhat closer together. The stone is of uniform colour and texture: while free from knots, it shows occasional veinlets—No. 414. As the quarry is situated at a reasonable elevation, within a quarter of a mile of tidewater, and as blocks of any desired size can be quarried with facility, this property should become a large producer in the future.

The quarrying has been done in a very crude manner and without the use of proper appliances, so that the cost of extraction can scarcely be said to have been determined. Nevertheless, this stone can be quarried and delivered in St. Stephen at 75 cts. per cubic foot: it is employed for buildings and for monument bases. Mr. Price produces about 700 cubic feet a year. With a gravity tramway to the water and a proper quarrying plant, this stone could be very cheaply produced.

A short distance farther south, on the property of Charles Jones, Mr. Price has made other openings. The floors are horizontal and undulating and sufficiently far apart to permit the obtaining of large stone. The main joints strike 40° east of north and are far apart. Another set strikes 22° south of east and is accompanied by minor fracturing. The stone is rather less pinkish than that at the upper quarry, and it containes a few black knots. This material splits with great facility; plug holes, 8 inches apart, suffice for the breaking of two-foot stone with a flat even surface—416.

The Little Ridge quarry is about two and a half miles from St. Stephen on the road to Scotch ridge. A large exposure of grey granite occurs here on the property of William Nixon. The stone hitherto obtained was cut from large boulders, but it is proposed to open on the ledge itself. The main joints are vertical and strike 40° west of south; they occur at intervals varying from 18 inches to several feet. The sheeting conforms to the ridge and is not excessive. Some black knots appear, and, in some parts, the stone is badly cut up by quartz stringers. The rift is horizontal and the grain vertical at 40° west of south. The average stone is described as No. 417. In some parts, a spotted type (418) is seen. About 60 cubic feet were quarried in 1910, the first work having been done in 1909.

The stone: No. 414.—This is a coarse grained, greyish granite with a slight cast of pink. The feldspar crystals are sometimes 15 mm. long and average more than 5 mm. Quartz crystals of smaller size are present to about one-third the amount of the feldspar. The third constituent is black mica, which is only sparingly present in small crystals. Both the grain and the colour are quite uniform throughout large blocks.

No. 416.—This stone is not essentially different from No. 414 already described. The grain is somewhat finer and the quartz crystals are smaller and aggregated into clusters, which gives the broken surface a slightly different appearance, which might be described as less "clean."

No. 417.—This stone is a handsome, fine grained, grey granite, so closely resembling the stone from Shelburne, N.S., which is described in detail on page 137 as No. 478, that no further remarks are necessary. The reader is referred to the description there given, and to No. 9, Plate XLV, as sufficiently indicative of the present example. It is to be noted, however, that the large glistening spots so characteristic of the Shelburne stone are not observed in the Little Ridge granite.

No. 418.—This stone is like No. 417, but it presents a much finer grain. The individual crystals would not average more than half the size of those of No. 417. The spots referred to in the general description are due to the aggregation of the mica crystals into small knots. These knots are about 5 mm. in diameter, and they are not very conspicuous as the mica is of a light colour. On weathered surfaces, however, they are somewhat more apparent, owing to a darkening which they undergo. Despite this slight imperfection, we must regard this stone as a highly desirable one, on account of its true grey colour and the exceeding fineness of the grain. In this latter respect it surpasses any other stone examined for this report.

These stones are valued at $1 per cubic foot, f.o.b. St. Stephen.

Levi Macpherson, St. Stephen, N. B.

This quarry is near that of Mr. Price at the Ledge: it is situated at a lower level and has produced a considerable amount of stone, which has been chiefly used for curbing. Last year the production was not more than

50 tons but two years ago nearly 1,000 tons were raised. The stone is essentially the same as that at Price's upper quarry at the Ledge.

Summary—St. Stephen Area.

Granite has been quarried at the ledge to the east of St. Stephen, and at the Little Ridge to the west of the town. The Ledge stone is a rather coarse grained, greyish type, which has been employed chiefly for curb stones, although some monument bases and building blocks have been prepared from it. The quarries are very favourably situated for shipment.

The Little Ridge stone is of a much finer type and is adapted to the manufacture of monuments: in many ways, it closely resembles the Shelburne granite from Nova Scotia. Alfred Price is the only producer at present: the total output is inconsiderable, now, but formerly a much larger amount of the Ledge stone was quarried.

NOVA SCOTIA.

Extensive areas of granite occur at many places along the Atlantic seaboard of the Province. Westward from Halifax, a great mass of granite stretches in a crescentic form through parts of Halifax, Lunenburg, Kings, Annapolis, Digby, and Yarmouth counties. Smaller areas occur south of the western horn of this crescent, in Yarmouth and Shelburne. In these masses, the granite has been quarried more particularly at Nictaux in Annapolis, northward from New Germany in Lunenburg, near Shelburne in Shelburne, and in the vicinity of the city of Halifax. The following economic areas are therefore recognized in western Nova Scotia:—

Nictaux area.
New Germany area.
Shelburne area.
Halifax area.

Eastward from Halifax, the granite masses are of smaller extent, but about a dozen distinct occurrences are known between Halifax and Cape Canso. As far as I could learn, there is no production of granite in this district: one quarry, however, was worked for a short time near White Head in Guysborough.

In Cape Breton there is no production of granite, but an exceedingly tough stone was formerly quarried for road metal near Barrachois in Cape Breton county.

Nictaux Area.

Near the village of West Nictaux, a short distance from Middleton at the junction of the Central railway with the Dominion Atlantic, is an extensive exposure of fine grained grey granite, which has earned a deserved reputation as a monumental stone. At this point, three firms have opened quarries within a short distance of each other:—

The Middleton Granite and Marble Co. (Hoyt and Reed).
Thelbert Rice, S. Williamston, N.S.
John Cline, Halifax, N.S.

The Middleton Granite and Marble Co., (Hoyt and Reed), Middleton, N. S.

The quarry is opened in the side of a ridge of slight elevation which is practically free from any overburden. The sheeting is thick with only one floor yet exposed; this plane strikes 15° east of north and dips 25° to the eastward and constitutes the present floor of the quarry, which at the eastern end presents a face of 20 feet down to this plane. Above this well defined sheeting plane, some horizontal cracks of secondary origin have assisted in quarrying operations. The main joints are vertical and variable in direction cutting the formation at from 75° to 100° east of north. In some places these partings are close together and cause the waste of considerable stone; but in the quarry proper they are widely spaced and constitute the successive working faces as the operations advance. A second, rather pronounced set of partings occurs at 20° east of north, while a third irregular series runs at 50° east of north. On the whole, the jointing is irregular, and in certain zones it is excessive; nevertheless, selected sections of the outcrop are capable of yielding large stone. There is little doubt that the minor fracturing would diminish with deeper working.

The stone: No. 482.—This stone is a medium to fine grained, grey granite, presenting a slight cast of red in the quartz crystals: the rock face is shown in Plate XLV, No. 8, and a polished surface in Plate XXXI.

Under the microscope, it is seen that this rock, like nearly all the so-called granites from the Maritime Provinces, is a grano-diorite, or quartz mica diorite, as the feldspars of the plagioclase class are more numerous than the orthoclase crystals. In this stone the individual crystals of plagioclase are sometimes two or three millimetres long, but the general average is much less. These crystals, for the most part, are in an excellent state of preservation and frequently present distinct zonal structure. The orthoclase is much less abundant and it is usually more decayed than the plagioclase. Quartz occurs in less amount than the feldspar, and brownish mica in flakes up to four mm. in diameter is fairly well distributed through the rock. On the whole, this stone is in an excellent state of preservation and should prove a very durable material. It is interesting to note how closely the microscopic examination agrees with the results of the physical tests; for the crushing strength of dry, wet, and frozen samples is practically the same. The similar but more decomposed material from the other quarry at Nictaux shows a corresponding decline in the power of resistance.

Granite quarry, Nictaux, Annapolis county, N.S.

The physical properties are:—

Specific gravity	2·695
Weight per cubic foot, lbs	167·628
Pore space, per cent	0·368
Ratio of absorption, per cent	0·137
Coefficient of saturation, one hour	0·57
" " two hours	0·68
Crushing strength, lbs. per sq. in	34058·
" wet, lbs. per sq. in	34300·
" wet after freezing, lbs. per sq. in	34000·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00081
Transverse strength, lbs. per sq. in.	3572·
Drilling factor, mm	4·2

Quarrying is carried on in a small way by hand work, advantage being taken ot the rift which is vertical at 75° east of north. The grain of the rock, according to the foreman in charge, is parallel to the "lift" (sheeting).

Three men are now employed in the quarry. Two hundred and seventy-five tons of building and monumental stone were quarried in 1910.

The following prices are quoted:—

Rough blocks, monumental, $1 per cubic foot, f.o.b. cars.

Dimension blocks, monumental, $1.10—$1.25 per cubic foot, f.o.b. cars.

Sills, two brick, rock face, hammered top and bottom, $1 to $1.25 per running foot.

The stone may be seen in the Methodist church, Annapolis; the Sir John Thompson monument, Halifax, and in the Bentley buildings, Middleton: it has also been largely used for cemetery work throughout the Maritime Provinces. (Plate XXXVI.)

The company operates a small mill in Middleton in which Nictaux stone is almost exclusively used. The building is 28 by 38 feet with an L 10 by 12 feet: it is equipped with one polishing machine operated by a gasoline engine. Eight men are employed. It is the intention of the company to extend the mill and to install a pneumatic plant.

John Cline, Halifax, N. S.

Mr. Cline operates a quarry immediately to the north of that described above. The surface of the outcrop, as exposed on this property, shows a considerable amount of close set jointing which cuts the formation in a direction a little south of east. Almost at right angles to this major set, is a minor series of joints which are less pronounced. The ill effect of the closeness of these parting planes is in some measure offset by the fact that they are more or less confined to zones, so that by a careful selection of the place of operation they may be avoided. In an extended quarry, however, such severe fracturing must occasion a large amount of waste.

In the actual quarry, which is of small extent, a further breaking of the formation is shown by irregularly inclined planes striking 20° west of north and dipping 55° to the southwest. Notwithstanding these various systems of joints some large blocks can be obtained: pieces 10 feet in length were observed in the quarry.

No work was being done on the property at the time of my visit, but it cannot be said that the quarry is abandoned, as Mr. Cline obtains stone from time to time as orders are received. The product is valued at $1 per cubic foot in Halifax.

The stone: The product of this quarry is exactly the same as No. 482 already described.

Thelbert Rice, S. Williamston, N. S.

This property of 5 acres is situated on the opposite side of the road from those described above, at a distance of almost a half-mile and at a lower level. The exposure of granite forms a hill running 40° west of south and rising 25 or 30 feet above the general level of the country. The main joints run with the hill and dip 85° southeast into the face of the exposure. The major joints appear to be from 4 to 10 feet apart, but there has been too little work done to justify exact statements in this regard. A second, ill-defined set of joints cuts the major series at right angles. Sheeting planes cannot be made out with any certainty. Two small openings have been made and surface stone has been removed at several places. In the north opening the major joints are, in places, accompanied by parallel partings, causing a considerable waste of stone. Irregular inclined joints also appear. Large blocks are obtainable, but here, as in the quarries south of the road, extensive quarrying operations would doubtless result in the production of much waste material. (Plate XXVIII.)

The stone: Throughout the exposure, the stone is of even and uniform grain and is free from any imperfections except an occasional small black knot.

No. 483.—This stone is represented in Plate XLV, No. 7. On the rock-face there is little difference from No. 482, but the polished specimen shows a slightly greenish tone instead of the pinkish effect of No. 482. The general grain of the two stones is identical. Under the microscope the present example is seen to be distinctly less fresh than the specimen from the Middleton quarries. It would be unfair to conclude that the whole product of this company is in a less satisfactory condition in this respect, but rather that the stone on different parts of the range varies in the freshness of the ingredients. It will be noted that the greater decomposition in the feldspars tends to lower the strength of the wet stone

Granite mill, Thelbert Rice, Nictaux, N.S.

Plate XXX.

SPOON ISLAND GRANITE.

Plate XXXI.

NICTAUX GRANITE.

as compared with the dry, rather than to increase the effect of the freezing test: this is not in accord with the observations on the St. George granites.

The physical properties are as follows:—

Specific gravity	2·692
Weight per cubic foot, lbs	167·503
Pore space, per cent	0·326
Ratio of absorption, per cent	0·137
Coefficient of saturation, one hour	0·47
" " two hours	0·60
Crushing strength, lbs. per sq. in	32607·
" " wet, lbs. per sq. in..	28050·
" " wet after freezing, lbs. per sq. in	27588·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·000
Drilling factor	3·6

The slightly lower drilling factor of this stone as compared with No. 482 was not to be expected. I am inclined to think that the difference, which is very slight, might be disregarded.

The following equipment is installed on the property:—Mill, 50 feet by 25 feet, (Plate XXIX), one engine and boiler, 50 horse power, New England Machine Co., Boston, one compressor, Canadian Rand, one surfacing machine, Livingston Mfg. Co., Rockland, Me., two hand derricks, one pneumatic plug drill, one rock drill, Canadian Rand. The product of about 250 tons a year is nearly all used for monumental purposes. Six men in all are at present working on the property.

Summary—Nictaux Area.

Near the village of West Nictaux, in Annapolis county, a considerable area of fine grained, grey granite is exposed. Three firms are at present engaged in quarrying operations, The Middleton Granite and Marble Company, Thelbert Rice, and John Cline.

The Middleton Company and Thelbert Rice also operate mills, the former in Middleton and the latter at the quarry. Mr. Cline ships his output to Halifax in the rough.

The stone is a fine grained grey granite, showing in places a slight cast of red: it varies somewhat in the freshness of the constituent minerals, but the better examples are in an excellent state of preservation. The polished face is shown in Plate XXXI.

Most of the product is used for monumental work for which purpose it is well suited. A less amount is used for building.

The general appearance and the durability of the stone are of high order. The most serious obstacle in the way of extended development is the rather excessive jointing of the formation.

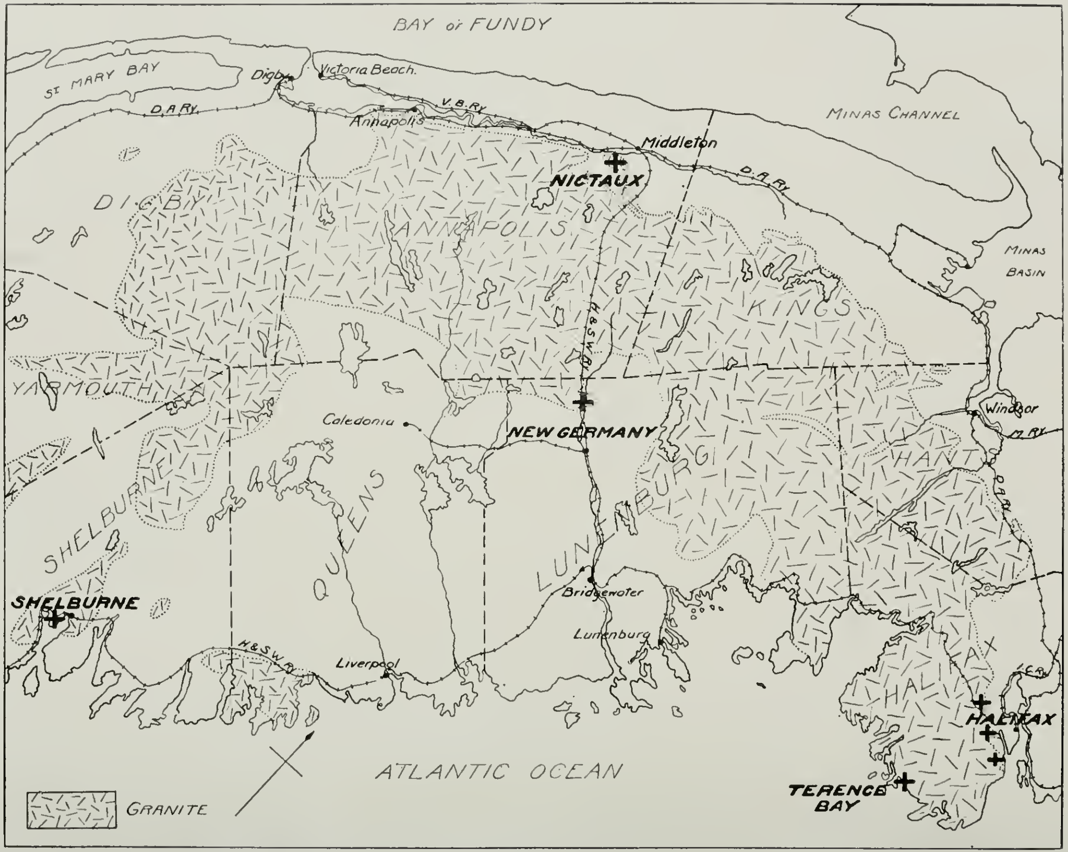


Fig. 7. Sketch map of southwestern Nova Scotia showing the granite areas and the location of the chief granite quarries.

New Germany Area.

The line of the Central railway of Nova Scotia north of Bridgewater crosses a large area of granite, which has been exploited to a small extent in the vicinity of New Germany. The rock is coarse and porphyritic and has been employed chiefly in railroad construction. The most important work was done at a point about four miles north of New Germany, on the property of J. J. Meisener. Another opening about a mile south of the above is on the land of C. O. Foss, and a third, about a mile west of Meisener's, was opened on the property of Elias Wentzel, West Northfield P.O.

J. J. Meisener, Meisener, N.S.

The quarry is close to the railway, on the east side, four miles north of New Germany. The rock is exposed over a considerable area, and stone has been taken from several places without the development of a regular quarry. As only the top stone has been removed the character of the sheeting is not revealed, but it appears to be thick and but slightly inclined. The formation is solid, with widely spaced main joints running 75° east of north. A less defined set cuts the main series at right angles, so that large stone can easily be obtained without undue waste.

The stone: The general run of the quarry is coarse and grey, and in places it is highly porphyritic, with feldspar crystals of more than 2 inches in length. Inclusions of finer grain and of both a lighter and of a darker colour appear in places, and are so closely aggregated that, with the large porphyritic crystals, the whole mass takes the appearance of a conglomerate when viewed from a little distance. The finer material is described in detail below.

No. 480.—The finer grained portions of this stone are scarcely distinguishable from the Nictaux stone represented in Plate XLV, No. 7. White feldspar, slightly brownish quartz, and glistening black mica make up the bulk of the rock. In spite of this similarity, the two stones are not comparable in appearance for the present example is never free from large crystals of feldspar and knots of mica. Many of the feldspars reach the large dimensions given above: even in the finer parts of the stone these crystals are as great as 10 mm. in diameter and occur at intervals of one or two inches over the whole of the surface. The knots of mica are less frequent and are usually about a half-inch in diameter. A considerable amount of bright red garnet is frequently to be seen in these black knots. The physical properties are probably very similar to those of the Nictaux stones.

The product of this quarry is 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 Caledonia bridge, and in the La Have bridge at Bridgewater.

Elias Wentzel, W. Northfield, N.S.

This quarry known locally as the Cliff is situated at a higher level than Meisener's and about a mile to the westward. No stone has been quarried for years, but formerly a small quantity was hauled to the railway and was used for bridges and also for foundations. The stone is somewhat finer in grain than Meisener's and has a reddish cast. The quarry was not visited, but large amounts of material are said to be easily obtainable.

The stone: No. 481.—This is a medium grained granite resembling No. 480 but presenting a less porphyritic structure. The general grain is coarser than that of No. 480, but the absence of the large porphyritic feldspars renders the stone more uniform in character.

Shelburne Area.

Granite is exposed for several miles along the west side of Shelburne harbour where quarries have been opened by the Shelburne Granite Co. North of this property, quarry lands are held by Winslow McKay: the same type of granite outcrops still farther north on the military lands of the Federal Government.

The Shelburne Granite Co., R. O. Cheney, president, Manchester, N.Y., T. Howland White, manager, Shelburne, N.S.

This quarry is situated on the shore of Shelburne harbour about a mile and a half from the village on the opposite (west) side. The opening is about 100 feet long and has been worked back into the hillside about 20 feet. The present face is 25 feet high at one end and 12 feet high at the other. At the higher end the stone comes to the surface, but at the lower end it is covered by 12 feet of debris. The strike of the sheeting is 30° south of west and the dip 25° to the northwest. The upper sheet is about 10 feet thick and the lower sheet 25 or 30 feet in thickness. The lower parting plane forms the floor of the quarry, which has been opened along the strike. This lower plane has a higher dip, averaging 35°. The main joints are approximately parallel to the strike of the sheeting, with a dip of 65° to the northwest. The interval between them varies from 1 to 6 or 8 feet. A second set strikes 30° north of west with a vertical dip and with a greater variation in the interval between the joints. In addition to these two sets, many other irregular partings occur, particularly an ill-defined series striking 30° west of north and dipping 80° to the east. On the whole, it must be admitted that the formation is badly cut up, but as only superficial work has been done, it is a reasonable assumption that many of the minor partings would disappear with more extensive development. Blocks 2 feet square and 6 feet long have been obtained,

Shelburne granite. Post-office, Shelburne, N.S.

but, in the present condition of the quarry, such material can be obtained only by the removal of a large amount of waste and smaller stone. The rift seems to coincide with the first mentioned set of joints. The stone is of an excellent uniform texture, without stains and with only an occasional knot: large pieces are obtained entirely free from such disfigurement

The stone: No. 478.—This stone is of an excellent, fine grained grey type, and is represented in Plate XLV, No. 9. A peculiarity not observed in any other granite which has been examined for this report is the presence of scattered spots of about one-half inch in diameter, which, when viewed from certain directions, present a glistening appearance. These spots are due to an intergrowth of quartz and feldspar after the manner of graphic granite, whereby, on fractured surfaces, the cleavage planes of the feldspar present parallel facets, giving rise to the appearance noted. One of these spots appears at the bottom of the figure. (Plate XLV, No. 9).

The physical features are as follows:—

Specific gravity	2·688
Weight per cubic foot, lbs	167·016
Pore space, per cent	0·458
Ratio of absorption, per cent	0·172
Coefficient of saturation, one hour	0·46
" " two hours	0·60
Crushing strength, lbs. per sq. in	28440·
" " wet, lbs. per sq. in	26940·
" " wet, after freezing, lbs. per sq. in	25538·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·00277
Drilling factor, mm	2·0
Factor of toughness, blows	12·

This property is in a good condition for a resumption of operations, as the following equipment is already installed: A good mill, 50 feet by 20 feet, with an L 30 by 20 feet; two derricks, engine and boiler in good condition, Knowles compressor, two steam hoists situated within the mill, wharf in good repair.

The quarry has not been worked for several years; nevertheless the stone now lying on the dump seems to have suffered no deterioration. The suitability of the stone to architectural work is well shown by the handsome custom house and post-office in Shelburne (Plate XXXII.) In this building the hammered work presents a very light colour, while the rock-face ashlar is slightly bluish, but very uniform.

Mr. White estimates that the stone could now be profitably put on the market at 50 cts. per cubic foot, f.o.b. lighters at wharf.

This company also controls quarry lands near the International boundary west of St. Stephen, N.B.

Halifax Area.

This area is made to include the quarries immediately to the west of the harbour, as well as those which were formerly operated at Terence bay, about 15 miles in a straight line south of the city. The quarries are situated on the eastern margin of the great granite mass, which, as already stated, extends far to the westward.

The stone, which is all of the grey type, 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. Although all the stone hitherto quarried is grey, the occurrence of boulders of bright red granite on the shores of St. Margarets bay indicates the presence of masses of that colour in the interior.[1]

The principal operators near Halifax are:—
- John Cline,
- Isaac Yeadon,
- Andrew Yeadon,
- Amos Yeadon,
- Francis Coughlan and Bros.

In addition to the quarries now working, many abandoned openings are seen, including a rather extensive one formerly operated by the government (Queen's quarry).

The only quarry opened at Terence bay was worked by S. M. Brookfield, of Halifax.

John Cline, Halifax, N.S.

The property consists of about 300 acres situated about a mile to the southwest of the head of the Northwest Arm. Mr. Cline has made openings at a number of different points and has now six derricks in position. These workings show a slight variation in the character of the stone and a difference in the complexity of the jointing. The stone is represented by a typical example described below as No. 474, but some coarser types occur, containing crystal up to 1 inch in length. None of the individual quarries are very large; the jointing and sheeting, though variable, conform to the general structure described below for the quarry of Isaac Yeadon.

The stone: No. 474.—Practically identical with No. 473, p. 139.

Mr. Cline has a small mill, in which are installed one Jenny Lind and one vertical polisher. Roughly squared stone is delivered in Halifax at $5 per ton.

The product has been largely used in Halifax for monuments and for building.

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[1] Verbal communication, H. Piers, Esq., Halifax.

Isaac Yeadon, Halifax, N.S.

This quarry lies to the southward of Cline's and is separated from it by the properties of Amos and Andrew Yeadon. The quarry property of twenty-three and three-quarter acres has been worked over an area of 150 feet by 150 feet to a depth of 10 or 12 feet. Vertical joints at 15° east of north occur at intervals of from 2 to 12 feet, with an average of about 8 feet. Another equally well developed set, somewhat more closely spaced, crosses the former at right angles. The sheeting is approximately horizontal and widely enough spaced to permit the extraction of blocks of convenient size; it is not very regular, however, but undulating and non-continuous. The rift is horizontal and the grain vertical in an east and west direction. Pieces 10 feet long and 3 feet wide are easily obtained.

The stone: No. 473.—This is a coarse grained, grey granite (?) in which the feldspar crystals occasionally reach a length of fully an inch. The great mass of the stone, however, is considerably finer, and is represented in Plate XLV, No. 11.

Under the microscope it is seen that the feldspars are nearly all of the plagioclase variety, and that, for the most part, they are in an excellent state of preservation. Where decomposition has begun to set in, it appears in the centres of the crystals. The quartz crystals are smaller than the feldspars, and, when viewed on the fractured surface, have a slightly brownish cast. The third constituent is dark, brownish mica, which is seen under the microscope to be quite fresh. Owing to the large amount of plagioclase the rock should be called a grano-diorite rather than a granite.

In the table of physical properties given below, the slight loss of strength on freezing is in accord with the fresh character of the stone. The considerable softening effect of soaking is rather remarkable; as the result of a single experiment, it should be regarded with some latitude.

Specific gravity	2·702
Weight per cubic foot, lbs.	167·757
Pore space, per cent	0·544
Ratio of absorption, per cent	0·208
Coefficient of saturation one hour	0·56
" " two hours	0·65
" " thirty-eight hours	0·79
Crushing strength, lbs. per sq. in.	25959·
" " wet, lbs. per sq. in.	23458·
" " wet after freezing, lbs. per sq. in.	22762·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.	0·000349
Tranverse strength, lbs. per sq. in.	2439·
Drilling factor	3·3

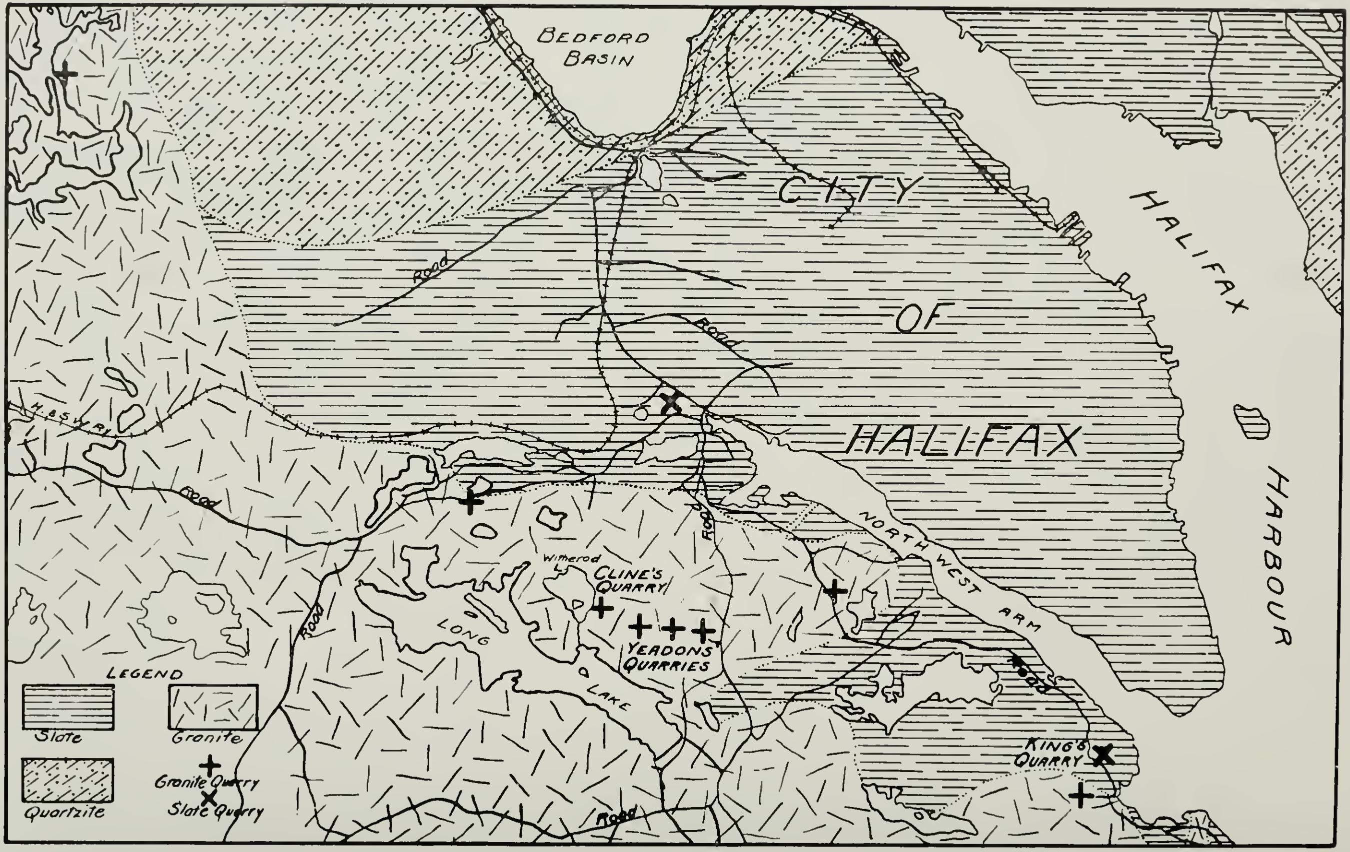


FIG. 8. Sketch map of the region about Halifax showing the location of granite and slate quarries.

The prevalence of black knots is the most unfortunate feature in this stone, as in all the product from the area. No pieces of any considerable size can be obtained free from this disfigurement.

The equipment consists of hand derricks only. Five or six men are usually employed, but there is no production at present. The haul into Halifax is about 4 miles, and to tidewater on the Northwest Arm, about 2 miles. Roughly squared blocks are delivered in the city at 40 cts. per cubic foot and rough building stone at $1.25 per ton. The stone may be seen in the custom house, and in the Parade wall, as well as in monuments and store fronts in Halifax.

Andrew Yeadon, Halifax, N.S.

This quarry adjoins that of Isaac Yeadon to the northwest. The opening is smaller and the jointing more irregular. Eight men are at present employed and two derricks are in position. The stone is essentially the same as No. 473; it is valued at 40 cts. per cubic foot in Halifax: 4,000–5,000 tons were quarried in 1910.

Amos Yeadon, Halifax, N.S.

This quarry lies between the property of Andrew Yeadon and that of John Cline. The excavation is not large and does not show well the character of the sheets or joints, which seem to be very irregular. Two derricks are installed and eight men are at present at work. The stone is quite the same as that previously described.

Many other quarries have been opened on the granite ridge in this vicinity, particularly by the Coughlan Bros. and by the government on the hill opposite the entrance of the Northwest Arm. The stone from this quarry may be seen in St. Mary's cathedral in Halifax. (Plate XXXV.)

S. M. Brookfield, Halifax, N.S.

This quarry has been opened at Terence bay, about twenty miles by road from Halifax. It is situated at the mouth of the narrow part of the bay on the eastern side opposite the village. The granite is exposed for many miles along the coast and excellent facilities for quarrying are presented at many places. The cliffs have a white appearance and show a different texture and a slightly different colour at different points. All the stone is coarse and porphyritic with crystals of feldspar as much as 3 inches in length. Black knots are present, but they occur in much less abundance than in the Halifax section. No regular quarry can be said to exist, as the stone has been removed at several points from the top layers only. Two types are seen in the rock which has been quarried—a grey type, No. 476, and a whiter variety, No. 475. The jointing is north and south and east and west, and varies from vertical to 75° in dip.

The sheeting is pronounced, with a westward dip of about 25°. Large blocks of stone can be obtained without difficulty.

The stone: No. 475.—This stone is very like that from Halifax described as No. 473. The grain, however, is considerably coarser and the feldspars are not as fresh as in the Halifax stone: it is represented in Plate XLV, No. 11. Under the microscope it is seen that nearly all the feldspar is plagioclase which shows only incipient alteration. The less abundant orthoclase is, however, seriously decomposed.

The physical properties listed below conform very closely to those already given for the Halifax stone:—

Specific gravity	2·657
Weight per cubic foot, lbs	164·948
Pore space, per cent	0·553
Ratio of absorption, per cent	0·209
Coefficient of saturation, one hour	0·50
" " two hours	0·64
Crushing strength, lbs. per sq. in	25893·
" " dry after freezing	23882·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·000705
Transverse strength, lbs. per sq. in	2269·
Drilling factor, mm	3·7
Factor of toughness, blows	9·

No. 476.—This example does not differ from No. 475, except that it possesses a rather greater amount of dark mica and that the weathering is further advanced, giving it a somewhat dirty appearance.

At the time the quarry was worked two derricks were erected and a wharf constructed. The stone was loaded into lighters and towed into Halifax.

All the equipment has been removed, and, at the present time, the quarry is entirely abandoned.

The most important structure, built of this stone, is the Bank of Commerce in Halifax. (Plate XXXIV).

At a point on the west side of St. Margarets bay a quarry was formerly operated in the same granite mass: the stone was used in the construction of the City Hall in Halifax.

Summary—Halifax Area.

A number of quarries, several of which are still in operation, have been opened near the eastern edge of the great granite mass which stretches westward from Halifax harbour.

The product is a very coarse, porphyritic granite, or rather granodiorite, which has been used for building and monumental purposes in

Halifax granite. Record building, Sydney, N.S.

Terence Bay granite. Bank of Commerce, Halifax, N.S.

Plate XXXV

Halifax granite. St. Mary's cathedral, Halifax, N.S.

Halifax. An unlimited amount of the stone is available, but its coarse texture and the prevalence of black knots must restrict its use to a great extent. The stone may be seen in many structures in Halifax, and in the Record building in Sydney. (Plate XXXIII).

A somewhat similar stone, but with fewer black knots, was formerly quarried at Terence bay to the southwest of Halifax.

Guysborough Area.

In the southeastern part of Guysborough are several large masses of granite of a whitish-grey colour inclining to yellow in part. This stone has been used locally, more particularly to the east of Tor bay, at White Head and Whitehaven, and a small quantity has been shipped to North Sydney, where it may be seen in the Bertram block. The following description of a typical property has been compiled from notes kindly furnished by Mr. Cline, of Halifax.

John Cline, Halifax, N.S.

The property consists of 57 acres at White Head, Guysborough county. 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. Mr. Cline states that a close examination revealed no sign of a seam for a length of 400 feet. He is of the opinion that this area is the most promising in the Province for the production of heavy stone.

The stone: 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.

Cape Breton Area.

Cape Breton Red Granite Co., W. M. Lawlor, president, North Sydney, C.B., Hector P. McDougal, manager, Christmas Island, C.B.

As far as I have been able to learn, the operations of this company constitute the only attempt that has been made to exploit the granites of the island of Cape Breton: this attempt, now abandoned, advanced no further than the crushing of granite debris for macadam pavements in the streets of Sydney.

A large mass of Pre-Cambrian rocks, consisting of schists and igneous intrusions, forms a long lenticular patch constituting the elevated axis of the strip of land between the east bay of Bras d'Or lake and St. Andrews channel. Much of this area consists of granite of a grey colour and coarse structure; in places, however, it is of finer grain and shows various shades of pink and red: in places also, it assumes a greenish aspect owing to the presence of patches of chloritic matter.

Many of its phases would be described as syenite rather than as granite, as the quartz component is inconspicuous or entirely absent. Owing to sub-aerial decay and the accumulation of soil, actual exposures are much fewer than might be expected in such a wide area.

About a mile east of Barachois station, on the Intercolonial railway, the right of way passes close to the face of this elevated tract, and cuttings have been made in the heavy talus at the foot of the hill. Here the company established a small crushing plant and operated on the granite fragments contained in the extensive mass of debris lying on the slope of the mountain.

The stone: Several types of stone are to be seen, particularly a reddish syenitic variety (529) and a light red granitic type. Both of these assume a greenish aspect in some examples, owing to a profusion of chloritic matter. None of the stone is of particularly handsome appearance, and of course, as far as the present quarry is concerned, has no value as a building or ornamental material. As the stone must occur *in situ* at the rear of the hill, and as it represents the only Cape Breton granite actually worked, the more abundant type is described in detail below.

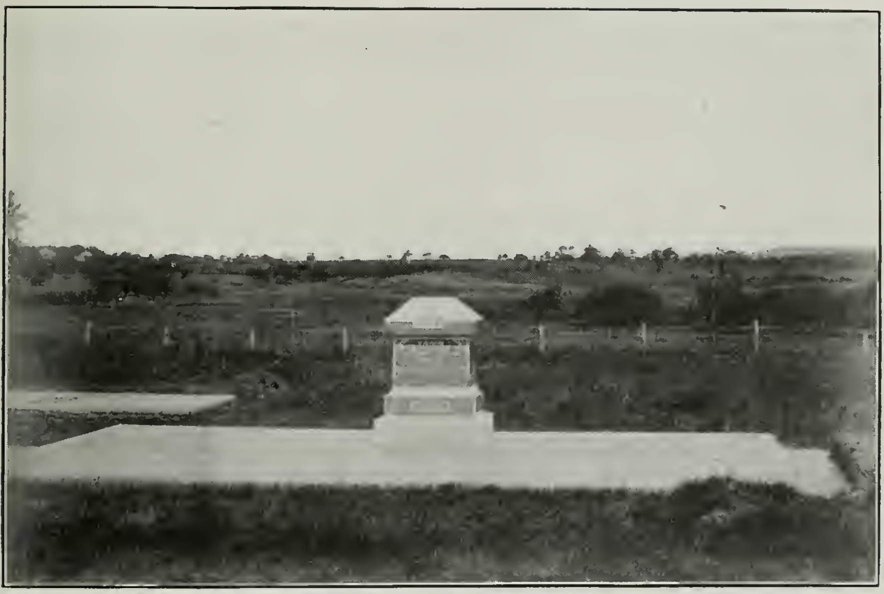
No. 529.—This stone is of a dull and unattractive reddish colour and medium grain. The mineral constituents appear to be very strongly interlocked and to be indistinctly separable on the broken surface. While the stone is not to be regarded as a desirable material for architectural purposes its low porosity and coefficient of saturation indicate a great durability, which, together with its extraordinary strength and toughness, should recommend it for certain structural purposes, and for use as a road metal.

The following list of physical properties is unique in many respects:—

Specific gravity	2·656
Weight per cubic foot, lbs	165·374
Pore space, per cent	0·259
Ratio of absorption, per cent	0·098
Coefficient of saturation, one hour	0·37
" " two hours	0·50
Crushing strength, lbs. per sq. in	48984·
Traverse strength, lbs. per sq. in	3751·
Drilling factor, mm	1·4

While no examples of the use of this stone as a building material can be cited, its suitability for the making of macadam may be judged by the roads on Townsend and Charlotte streets in Sydney.

Plate XXXVI



Monument of Nictaux granite, Bridgetown, N.S.

CHAPTER V.

The Black Granites.

Many of the dark coloured igneous rocks, such as diabase, diorite, gabbro, etc., are used for monumental purposes. The great toughness of this class of stone and the consequent difficulty of working has restricted its use; but at the present time, there seems to be a constantly increasing demand, owing probably to the suitability of the dark colour to tombstones. None of these stones are granite in the proper sense of the word, but as the general term black granite is so universally used by stone workers, it is retained in this report.

The reported occurrences of these stones are too numerous, and for the most part, too unimportant to warrant their enumeration here. Actual production is confined to a limited area near Bocabec, in Charlotte county, New Brunswick. In this region also a small amount has been obtained from the vicinity of St. Stephen, and from between Upper Mills and Red Rock. At Welsford, in Queens county, a similar stone was quarried by the Dominion Granite Company, and a large mass occurs on the property of D. Mooney and Co. near Hampstead. As far as I have been able to learn, the only attempt to work this class of stone in Nova Scotia was made near Shelburne, in Shelburne county.

Bocabec Area.

Epps, Dodds and Company, operators, St. George, N.B., R. H. Stewart, owner, St. Andrews, N.B.

In the parish of St. Patrick, northwest from Bocabec bay, the road from St. Andrews passes between large hills of black granite. On the eastern side of the road, Epps, Dodds and Company are now operating a quarry, and are shipping the output to St. George for use in monumental work. The excavation is well up on the mountain side and is about 50 feet square, with a maximum depth of 15 feet. The rock lies in beds, or more properly sheets, with an east and west strike and a dip of 45° degrees to the south. On the average, the parting planes are 3 feet apart. A set of joints runs through the formation, with a southeast strike and a dip of 70° to the southwest: it is very irregularly developed. A second set, with a northeast strike, dips 80° to the northwest.[1] These two sets of joints, together with the sheeting planes, divide the formation rather

[1] I am not sure of these directions, as it was raining heavily at the time of my visit and the compass acted in an erratic manner, owing probably to the ferruginous nature of the rock.

severely; nevertheless, blocks of 4 feet 6 inches by 2 feet 6 inches by 1 foot 6 inches have been obtained free from flaws. The foreman informs me that a pronounced vertical rift is encountered in a northeast and southwest direction and a less distinct horizontal grain. In a northwest and southeast direction, the stone is very hard to split (head). While much of the stone is free from imperfections, there are places in which the development of flints and dries causes the rejection of otherwise perfect blocks (404, Glenley). Lower on the hillside is another small opening in a solid ledge presenting a coarser and darker coloured stone (411, Pine Tree).

The stone: No. 404.—The rock face of this stone is shown in Plate XLV, No. 12. The grain is uniform, with both the black and the white constituents ranging from 2 to 4 mm. in extent.

Under the microscope, the white portion proves to be feldspar of the plagioclase type, which probably belongs to the variety known as labradorite: it is, for the most part, in a fair state of preservation, although some decomposition has begun. The dark mineral is in part hornblende and in part augite, the former mineral having arisen by the decay of the latter. Considerable magnetite (magnetic iron ore) accompanies the dark minerals. The feldspar crystals penetrate the original crystals of augite, producing the so-called *ophitic* structure, in consequence of which the rock should be properly called *diabase.*

The effect of the corrosion test is distinctly seen in a pitting of the surface of the dark minerals, and the production of a lighter greenish cast in the same.

This rock is hard and tough but it is capable of receiving an excellent polish. The crushing strength, etc., is much lower than that of the finer stone of the same type described later as No. 405.

Specific gravity	2·924
Weight per cubic foot, lbs.	181·557
Pore space, per cent	0·535
Ratio of absorption, per cent	0·224
Coefficient of saturation, one hour	0·45
" " two hours	0·66
Crushing strength, lbs. per sq. in.	38906·
" " wet, average of three, lbs. per sq. in.	35620·
" " wet after freezing, lbs. per sq. in.	34000·
Loss on treatment with carbonic acid and oxygen, grams per sq. in.	0·00607
Transverse strength, lbs. per sq. in.	3545·
Drilling factor, mm.	5·5
Factor of toughness, blows	9·

No. 411.—This stone is very similar to No. 406: it is, however, slightly coarser in grain. For all practical purposes the two stones may be regarded as identical, see page 148.

Across the road from the quarries described above, on Townsend mountain, heavy masses of dark rock are accessible in the hillside. The sheeting is pronounced and slightly inclined and the formation is cut by irregular joints. Very little work has been done and the quarry is not now in operation. The stone is of finer grain than the Glenley, and of a darker colour. The company refers to it as the Townsend mountain or black stone (405).

The stone: No. 405.—This stone resembles No. 404 but it is very much finer in grain, the individual crystals seldom exceeding 2 mm. in length. The polished surface is shown in Plate XXVII.

Under the microscope the same structure is revealed as in the case of No. 404. The decomposition is, if anything, slightly more advanced in this example. Under the corrosion test a distinct pitting of the dark minerals is to be observed, and they seem to stand out more prominently after the operation.

Specific gravity	2·918
Weight per cubic foot, lbs.	181·703
Pore space, per cent	0·35
Ratio of absorption, per cent	0·085
Coefficient of saturation, one hour	0·38
" " two hours	0·51
Crushing strength, lbs. per sq. in.	50246·
" " wet, average of two, lbs. per sq. in.	46400·
Crushing strength, wet after freezing, lbs. per sq. in.	46511·
Loss on treatment with oxygen and carbonic acid, grams per sq. in.	0·001231
Transverse strength, lbs. per sq. in.	5064·
Drilling factor, mm.	3·5
Factor of toughness, blows	18·

Both the crushing and the transverse strength are higher in this stone than in any of the other specimens tested for this report. The pore space and the ratio of absorption are remarkably low and the coefficient of saturation is far below the danger line. The results of the crushing tests on the wet and frozen samples are slightly contradictory. The former of these tests was performed in duplicate: if the higher number were used the anomaly would disappear. It is likely that very little difference exists between the crushing strength dry, wet, or frozen, as at such high pressures the instrumental errors are considerable. The factor of toughness is remarkably high.

In quarrying these stones, a 5 foot hole is drilled with a 2 inch bit, rimmed and charged with about a half pint of black powder. The crack thus produced is charged with a larger amount of powder and the block dislodged. Plug and feathers are employed for dressing the blocks to size. The haul to tidewater at Birch cove is two and a half miles.

R. A. Stuart, St. Andrews, N.B.

On the brow of the same mountain on which the Glenley stone is quarried, a small quarry was opened some years ago by Sheriff Stuart. The product closely resembles the Pine Tree stone (411): it is very difficult to cut, as may be seen from the low drilling factor given below. On this account it is not so largely used as its susceptibility to fine polish would warrant. The description given below would probably apply, in a general way at least, to No. 411.

The stone: No. 406.—This stone is similar to No. 404, but it presents a coarser grain as shown in Plate XLV, No. 13. The general appearance is somewhat different, however, owing to the feldspars lacking the dead white colour of those in the Glenley type. The polished surface also presents a less opaque appearance, particularly in the white portions. The reason for this difference is at once seen in a microscopic section, for the feldspars are almost unaltered, and much of the augite appears in its original condition without having been changed into hornblende. In a word, the present example differs from the Glenley in its slightly coarser grain and in its better state of preservation. The rock is a typical coarse grained diabase. The corrosion test shows that the dark minerals are attacked and that a surface film of lighter green appears.

The greater weight, the higher specific gravity, the lower pore space' the lower coefficient of saturation, the considerably greater transverse strength, and the much lower drilling factor are all in accord with the fresher nature of this stone as compared with No. 404. The low factor of toughness is rather anomalous.

Specific gravity	2·958
Weight per cubic foot, lbs.	184·132
Pore space, per cent	0·29
Ratio of absorption, per cent	0·096
Coefficient of saturation, one hour	0·30
" " two hours	0·39
Crushing strength, lbs. per sq. in	39928·
Loss on treatment with carbonic acid and oxygen, grams per sq in	0·00038
Transverse strength, lbs. per sq. in	4543·
Drilling factor, mm	1·4
Factor of toughness, blows	5·

H. McGrattan and Sons, operators, St. George, N.B., Gibson, Stuart and Hanson, owners, St. Andrews, N.B.

This property consists of 80 acres, and is situated to the eastward of those described above, near Bocabec village. The quarry is known as the Hanson quarry, and produces a dark stone which is not essentially different from the variety described above as No. 406. This type is known to the operators as Egyptian Black, under which name it is placed on the market.

Miles Gilmour, Bonny River, N.B.

This quarry is situated on the south side of the road about half way between Upper Mills and Red Rock. Very little stone was produced here, and the quarry has not been worked in many years.

The stone: No. 413.—This example is of the same general character as the black stones from the Bocabec district. It is a medium grained diabase in which the constituent minerals appear to be fairly well preserved. In grain, it lies between the Glenley and the Townsend mountain varieties.

Kennedy quarry, Limeburner lake, Charlotte county, N.B.

An attempt was made to quarry black granite at this point in 1896. The formation was found to be so badly broken that operations ceased without any stone having been shipped.

Summary—Bocabec Area.

The only locality in which black granite is being actually quarried at the present time is near Bocabec, in Charlotte county, New Brunswick. The area is made to include an abandoned quarry near Upper Mills, north of St. George, and a quarry to the south of Bocabec, at Limeburner lake.

The black granites quarried near Bocabec are all to be described as *diabase*, as they consist essentially of labradorite (feldspar), and augite. Considerable hornblende is present in some examples: this has resulted from the alteration of the original augite. Magnetic iron ore (magnetite) is present in some abundance and is plainly to be seen on polished surfaces.

An appreciable amount of variation in colour and in freshness is to be observed in the product of almost every opening that has been made. All of the varieties are susceptible of a fine polish and make handsome monumental material.

Rather excessive fracturing, together with the occasional presence of lighter coloured stringers and other blemishes, causes the waste of a large amount of the material quarried. If this waste stone could be delivered in the towns it would prove very desirable as a road metal.

Three types of stone were examined in detail. As they furnish a very interesting illustration of the effect of decomposition and fineness of grain on the physical properties of stones. otherwise alike, the results are tabulated below for purposes of comparison.

No. 404 is of medium grain and slight decomposition.

No. 405 is of fine grain and greater decomposition.

No. 406 is of coarser grain and is the least decomposed.

	404	405	406
Specific gravity	2·924	2·918	2·958
Weight per cubic foot, lbs.	181·557	181·703	184·132
Pore space, per cent	0·535	0·25	0·29
Ratio of absorption, per cent.	0·224	0·085	0·096
Coefficient of saturation, one hour	0·45	0·38	0·30
Coefficient of saturation, two hours	0·66	0·51	0·39
Crushing strength, lbs. per sq. in.	38906·	50246·	39928·
Crushing strength, wet, lbs. per sq. in.	35620·	46400·	
Crushing strength, wet after freezing, lbs. per sq. in.	34000·	46511·	
Loss on treatment with carbonic acid and oxygen, grams	0·0067	0·00123	0·00038
Transverse strength, lbs. per sq. in.	3545·	5064·	4543·
Drilling factor, mm.	5·5	3·5	1·4
Factor of toughness, blows.	9·	18·	5·

A comparison of No. 404 and 406, which are not greatly different in grain but which are different in the degree of alteration, shows that the fresh stone is heavier, slightly stronger in crushing strength, and considerably stronger in transverse strength; that it has a smaller pore space and a lower coefficient of saturation; that it is less susceptible to oxidation, and that it is much harder to cut. The lower factor of toughness is rather unexpected: it is probably to be explained by the greater brittleness of the fresh feldspar crystals, but one would expect a corresponding lowering of the transverse strength, which is not the case.

As to the effect of fineness of grain, a fair comparison would be between No. 405 and 404. The fine grained stone is seen to have a lower specific gravity, pore space, ratio of absorption, and coefficient of saturation. On the other hand, it has a much higher crushing and transverse strength; it is harder to cut; and it possesses a factor of toughness double that of the coarser grained stone.

The production of black granite in this locality is quite small: about 1400 cubic feet were cut in the mills at St. George in 1910.

St. Stephen Area.

Alfred Price, St. Stephen, N.B.

This quarry is situated at Oak point, east of St. Stephen, in the same district from which the Ledge granites are quarried by Mr. Price. The openings are insignificant and the output small and intermittent. The formation is evidently older than the Ledge granites which have invaded it. The rock is badly shattered, with a major series of joints striking south 35° east, and with numerous veinlets of the granite cutting it up in places. The stone, when free from these veinlets, is of a fine quality and resembles the Townsend mountain stone (415.) The present openings do not hold out much promise of a large production, but it is quite possible, when the formation is revealed at a point farther from the granite, that less broken material may be encountered. Mr. Price values this stone at $1.50 per cubic foot in St. Stephen. Five monuments were cut from it in 1910.

The stone: No. 415.—In general appearance, this stone resembles very closely the variety from Townsend mountain described as No. 405. The grain is possibly a little coarser.

St. John River Area.

The Welsford quarries, Queens county, N.B.

These quarries were opened near Welsford, in Queens county, about 22 miles from St. John, on the Canadian Pacific railway. As all operations have been suspended it will suffice to quote Dr. Bailey's description as follows:—

"During the summer of 1897, a company known as the Dominion Granite Company, of Bridgewater, N.S., have 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 takes a good polish, and is being worked for monumental purposes."[1]

Dr. Bailey also mentions the occurrence of dark coloured basic stones at Dolins lake, near St. John, and at Bull Moose hill, Kings county.

D. Mooney and Sons, St. John, N.B.

At the eastern end of the property held by this company at Hampstead and described on page 124, is a large exposure of black stone, which has not yet been worked. The formation is covered by vegetation and little is to be seen of its characteristics. The company intends to open up the belt and to determine its possibilities as a producer of black granite.

[1] Geol. Sur. Can., Rep. 1897, p. 107 M

Restigouche Area.

Thomas Chesser, Matapedia, Que., Lot 59, Parish of Eldon, Restigouche county, N.B.

Black granite was quarried on this property by the Intercolonial railway at the time of construction but no work has been done since that date. The opening was made at a point on the river 2½ miles above the railway bridge at Matapedia. The formation is rather severely shattered and shows three sets of joints S. 20° E., dipping 80° E.; east and west, dipping 70° S.; and northeast, dipping 30° northwest. As the excavation is close to the Restigouche river and at a considerable elevation above the water, the stone could be loaded into scows without difficulty.

The stone: No. 823.—A fine and even grained diabase resembling the stone from Bocabec shown in Plate XXVII. The general effect is somewhat lighter with a slightly greenish cast. Under the microscope, the stone shows rather serious decomposition, particularly in the plagioclase, which is converted almost entirely into secondary matter. The augite crystals are fresher and are easily recognized as such although a large amount of chlorite is developed throughout the stone.

NOVA SCOTIA.

Charles C. Reid, Shelburne, N.S.

Mr. Reid has quarried a small amount of stone from the west side of Jordan river, about two miles above the railway. The stone occurs in light and dark shades and is said to be rather badly shattered, although blocks 6 feet by 3 feet have been obtained.

Alexander McDonald, Barachois, N.S.

A medium grained, black granite occurs on the farm of Alexander D. McDonald, one-half mile east of Barachois station in Cape Breton county. Several of the hills a short distance inland from Bras d'Or at this point are said to be composed of this material.

The stone: No. 528.—A medium grained diabase of a dark, greenish aspect. The specimen, which is from the surface, is somewhat decomposed.

CHAPTER VI.

Limestone.

The Maritime Provinces are not rich in beds of limestone suitable for purposes of construction. As far as could be ascertained there is not a quarry in the three Provinces at the present time producing limestone for structural use: even for the making of lime the production is insignificant, as that commodity is largely prepared from the crystalline limestones, more particularly at St. John, N.B. Certain of the limestone beds of Silurian and Carboniferous age, however, have been worked in the past for lime-making, and to a very small extent for purposes of construction. The demand for flux in the iron furnaces of Sydney and New Glasgow has led to the opening of quarries in the thin bedded Carboniferous limestones, but most of these have been abandoned in favour of the more desirable crystalline limestones from River George and Marble mountain. Without doing great violence to the object of this report the whole subject of limestones might therefore be omitted. From an historical rather than from an economic viewpoint, the following summary of the more important limestone regions is given. Owing to the slight economic importance of the deposits, it is not thought necessary to treat them under their respective formations or to ascribe them to areas in accordance with the general practice in this report.

LIMESTONE IN NEW BRUNSWICK.

The writer is unaware of any limestone having been quarried on a commercial scale for building purposes in this province, but doubtless small quantities have been used locally from the quarries referred to by Bailey in the following words:—

"It has been already stated that the calcareous strata of the Silurian system are in places accompanied by beds of limestone sufficiently pure to be available as sources of lime, and details of their distribution and relations have been given. Quarries have been opened at a number of points and kilns erected, but there are only two at which operations have been carried on upon anything like an extended scale. One of these is that known as Turner's kiln, in the valley of the Beccaguimic. and the other as Henderson's in Windsor settlement a few miles to the north of the former. The annual production at Turner's is said to be about 500 casks (2,000 bushels) and to be valued at from $1 to $1.40 per cask. It is used chiefly for local consumption, but is frequently sent as far down the river as Woodstock. The Hendersons first commenced burning lime in 1880, since which time their annual production has averaged about 1,000 bushels."[1]

[1] Geol. Sur. Can., Rep. 1885, p. 29 G.

At a later date (1889) Dr. Bailey states:—

"Limestones are met with in the Province of New Brunswick in not less than six distinct geological formations, and therefore with much diversity of association and character. As will appear below, their value as a source of lime appears to be nearly in direct proportion to their age. (Here follows an account of the Laurentian and Huronian crystalline limestones which are treated under a separate heading in this report) . . . . . Cambro-Silurian limestones are of rare occurrence, but nevertheless are found at one or two points, chiefly in the northern part of York county, in the district lying north of the central granite range between Eel River settlement on the St. John river and Canterbury station. They have been utilized to a limited extent, but are quite impure, and have been used only for local consumption.

"A large part of the counties of Carleton, Madawaska and Gloucester are underlain by slates (Silurian) which are highly calcareous, and in places these become pure enough to be entitled to the designation of limestones. . . . . Of these, perhaps the most important is the Beccaguimic valley and its vicinity . . . ."

"About the year 1874 quarries were opened at Henderson corner, in the parish of Brighton, and work carried on by the Hendersons until 1886. . . . . . About 1885 other quarries were opened in the Beccaguimic valley, at Turner's, with an annual production of 500 casks, or 2,000 bushels. In the same vicinity the Belyea Bros. are now burning lime at about the rate last stated.

"The Lower Carboniferous limestones, though abundant and widely distributed, are comparatively unimportant as a source of lime, the material which they yield being unable to compete with the highly esteemed product of the St. John quarries. They have, however, at times been the basis of somewhat extended operations, more especially in the vicinity of Demoiselle creek, Albert county, where at one time lime-burning was largely carried on for several years.

"Other localities of Lower Carboniferous limestones, some of which have been worked locally, are Rush hill and Merritt landing (Long island), in Queens county; Butternut ridge, in Kings county; vicinity of Hillsborough, in Albert county."[1]

Wilson brook, Demoiselle creek, Albert county, N.B.

"A fine quality of reddish grey limestone was opened in the vicinity some years ago by Mr. McHenry and a large quantity of lime of excellent quality has been burned."[2]

The more recent report of Dr. Ells on the Mineral Resources of New Brunswick[3] contains no reference to the use of limestone as a building material.

[1] Geol. Sur. Can., Rep. 1897, pp. 78–84 M.
[2] Geol. Sur. Can., Rep. 1885, p. 35 E.
[3] Geol. Sur. Can., Rep. No. 983, 1907.

LIMESTONE IN NOVA SCOTIA.

The localities in this Province at which limestone has been worked are more numerous than in New Brunswick. Nearly all the operations have been conducted for the making of lime or for the obtaining of flux for the iron furnaces. Small amounts of building stone, however, have been produced, more particularly in the county of Antigonish.

Antigonish County.

"The numerous quarries from which limestone has been obtained (in the Lower Carboniferous basins) for burning and building are shown on the map, and many of them, as at Brierly brook, Dunmore, Ashdale, St. Andrews and other places, have been incidentally described in the course of this report. The grey limestone of the monastery at Tracadie has been largely quarried for both of these purposes. Near Black river it contains veins of white calc spar with ferruginous streaks and crystals of purple fluorspar. In Limestone brook, at Frasers Mills, in contact with red Devonian slates, is a light and dark grey limestone of good quality, like that at Blue cape, which has been quarried for seventy years. Veins of calcspar, spotted with fluorspar, are so numerous as to form a mottled breccia, with which a little conglomerate is sometimes mixed. The limestone follows the brook on the strike in high cliffs and knolls. The dark, bluish-grey, strongly bituminous Carboniferous limestone of upper Ohio can easily be traced along its contact with the felsites. . . . ."

Of the localities mentioned by Fletcher in the report cited above, that at Brierly brook was examined as typical of these Carboniferous limestones.

Alexander McDonald, Brierly brook, N.S.

The stone is exposed in a narrow ravine just north of Brierly Brook station. It overlies heavy masses of coarse breccia-conglomerate and is exposed for a very short distance along the stream. The formation strikes 10° south of west and dips 30° to the southward. The quarry has been worked to the west along the strike; but to the east, the stone has not been attacked. Further extension of the quarry could be effected only by the removal of a heavy overburden. The stone shows very distinct and even bedding and splits very easily on the bed, so that coursing stone could readily be prepared. The surface rapidly loses the dark colour and turns grey with much ferruginous staining. Calcite veinlets traverse the rock in all directions (No. 504).

A short distance to the eastward the same beds are again exposed on the McNeil farm, where they crop out in the side of a hill at a point where denudation has removed the heavy overburden of drift. The beds are somewhat thicker and a few holes have been made for the extraction of stone for lime-burning. A heavy overburden would have to be removed for any extensive operations. The stone is practically the same as that from the opening first described (No. 505).

The stone: Nos. 504 and 505.—A dark grey to black, compact, fine grained limestone cut in all directions by veinlets of white calcite. The rock is remarkably like No. 489 from Parrsboro in Cumberland county, and No. 524 from Barrachois in Cape Breton county. The physical constants determined for this stone may be considered applicable, with slight modifications, to any of these black Carboniferous limestones:—

Specific gravity	2·715
Weight per cubic foot, lbs.	167·867
Pore space, per cent	0·9609
Ratio of absorption, per cent	0·357
Coefficient of saturation, one hour	0·18
" " two hours	0·25
Crushing strength, lbs. per sq. in.	29419·

This stone was formerly employed for lime-burning, but there has been no production for many years. A small amount was used locally for foundations.

Mount Cameron.

The same bed of limestone referred to above crops out on both sides of a stream about $1\frac{1}{4}$ miles to the northward of Antigonish. The ravine is coincident with the strike of the formation, so that the limestones form the slope on the north side and appear, resting on the conglomerate, at the base of the escarpment on the south side. Here the beds are not very thick and fade upwards into a heavy mass of overlying shales. The quarries are situated on the northern slope where the beds are not covered by later formations. The beds are much fractured and the bedding is less even than in the Brierly Brook quarries. The same profusion of calcite stringers is apparent: the stone is of a rough character, not adapted to fine construction, although it may be obtained in blocks up to 2 feet in thickness. A considerable amount of material was obtained here for lime making, and for the construction of bridge piers and foundations for houses.

The stone: No. 506.—This stone is very similar to Nos. 504 and 505; it is somewhat coarser, however, and might be considered a less desirable material for buildings, although it has proved quite satisfactory for purposes of heavy construction.

There is no present production from these quarries, but the stone may be seen in the walls of St. Ninian's cathedral in Antigonish. The material seems to have stood the weather well, as far as disintegration is concerned, but the whole of the exposed surface of the stone has assumed a brownish-yellow colour, owing to the oxidation of the iron. In view of the improved means of transportation, whereby better stone can be obtained, it is unlikely that these quarries will ever again be worked for other than the roughest purposes.

Cumberland County.

"Limestone is quarried to some extent in the vicinity of Pugwash and shipped to Prince Edward island, where it is burned. Local kilns are found at several points, but the supply of rock being practically unlimited the demand is not great. The largest deposits observed were on the road southeast from Amherst to Economy, on the Spring Hill branch railway, and in the vicinity of Pugwash and Wallace river."[1]

"The Carboniferous limestones have been quarried near Partridge island and at Clarkes head. At another quarry at Kirkhill, two miles and a half northwest from Parrsboro, a dark grey flaggy limestone, in a nearly vertical attitude, includes lenticular layers of coal. . . ." [2]

"The banks of red clay marl dug for the use of the brick works at Pugwash, broken land, and a long ledge of limestone indicate the Lower Carboniferous on the west side of Pugwash harbour. This limestone is whitish and grey, nodular and compact, dips north 58° east $\angle$ 73°, but is slightly contorted in massive beds of considerable thickness, of an aggregate section of 150 feet. It has been quarried for some distance along the strike for shipment to Prince Edward island."[3]

"From Nappan station they (sandstones) extend, as shown on Dr. Ells' map, towards the Salem road, where a limestone holding manganese has been largely quarried at Mr. Fred. Shipley's, occupying a broad belt near his house. . . . . .The limestone is concretionary, yielding no fossils. and produces good lime."[4]

From the above quotations it is seen that the limestones of Cumberland county have been exploited, chiefly for lime-burning, in the vicinity of Parrsboro, Pugwash, and Nappan. None of the quarries are now in operation, nevertheless a visit was made to one near Parrsboro for the purpose of obtaining a specimen which might be regarded as typical of the region.

Robie Kirkpatrick, Parrsboro, N.S.

This quarry was opened on a minor elevation facing Kirks hill to the northward at a point about 2½ miles northeast of Parrsboro. The ridge is about 40 feet wide and strikes nearly east and west, with a steep dip varying from north to south of the vertical; it has been traced for a distance of about 300 yards under a varying amount of overburden. Joints

[1] Geol. Sur. Can., Rep. 1885, p. 68 E.
[2] Geol. Sur. Can., Rep. 1900-1901, p. 172 P.
[3] Geol. Sur. Can., Rep. 1903, p. 163 A.
[4] Geol. Sur. Can., Rep. 1897. p. 101 A.

cross the formation in a north and south direction at intervals of from 2 to 4 feet. The stone is very evenly bedded and can be obtained in layers up to 2 feet in thickness. The quarry is in very bad condition and little can be said, except that there seems to be a very large amount still available in blocks of sufficient size for ordinary building purposes. The stone was used for lime-burning and was also utilized for structural purposes in Parrsboro. All the joint planes are filled with white calcite, and that material also occurs in fine veinlets throughout the stone. Mr. Kirkpatrick holds the opinion that the black colour of the stone together with the profusion of these white stringers should make it a valuable decorative substance.

The stone: No. 489.—A very dark, almost black fine grained, compact limestone, traversed by stringers of white calcite. The physical properties are doubtless similar to those of No. 505 described on page 147.

As in the case of the similar stone from Antigonish, this material resists well the action of the weather as far as disintegration is concerned, and although it assumes a grey colour, there is little evidence of the excessive iron staining so marked in the Antigonish stone.

Colchester County.

Limestone for burning, for flux, and for use as fertilizer, has been quarried in the county, but I have been unable to learn of its use as a structural material. Most of the product has been obtained from beds of lower Carboniferous age, but some Permian and some Devonian strata have been worked. Among the localities mentioned by Fletcher, Clifford brook, Brookfield, Pennys mountain, and Beaver brook are the more important.[1]

Cape Breton County.

Carboniferous limestones have been quarried at several points near Sydney harbour, on George river and near Christmas island. The stone is of a rough character and is suited only for lime-burning, for use as flux, or for the construction of foundations. As far as could be ascertained there is no production from any of the localities.

George River.

Limestones crop out on the south side of the river a short distance above the railway bridge and close to the big quarries in crystalline dolomite now being worked by the Dominion Coal and Steel Company. The beds strike 25° west of south and dip 70° to the southwest. The stone is thin and is covered with a varying amount of drift: it was formerly quarried for flux—545.

[1] Geol. Sur. Can., Rep. 1890–91, pp. 91, 92, 94, 95, 188.

About a half-mile above the big quarries, on the north side of the valley, limestones are exposed in a cliff of 50 feet. The stone appears to have been originally in thick beds, but it is now excessively shattered. In character it differs from the typical dark bituminous stone and presents a brownish colour. It further differs in that it is extremely cavernous and particularly susceptible to disintegration under the action of the weather. The stone was formerly quarried for flux, the quarry being connected with the larger workings by a narrow gauge track. There is no future for this stone as a building material—546.

The stone: No. 545.—A dark coloured, compact limestone like those from Antigonish.

No. 546.—A dirty coloured, brownish-grey, mottled dolomitic limestone. In places, this stone is very cavernous with the cavities lined with crystals of secondary calcite.

Hector McDougall, Christmas Island, N.S.

A narrow belt of limestone extends from 5 miles west of Iona to 6 miles east of Grand Narrows, and is accessible at many points. The strike, as exhibited in a railway cutting near Christmas island, is almost due east and west and the dip 25° to the northward. Like the similar band in Antigonish it overlies heavy beds of conglomerate. The bedding is pronounced, with strong smooth parting planes. Much of the stone is thin, but in places, layers of 2 feet in thickness were observed. I am informed by Mr. McDougall that he has employed this stone for building purposes. As observed in foundations in Grand Narrows, the material is quite resistant to the action of the weather, but it assumes a rather dirty grey appearance.

The stone: No. 524.—A dark coloured, compact limestone with distinct evidence of the bedding planes shown throughout.

Hants County.

The production of limestone in this county is quite insignificant, whether for structural or other purposes. Impure limestones have been obtained from Gaspereau lake and Canaan, and flinty, quartzose flags from Highbury. Limestone quarries for local use have been opened at Northfield, Glencoe, Maitland, Whale river, and other places.[1]

In the Economic Minerals of Nova Scotia, Mr. Harry Piers, curator of the Provincial Museum at Halifax, describes a sample from Ferry Farm, Windsor, Hants county, in the following words: "This Lower Carboniferous limestone is being manufactured into lime by J. T. H. Muller of Windsor. The sample shows the highly fossiliferous character of the rock.

[1]Geol. Sur. Can. Rep. 1892-93, p. 66 AA.
" " " " 1901, p. 215 A.

The following analysis was made by Dr. How:—"

Carbonate of lime	97·64
Carbonate of magnesia	1·10
Oxide of iron	0·07
Phosphoric acid	trace
Insoluble residue	0·68

Devonian limestones have also been quarried in the county. They are usually magnesian and are mixed with trap so as to give little promise as building material.

Inverness County.

A small amount of limestone has been quarried for local use near Whycocomagh in this county. The quarry is situated to the south of the village on the property of Peter McKinnon: it is opened in the side of a hill about 70 feet high. The formation strikes 60° west of north and dips 25° to the southwest: the slope of the hill conforms to the dip of the rock. The upper 10 feet, which has been largely removed, consists of thin material; the lower stone occurs in beds of varying thickness, with a maximum of about 4 feet. All the stone shows a pronounced lamination and possesses a strong tendency to split parallel to the bedding. Joints traverse the formation at 15° north of west with a vertical dip. A second set, almost exactly at right angles, divides the rock into rectangular blocks. In parts of the quarry there is evidence of considerable distortion, the bedding planes being twisted and separated, with the interstices filled in with calcite. This material has been used locally for building, and also for the manufacture of lime, which is said to be very strong but of dark colour.

The stone: No. 523.—A dark grey, semi-crystalline, brittle limestone, with distinct lamination throughout. The joint planes are sharply defined and of frequent occurrence: the stronger planes of jointing are marked by a film of white crystalline calcite.

Lunenburg County.

"Beds of Carboniferous limestone are quarried at East Chester, on Indian point and on the shore of Goat lake."[1]

"Capt. Ed. Lordley's quarry, Indian Point, Lunenburg county. This Lower Carboniferous limestone was quarried and burned for lime in an old flare kiln for many years. It is light grey in colour and makes a very strong lime but a little dark. It is said to possess hydraulic properties, which should bring it into notice in the future, as it occurs in large quantity and on tidewater, while the Halifax and Southwestern railway passes close to it. The following is an analysis made by the Geological Survey:—

[1] Geol. Sur. Can., Rep. 1896, p. 103 A.

Carbonate of lime	97·21
Carbonate of magnesia	0·55
Carbonate of iron	0·48
Carbonate of manganese	0·58
Sulphate of lime	0·07
Alumina	0·41
Silica, soluble	0·02
Insoluble matter	0·49
Organic matter	0·11
	99·92"[1]

According to Mr. Piers, a limestone similar to the above occurs on an adjoining property belonging to James Cook, Indian point, East river.

Pictou County.

The chief area in which limestone has been quarried in this county lies to the southward of Stellarton on the East river of Pictou. The product has been used for lime-burning and as flux in the furnaces at Trenton: it is not referred to in the literature as being adapted to purposes of construction. Among the localities mentioned are McLellans mountain and brook, Bridgeville, Springville, Churchill, and Lorne. "Near Hopewell, limestone has been worked on Halliday's, Grant's, McDonald's, and other farms, but the largest quarry is probably that at Dunbar's, where a light grey and blackish, massive, bituminous, and vesicular, compact limestone contains spots of hematite and blotches or veins of calcite and ankerite, and yields many corals and shells."[2]

"An analysis of a sample from a bed of limestone 15 feet thick, which is extensively quarried at Springville to supply lime for the local demand, yielded:—

Carbonate of lime	96·26
Carbonate of magnesia	2·33
Oxide of manganese	0·55
Oxide of iron	0·57
Alumina	0·10
Sulphur	0·02
Phosphoric acid	0·03
Silica	1·99
Moisture	0·17
	102·02[3]

[1] Econ. Min., Nova Scotia, H. Piers, King's Printer, Halifax, 1906.
[2] Geol. Sur. Can., Rep. 1890–91, p. 188 P.
[3] Geol. Sur. Can., Rep. 1886, p. 123 P.

This limestone is said to be the same as that from Brierly brook: the description of Nos. 504 and 505 given on page 156 may therefore be applied to this stone as well.

Summary—Limestone.

The sedimentary limestones of Silurian, Devonian, and Lower Carboniferous age have been quarried at many places in both Provinces for lime-burning and for use as a flux. Incidentally, some of this stone has been used for building; very little, however, has ever been deliberately quarried for this purpose and there is none being produced at present.

The most important limestone area, as far as the present report is concerned, is the vicinity of Antigonish, where a dark Carboniferous limestone has been used in the construction of St. Ninian's cathedral.

CHAPTER VII.

Crystalline Limestone and Marble

The term marble is applied to materials of such varied character and origin that it is almost necessary to define the word in each instance where it is employed. The term is here used to indicate all calcareous stones of sufficient beauty to be employed for purposes of decoration. Ordinary limestones pass into marbles by the assumption of a crystalline structure, or by the possession of agreeable and variegated colours together with fineness of grain. In the Maritime Provinces, both types are represented — the former by the crystalline limestones of the Pre-Cambrian age, and the latter more particularly by metamorphosed beds of Carboniferous limestone. No marble of either type is now being quarried for purposes of decoration, but the crystalline stone is extensively used for lime-burning and for flux, and finds also a very limited market as a building material. Several attempts to utilize certain of the deposits for decorative purposes have not met with success. The more important of the occurrences will be considered according to the following classification:—

1. Crystalline limestones of Pre-Cambrian age.
2. Metamorphic marbles of Silurian, Devonian, and Carboniferous age.

THE CRYSTALLINE LIMESTONES OF PRE-CAMBRIAN AGE.

The limestones of this type are, for the most part, coarse in grain and possessed of a strong banding, with variations in colour: they are therefore to be classed as variegated, clouded, or banded stones. Rock of this character is largely quarried for lime-burning at St. John, N.B., and for flux at Marble mountain and George river, N.S.

NEW BRUNSWICK.

There are only two areas in this province in which crystalline limestone of Pre-Cambrian age has been quarried. One of these lies in northeastern Kings county and is of little importance, and the other in St. John county, near the mouth of the St. John river.

Kings County Area.

Impure beds of crystalline limestone, possibly of Huronian age, have been reported "in the vicinity of Tennants cove in the parish of Kars, and on tributaries of the Pascabec river, north of Callina corner, in the parish of Springfield "[1]

[1] Geol. Sur. Can., Rep. 1870–71, p. 232.

Later reports contain only the briefest notice of these, and of some other scattered deposits which are of no known economic importance.

St. John Area.

The crystalline limestones in the vicinity of St. John, N.B., have long been employed as a source of material for the manufacture of lime. The use of this stone for purposes of decoration or building, however, has been very limited, although a few structures in St. John have been built of it. At the present time, the only material used for building purposes consists of a few blocks, which are produced incidentally in the quarrying of stone for lime-burning: they are used for foundations only.

Dr. Geo. F. Matthew, of St. John, considers that the crystalline limestones of St. John belong to two different periods of the Archaean. The lower of these shows gneisses and interstratified belts of crystalline limestone rich in serpentine. Specimens of this serpentine limestone, from a band about 50 feet wide, exposed near Burpee avenue, have found their way into many museums and collections, but I am unable to learn of any attempt to place the stone on the market (436). An examination of the locality leads to the belief that only small pieces could be obtained.

The stone: No. 436.—This material is a typical serpentine marble of the verde antique type, consisting of rather coarse grained white, bluish and greyish calcite irregularly mingled with greenish and yellowish serpentine. At all too frequent intervals the rock shows evidence of secondary displacement, with the production of fractured and sheared zones. In small pieces the stone constitutes an exceedingly handsome material, but, as stated above, the probability of its occurrence in workable masses seems to be remote.

The upper series consists of heavy beds of crystalline limestone disposed in east and west bands, which are thus described by Dr. Bailey:— "The Laurentian limestones include all the heavy beds of this rock on either side of the St. John river from Grand bay to the suspension bridge, together with their extensions westward to Musquash and Lepreau, and eastward along either side of the Intercolonial to Hampton. They are distributed in several parallel belts, disposed with reference to a general anticlinal structure, but severally exhibiting great diversity of attitude, as also of colour and texture. Certain beds sometimes attain a thickness of 350 feet, but usually alternate in thinner beds with fine grained siliceous and diorite rocks or with quartzites. Diorite dykes of all dimensions also cut the beds, the latter frequently exhibiting, for some distance on either side of the intrusive mass, a marked alteration as the result of the temperature accompanying the intrusion of the diorite. The best limestones are dark grey in colour from disseminated graphite, which, however, is wholly lost in calcination.

'It would appear that the limestones of the St. John River narrows, which still form a striking feature of the scenery, were seen and described by Champlain and his associates not less than 300 years ago. It is also asserted that from them came the lime used by Brouillon in rebuilding the fort at Port Royal in the year 1701. Somewhat later, but before the landing of the Loyalists, St. John lime was exported, in small sloops, to Newburyport and other New England ports, having even then a high reputation. It has at all times been preferred to other limes for use in the Maritime Provinces, but as an article of export has only acquired importance in recent years."[1]

The following quarries are listed in the above report by Dr. Bailey:—

I. and F. Armstrong, Green Head.
Miller and Woodman, narrows of St. John river.
Randolph and Baker, " " "
Stetson, Indiantown.
W. D. Morrow, narrows of St. John river.
Stevens, South Bay.
Wm. Lawlor and Sons, Brookville.

In 1906 the chief quarries in operation were those of Stetson and Cutler, Purdy and Green, and W. Lawlor and Son. Dr. Ells' observations in these quarries led him to state—"A peculiarity observed in all these quarries is the large number of dykes of epidotic green diabase which cut the limestone in all directions and often seriously interfere with the quarrying. Some of the larger dykes have masses of the limestone caught in the igneous mass, and the alteration of the limestone is most pronounced as the dyke is approached."[2]

The extent of the bands of limestone near St. John is shown on the accompanying map (Fig. 9) as well as the position of the chief quarries. Although the output is practically all used for lime-burning, its possibilities as a structural material brings it within the scope of this report.

Purdee and Green, St. John, N.B.

This quarry is close to the city on the north side and is about 1000 feet long by 500 feet wide. The formation strikes northeast and dips to the southeast at 40°. Both strike and dip however are extremely variable. The main joints cross the formation north 40° west, with a dip of 80° to the southwest. Many other irregular cracks run in all directions, so that, on the whole, the formation is badly shattered. In addition to the jointing, the formation is disturbed by the injection of the dykes already referred to (Plate XXXVII). There does not seem to be any possibility of quarrying large blocks on a commercial scale, but pieces of sufficient size for ordinary building are produced in the course of operations.

[1] Geol. Sur. Can., Rep. 1897, p. 78 M.
[2] Geol. Sur. Can., Pub. No. 983, 1907.

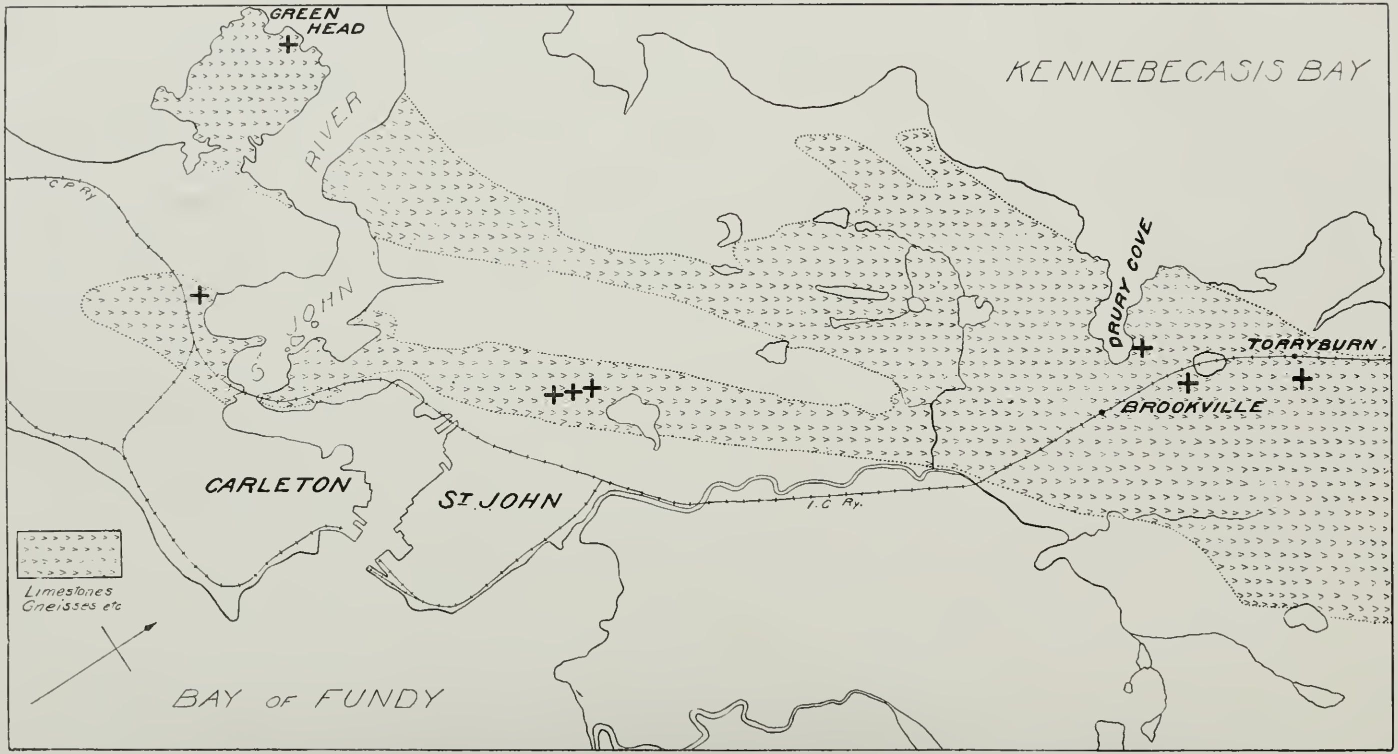
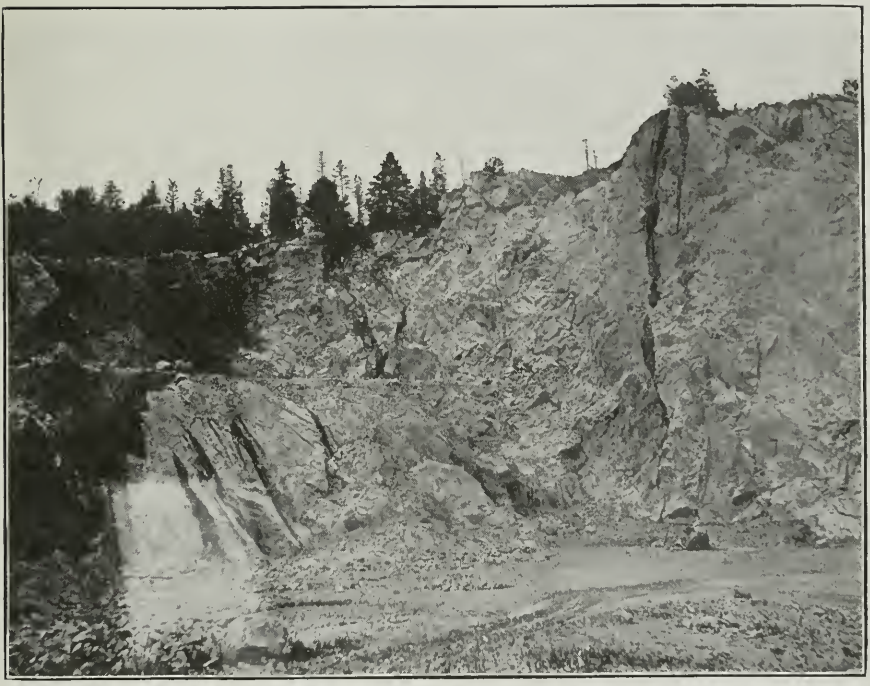


Fig. 9. Sketch map showing the areas of crystalline limestone and the principal quarries near St. John, N.B.



Dyke cutting crystalline limestone, St. John, N.B.

The stone: No.429.—In the rough, this stone is a coarse grained blue and white banded rock; the bands representing the original bedding of the limestone now upturned at an angle of 40°. The general blue colour of the stone is shown in Plate XLV, No. 15. Under the corrosion test, the colour is materially altered, as the cube became etched all over with fine white lines and presented a rough, dull, and unattractive appearance.

The physical constants are as follows:—

Specific gravity	2·715
Weight per cubic foot, lbs	169·146
Pore space, per cent	0·087
Ratio of absorption, per cent	1·032
Coefficient of saturation, one hour	1·00
" " two hours	1·00
Crushing strength, lbs. per sq. in	16000·
" " wet, lbs. per sq. in	12013·
" " wet, after freezing, lbs. per sq. in	10207·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·24507
Transverse strength, lbs. per sq. in	(2232·).....
Chiselling factor, grams	4·7
Drilling factor, mm	10·8

The transverse strength as given above is undoubtedly low, as the specimen was cut directly across the bedding. This same circumstance has also much reduced the chiselling factor as it has eliminated the element of chipping, which would come into play if the slab had been properly cut parallel to the bedding. The high coefficient of saturation is significant. Although the actual pore space is small, it becomes completely filled with water on ordinary exposure to the weather, rendering the stone liable to serious injury on freezing. The marbles, as a class, are much the worst offenders in this respect.

An analysis of this stone by Mr. H. A. Leverin resulted as follows:—

Insoluble matter, per cent	0·20
Aluminium oxide, per cent	0·10
Ferrous oxide "	0·26
Ferric oxide "	0·14
Calcium carbonate "	96·69
Magnesium carbonate, per cent	1·30

In addition to the large production for lime-burning, this company disposes of about 1,000 tons a year for purposes of construction. Building stone in rough pieces is valued at 50 cts. per ton in the quarry.

Stetson and Cutler, St. John, N.B.

This quarry adjoins that of Purdee and Green; the excavation is 200 feet by 200 feet with a depth of 50 or 60 feet. The bedding and jointing are quite different from that in the adjoining quarry, showing the twisted and variable nature of the formation. The stone is of practically the same kind, but none has been sold for building purposes during recent years.

Charles Miller, St. John, N.B.

This quarry adjoins those described above. There is no essential difference in formation or in output.

Randolph and Baker, St. John, N.B.

This quarry lies across the river from those described above. No essential differences are presented.

L. Rokes, Brookville, N.B.

This quarry is situated on the shore of Drurys cove, a small bay extending south from Kennebecasis lake about five miles east of the city. The excavation is 200 feet by 200 feet in extent and has a maximum depth of 40 feet. The stone is badly fractured by the use of explosives, and shows in addition three imperfect sets of joints—east and west with a dip of 70° to the north; southwest with a dip of 60° to the southeast; and northeast with a dip of 60° to the northwest. This excessive fracturing renders impossible the systematic quarrying of large blocks, but it does not prohibit the production of fair sized stone as an accessory product in operating for lime. The main mass of the stone is a medium grained, white variety (422) which is interbanded with a blue type (423), or contains the blue in the form of irregular masses sometimes 20 feet in diameter. Where the blue and the white varieties come into contact, clouded examples with either colour predominating may be obtained.

The stone: No. 423.—In appearance this stone does not differ materially from No. 429 already described. The blue colour, however, is less aggregated into bands, being distributed more uniformly throughout the mass. Under the corrosion test, the changes are practically the same as in No. 429; the physical properties are also nearly the same, except for the differences arising out of the fact that the slab for transverse strength broke along a flaw, giving a low result, and that the chiselling test was made on a surface parallel to the bedding. It might be said that an average of the two sets of results could be applied to either example.

The physical constants are as follows:—

Specific gravity	2·722
Weight per cubic foot, lbs	169·49
Pore space, per cent	0·225
Ratio of absorption, per cent	0·094
Coefficient of saturation, one hour	0·96
" " two hours	1·00
Crushing strength, lbs. per sq. in	17583·
" " dry after freezing, lbs. per sq. in	13618·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·2477
Transverse strength, lbs. per sq. in	3399·
Chiselling factor, grams	9·8
Drilling factor, mm	7·8

An analysis by Leverin shows that this example does not differ greatly from No. 429: there is more insoluble matter and less magnesia.

Insoluble matter, per cent	2·24
Aluminium oxide	0·10
Ferrous oxide	0·26
Ferric oxide	0·14
Calcium carbonate	95·27
Magnesium carbonate	0·79

No. 422.—In contrast to No. 423 this example is called white: it is not, however, of a pure white colour but presents a shade of mottled light blue. The stone may be regarded as a less distinctly coloured phase of No. 423.

C. H. Peters and Sons, Torryburn, N.B.

This property of 150 acres lies to the south of the main road near Torryburn station. There are several openings in which somewhat different stone is exposed. The more northerly excavation is about 125 feet by 50 feet in extent with a depth of 30 feet; it shows a strongly bedded formation striking 10° south of east and dipping 60° to the south. A fairly well pronounced set of joints strikes approximately with the formation but dips 80° to the north. Other joints cut the rock in all directions without any apparent regularity. The stone is a banded blue and white type with considerable amounts of foreign material: it is not considered of the best quality for lime-burning (427). The second opening shows stone of a lighter and less impure type, and the third and fourth excavations present a dark bluish variety in much flatter beds which are less severely jointed. This stone is strongly laminated and can be obtained in blocks of considerable size (426): it has been used for building purposes in Rothesay and other villages in the vicinity.

The stone: No. 427.—This example is a dark blue, medium grained, laminated crystalline limestone. The alternating bands of blue-grey and white are closely set and do not average more than two or three millimetres in thickness. Some of the dark bands are almost slate-like in character and in places are associated with considerable pyrite.

No. 426.—Distinctly banded, blue and white like No. 427. The bands are much wider, however, and there is less slate-like material developed.

Wm. Ryan, Brookville Station, N.B.

This quarry is situated near other old workings in the vicinity of Lawlors lake: it lies about half way between Rokes' and Peter's quarries. The stone here is, on the whole, of a lighter and brighter colour than was observed in the other two quarries, and is described below as No. 424. The formation is much fractured with a prevailing east and west jointing. The joint-planes are frequently stained red, and red veinlets traverse the rock itself in some places (425). The prevailing blue type of stone is seen in contiguous openings.

The stone: No. 424.—A coarse grained, white crystalline limestone marked with ill defined, narrow bands of light blue at intervals of from a quarter of an inch up to several inches.

No. 425.—A coarse grained, white crystalline limestone like the above, but presenting irregular clouds of a pinkish colour. Parts of the rock are traversed by fine veinlets of secondary origin, showing the same or a deeper tone of pink.

This quarry was formerly worked for dolomite, which was employed by the Miramichi Pulp and Paper Company. A small amount of the output was used in building, the stone having been shipped to Moncton and other places.

Summary—St. John Crystalline Limestones.

In the vicinity of the city of St. John two types of crystalline limestone occur: (*a*) a serpentine variety of considerable beauty, but of very limited extent and probably of little economic value (page 164); (*b*) a blue and white banded, medium to coarse grained crystalline limestone. The great mass of the formation is distinctly banded with a predominance of the blue type. The white portions are sometimes large enough to furnish blocks of stone of limited size. The formation is all steeply inclined, and it is much fractured and cut by dykes or eruptive rocks. The stone is similar to that of many of the bands of Grenville limestone in Ontario and Quebec, but it is much more fractured and is less likely to prove valuable as a source of building stone. When fresh, some of the material is of handsome appearance, but it has a strong tendency to turn grey on exposure to the weather. These bands have been quarried for the manufacture of lime and for use in the pulp industry. As a building material, the application has been limited, and at the present time is restricted to foundations and rough walls. The stone may be seen in Trinity Episcopal church and in the Cathedral of the Immaculate Conception, in St. John. The stone for the latter building was obtained near Brookville. A description of typical examples from the narrows of the St. John river may be seen on page 165, and from the vicinity of Brookville and Torryburn on pages 168, 169. As a source of lime, this rock is held in high esteem and a very large number of quarries have been worked from time to time. Building stone has been produced only as an accessory to the lime industry. The shattered nature of the formation would prove an insuperable obstacle in any attempt to quarry large blocks suitable for sawing into slabs.

NOVA SCOTIA: CAPE BRETON.

It is questionable if any crystalline limestone of Pre-Cambrian age occurs on the mainland of Nova Scotia. Certain authors, however, regard some obscure deposits as possibly of this age:—"On the sea shore at Arisaig and Georgeville are exposures of very crystalline limestone and other rocks, which have also been referred to the Archæan, but of which no more can be at present affirmed than that they form pebbles in certain conglomerates, which are apparently Cambro-Silurian."[1]

"The limestone is bluish-grey, whitish, and greenish, of varying purity, with indistinct bedding, serpentinous, and showing Eozoon-like wrinkles, compact to broadly crystalline, holding small ferruginous patches, in one place forming a cliff twenty feet high and apparently of great thickness."[2]

"On the shore road, about one mile west of Georgeville chapel, is an outcrop of crystalline limestone, the only one seen inland."[3]

In the island of Cape Breton are large areas in which the ancient crystalline rocks of the Pre-Cambrian (Archæan) are exposed. In these areas are many belts of crystalline limestone, which, together with certain associated rocks, constitute the George River series. Although many of these belts are thin and of no known economic importance, it is always possible that they may hold marbles of attractive appearance and of future value. It must be plainly stated at the outset, however, that past experience has not shown even the best of these deposits to be capable of profitable working. The best known and, in all probability, the most valuable bands of crystalline limestone are those at River George, Eskasoni, Marble Mountain, and Whycocomagh. Practically no work has been done at Eskasoni and Whycocomagh, but the Marble Mountain and River George deposits have been unsuccessfully worked for marble, and are now producing great quantities of stone for use as flux in the iron furnaces. Before proceeding to a consideration of these more important localities

[1] Geol. Sur. Can., Rep. 1886, p. 44 A.
[2] *Ibid*, p. 8 P.
[3] *Ibid*, p. 9 P.

it seems advisable to present, in a tabular form, a summary of the known occurrences of crystalline limestones of the George River series. This summary is accompanied by a map and is provided with references to the original descriptions. As most of these deposits are of no known economic importance, the list is intended as a guide to the prospector and is not to be interpreted as a summary of economic occurrences.

Occurrences of Crystalline Limestone of the George River series in the island of Cape Breton.

For convenience of description it may be said that there are ten or twelve areas in which Pre-Cambrian rocks are exposed, as follows:—

(1) Northern Inverness and Victoria—Northern area.
(2) An area west of Lake Ainslie in Inverness—Ainslee area.
(3) An area on the gulf coast near Mabou—Mabou area.
(4) An area between Lake Ainslie and the head of St. Patrick channel—Mullach area.
(5) An area stretching from Whycocomagh at the head of St. Patrick channel almost to the Straits of Canso—Craignish Hills area.
(6) An area on the north side of the west bay of Great Bras d'Or—North Mountain area.
(7) An area on the south side of the west bay of Great Bras d'Or—St. George area.
(8) An area on the south side of the east bay of Great Bras d'Or—East Bay area.
(9) An area stretching from the mouth of River George on St. Andrews channel to McIntosh brook on East bay—George River-Eskasoni area.
(10) A small area southeast of the River George area in Cape Breton county—Coxheath area.
(11) An area along the Atlantic coast from Red point to the extremity of Scatari island—South Coast area.

The occurrences of crystalline limestones are tabulated below under these Pre-Cambrian areas in the order named.—(See Fig. 4, p. 96.)

(1.)—The Northern Pre-Cambrian Area.

North River, St. Anne Harbour, Victoria County—"Include a marble, more or less white, but often greenish or cream coloured, roughened and whitened on the surface by spots of serpentine." (*G.S.C., Rep. 1876-77, pp. 427-428*).

Between Cape North and Bay St. Lawrence, Victoria County—"A white point said to consist of crystalline limestone." (*G.S.C., Rep. 1882-84, p. 98 H.*)

Ingonish, Victoria County—On McKinnons, Power, and Clyburn brooks. (*G.S.C., Rep. 1882-84, p. 36 H.*)

Middle River, Victoria County—Savach and Fionnar brooks. (*G.S.C., Rep. 1882-84, pp. 34-35 H.*)

St. Anne Mountain, Kelly Cove, and Cape Dauphin, Victoria County—'White and variously tinted marbles can be procured with great facility.' (*G.S.C., Rep. 1874–75, p. 264.*)

Meat Cove and Cape North, Inverness County—Crystalline limestone and serpentine. (*G.S.C., Rep. 1882–84, p. 20 H.*)

North Aspy River—Big southwest branch, Wilkie brook—(*G.S.C., Rep. 1882–84, p. 19 H.*)

Near Campbellton—'The bed of white, massive, grey-weathering, broadly crystalline dolomite discovered in the limestone series has been to some extent utilized by the Messrs. Burchell.'—(*G.S.C. Rep. 1895, p. 110 A.*)

It will be observed that many of these occurrences are in localities in which the standard maps of the Geological Survey show no exposures of the George River series.

(2.)—Lake Ainslie Pre-Cambrian Area.

This area is described in the Report of the Geological Survey for 1882–84, p. 9 H. No occurrence of the George River series is mentioned.

(3.)—Mabou Pre-Cambrian Area.

This area is described in the Report of the Geol. Sur. for 1882–84, p. 8 H. There is no mention of crystalline limestone.

(4.)—Mullach Pre-Cambrian Area.

The southern half of this area is formed of the George River series and contains bands of crystalline limestone.

Mullach Brook, Inverness County. (*G.S.C., Rep. 1882–84, p. 34 H.*)

(5.)—The Craignish Hills Pre-Cambrian Area.

Victoria road between Queensville and McMaster brooks;

North of Queensville brook;

Hills behind Craignish;

McPherson brook above River Inhabitants road;

Glendale brook;

Near the source of the Graham River—"A whitish and bluish grey finely crystalline calcite, with canary-yellow spots, strikes north, 56° west, near the syenite, but more northerly higher up stream. Sometimes it is a compact, beautiful ringing stone."

Queensville;
Victoria road, Glendale to Whycocomagh;
Road from Glendale to River Denys chapel, McLennans mill brook, etc.;
Diogenes brook and others in vicinity;
Roads near Kewstoke and Skye mountains;
(G.S.C., Rep. 1879–80, pp. 24–32 F.; ibid, Rep. 1882–84, p. 33 H.)

(6.)—North Mountain Pre-Cambrian Area.

(Marble Mountain Area.)

The crystalline limestones of this area occur as patches along the coast of West bay. The following actual exposures are mentioned:—

Source of Big Brook and on road to West Bay.

Eastward of Ross Brook—"On the tracks about McCuish's, a mixture of quartz and hornblende occurs with flesh-red, quaternary granite, rather compact, with the quartz and feldspar, hornblende, and golden mica in small grains: and with compact, light coloured, subcrystalline to crystalline limestone, weathering white or dull grey, dipping north, 43 degrees east, at a high angle, and of various shades of white, green, and blue, spotted with some black extraneous matter. Seams of golden mica in fine scales run through the limestone, the layers of which are often less than an inch in thickness. On a neighboring track, thin and thick bedded limestone dips north 64° west; it is of a mottled, greenish-yellow and white colour and contains specks and streaks of black and silvery mica, so plentiful in places as to constitute the greater part of the rock."

Hills eastward of McCuish's;

Dallas Brook—Near Norman McKinnon's house;

Brook north of Dallas Brook—........"is succeeded by a bluish, fine, crystalline limestone which has been quarried. This contains large masses of white calcspar, which shine like burnished silver in the sun, in bright contrast with the dull lustre of the limestone."

Campbell's Brook and others in this District;

Small Outlier west of Sydenham Brook—At Rory McLeod's;

"Unlike the crystalline limestone elsewhere, the whole mass is homogeneous, not shaly nor even clearly bedded: it has been quarried to some depth and is white and good." This was the first marble wrought by Mr. Brown.

Left bank of Church brook;
Marble mountain (Vide postea);
Shore north of Marble mountain;
Lake on branch of McKenzie brook;
West of the track from Marble mountain to McKenzie creek;
One half mile southeast of Little harbour;
(Geol. Sur. Can., Rep. 1879-80, pp. 17-24 F.)

(9.)—George River–Eskasoni Pre-Cambrian Area.

Murphy's North Brook—Bands of white and variegated marble.
Murphy's South Brook— " "
Macdonald Brook—Varied crystalline limestones and marbles and serpentinous limestone.
Rocky Brook and Crane Brook;
Near Church on Boisdale road
Guthro road and Guthro Lake—White and light grey marble. (*Geol. Surv. Can., Rep. 1875-7, pp. 381-388.*)
French vale and Bourinot roads.
Laughlin Curry's road. (Geol. Sur. Can., Rep. 1876–7, p. 426.)
Eskasoni, from the Eastern Line of the Indian Reserve (*on East Bay*) *towards Indian Brook.* (*Vide postea*). (Geol. Sur. Can., Rep. 1876-7, p. 427.)

The remaining Pre-Cambrian areas require no further mention.

Of the numerous occurrences mentioned above, there are only four which have acquired sufficient reputation to warrant a more detailed description in the present report:—

The Marble Mountain area, in the North Mountain Pre-Cambrian area.
The George River area, in the George River–Eskasoni Pre-Cambrian area.
The Eskasoni area, in the George River–Eskasoni Pre-Cambrian area.
The Whycocomagh area, in the Craignish Hills Pre-Cambrian area.

Marble Mountain Area.

The above summary gives the chief localities of occurrence in this area: Marble mountain itself is typical of the region and represents the best available section. This deposit was discovered by N. J. Brown in 1868, and has been worked for marble, for lime, and more recently for flux. In view of its varied history, the following quotation is interesting:—

"The finest deposit of workable marble yet developed in Nova Scotia is that of Marble or North Mountain on the west bay of the Bras d'Or lake, which was discovered by Mr. N. J. Brown in 1868, but has attracted less attention than it deserves, owing to the difficulties which beset a new enterprise, the occupation of the Canadian market by older quarries, more favourably situated, and the exclusion of Canadian marble from the United States by a duty of fifty cents per cubic foot imposed on all foreign marbles. Still, there can be little doubt that this will ultimately become a source of profit to its owners.

"In variety of colour and tint this rock is like the crystalline limestone of the George River series, of which it forms a part; but it contains little or no admixture of the foreign minerals that elsewhere render them unfit for use, is more uniform in texture, and in unequalled abundance. It has been traced by means of natural outcrops and by trial pits from the shore of the lake to a height of 500 feet or more, on the side of a steep hill, with a nearly vertical southerly dip; and its extension on the strike appears to be considerable.

" Professor How in a report addressed to the Cape Breton Marble Company speaks highly of the extent and quality of the marble, and his opinion is corroborated by Professor Hind, Mr. Poole, inspector of mines, and practical quarrymen who have visited the place. Samples have been sent to marble cutters in England, the United States and Canada, with the most gratifying results. Its texture and quality are excellent; it works freely, takes a good polish, stands the weather well, and is especially adapted for monuments and ornamental work. According to Professor How, the rock while somewhat similar to the Vermont and New York marbles is tougher, and takes a much sharper cutting. In blocks it has greater resistance to crushing power than any rock except granite. Professor How enumerates the following varieties:—

(1) Fine white statuary marble.
(2) Fine white building marble.
(3) Coarse white building marble.
(4) Blue and white, clouded or Brocatello marble.
(5) Brocatello marble mixed with some six varieties of coloured marbles.
(6) Fine flesh coloured marble; changing to darker marbles, often striped and variegated.

"Several quarries have been opened. The Grand Quarry, about 450 feet above the lake and 300 yards from deep water, is in the centre of the very best pure white and variegated rock, which is found over about 200 or 300 acres, and exposed in the quarry to a height of 60 feet. A tunnel, 120 feet long, driven from a point about 200 yards from the margin of the lake, runs through bluish and white crystalline limestone and strikes the solid rock at the bottom of this face. A bed of yellowish crumbling rock, 8 feet thick, overlies the marble and greatly facilitates its removal. At the upper part of the face the rock is very much broken, but the cracks diminish in number and extent in depth, and for some distance around the tunnel the rock is white, solid, and free from flaws, and as the beds here are from 4 to 5 feet thick, immense blocks can be removed. Another tunnel has been driven from a point half way between the first tunnel and the shore, to strike the wall-face 170 feet below the surface, where the marble is clear white and free from flaws.

" The facilities for mining, drainage and shipment could hardly be surpassed. A short tramway has been laid to a shipping place, from which Canso light is but a few hours' sail. The buildings and plant are in good repair. Mr. Underhill, of West Rutland, Vermont, a marble worker of thirty years' experience, estimates " that $5,000 will put the Grand Quarry in good working order and build a mill sufficient to commence with." It is hoped that the reopening of St. Peters canal will add a fresh stimulus to this undertaking and develop a new industry and source of wealth in Cape Breton." [1,2]

Dominion Coal and Steel Co.

The quarry now operated by the company was formerly the property of Mr. N. J. Brown, from whom it passed to the Bras d'Or Marble Company, who in turn sold it about eleven years ago to the present owners. The Bras d'Or Company installed quarrying machinery including channelling machines and erected a mill equipped with gang saws and other appliances. Some slabs were produced and shipped to Halifax, but the venture does not seem to have been a success. I am informed that the chief difficulty which contributed to the failure was a tendency of the slabs to part along the lines of banding in the stone. The quarry is opened in the side of the mountain at an elevation of about 400 feet above the water. It extends, at about 75° east of north for a distance of 250 yards, and is worked in two benches, the lower presenting a face of about 75 feet, and the upper a somewhat less extent. On the hill behind the upper bench the limestone continues to a height of at least 160 feet more. A drill-hole, sunk in the lower floor, shows continuous limestone to a depth of 264 feet. The whole formation is steeply inclined, with a varying strike and dip. Beginning at the southwest corner of the quarry, a circuit around the face shows the following segments:—

1st. 15° west of north, 56 paces.

The strike of the formation is 25° east of north and the dip is vertical or slightly to the west. The stone on this stretch is mostly blue (513), or blue banded with white (514) and with occasional bands of white. The formation is fairly solid in places but broad zones occur in which the stone is only a few inches thick. Irregular joints cut the rock at 20° north of west, with a dip of 80° to the north. Another series, still more wavy and irregular, runs north and south, with a dip varying from 60° to 85° to the east. Towards the end of this segment there is more white in the stone than at the southwest corner.

2nd. 45° east of north, 118 paces.

The strike here is about 45° east of north and is therefore a little more to the east than in the first segment. However, towards the end,, it again swings northward, and at the very end it is almost due north and south with a dip of 80° to the west. The stone is of the blue, or blue and white banded type. The formational bedding is heavier than in the first segment, but the rock is cut by joints and flaws in all directions.

3rd. 60° east of north, 151 paces.

[1] Geol. Sur. Can., Rep. 1877-8, pp. 30-32 F.
[2] Geol. Sur. Can., Rep. 1879-80, p. 22 F.

The stone on this stretch is much lighter in colour. At first lenses of the white stone appear in the blue with a resumption of the original strike. Gradually the white increases in amount until a large continuous mass is presented—512. In this the most pronounced parting planes occur at 60° east of north with varying dips to the northwest. The bedding is heavy, with a strike of 30° west of north and a dip of 30° to the southwest.

4th. 35° south of east, 60 paces.

White stone to a shaly parting running at about 10° east of north with a dip of 80° to the westward.

5th. 5° east of south, 50 paces to the northeast margin of quarry.

The stone here resumes the predominating blue tone. It is thin bedded, shaly, and contorted, and much cut by checks. Here also occur narrow bands and blotches of pinkish and varigated stones, none of which, however, are in sufficient amount to have any economic value—511.

Two isolated masses of stone have been left standing on the floor of the quarry near the line of the original face. The more westerly of these shows blue and blue and white banded marble, striking 10° east of north with a dip of 80° to the east. The easterly mass marks the point at which the early quarrying for marble was done.

The stone is of the white variety and shows two distinct sets of joints, one striking 60° east of north with a dip of 80° to the northwest, and the second striking 20° east of north, nearly vertical.

The upper bench of stone shows no essential differences from the lower.

Summing up the above observations, it is seen that the predominating type is a blue and white banded stone. In this there is much more blue than white, nevertheless it is difficult to obtain a specimen of any considerable size which is pure blue. The band of white stone is of sufficient size to yield some good blocks, but a great portion of its extent as given above is occupied by transitional varieties, among which a blue and white clouded type is prominent (515). The pinkish or otherwise tinted stones of the eastern margin could be obtained only in small pieces and cannot be regarded as of economic value. Throughout the quarry the jointing is excessive and would constitute a serious drawback to any systematic exploitation of the deposit for the present purposes. The white band is less cut up than the more thinly bedded blue; but even in it, the waste in quarrying would be enormous. (Plate XXXVIII.)

The stone: No. 512.—This example probably represents the finest monumental or building marble to be obtained at Marble mo ıntain. It is of almost pure white colour and of medium to coarse grain. The physical properties which were determined are as follows:—

Crystalline limestone, Marble Mountain quarry, Inverness county, N.S.

Specific gravity........................	2·72
Weight per cubic foot, lbs................	169·5
Pore space, per cent.....................	0·087
Ratio of absorption, per cent.............	0·032
Coefficient of saturation, one hour........	0·87
" " two hours.......	1·00
Crushing strength, lbs. per sq. in.........	18197·
" " dry after freezing, lbs. per sq. in.........................	16148·

It will be observed that this stone is somewhat stronger than the examples from St. John, New Brunswick. The pore space also is somewhat lower.

No. 513.—A medium grained, dark blue crystalline limestone of finer texture than No. 512 described above. In small specimens the stone is uniform throughout, but, as stated before, it is difficult to obtain large pieces of this uniform character.

No. 511.—A salmon-coloured, medium grained, crystalline limestone shading into pink and white. Darker coloured varieties also occur in which the blue type is clouded with the coloured varieties as above.

Nos. 514 and 515.—These may be described as clouded and banded intermixtures of the white and the blue types in various proportions.

Twelve analyses by Mr. O. Herting of Ferrona gave the following average result:—

Silica, per cent............................	2·58
Calcium carbonate..........................	88·67
Magnesium carbonate......................	7·89[1]

The blue limestone, from the adjoining quarry of the Bras d'Or Lime Company, gives the following analysis:—

Silica, per cent............................	0·90
Sulphur, per cent..........................	0·01
Carbonate of lime..........................	96·31
Carbonate of magnesia.....................	0·83[2]

The present company operates the quarry exclusively for the production of flux for the furnaces at Sydney. The importance of the industry is shown by the fact that 500 men are employed and that about 3,000 tons of crushed stone are shipped per diem. The maximum production was reached on July 10, 1911, when 3,360 tons were shipped.

Particular importance is attached to this quarry, for it has long been regarded as indicative of the possibilities of the production of marble in Cape Breton. Despite the high promise held out in the early days, the attemps to utilize this material have not met with success. As to the

[1] Geol. Sur. Can., Rep. 1895, p. 110 A.
[2] Rep. Min. and Met. Industries, Dept. of Mines, p. 920.

cause of this failure, it may be said that the stone is not of the exceptional beauty necessary to offset the great loss in quarrying entailed by the shattered nature of the deposit.

Bras d'Or Lime Company, Halifax, N. S.

This company has a large quarry on the property adjoining that of the Dominion Coal and Steel Company, to the southwest. The excavation is about 300 by 200 feet in extent with a depth of 100 feet. The stone is of the blue variety with an admixture of whitish bands as in the western part of the other quarry. The formation has a more distinct and uniform strike and dip, as the rock runs 40° east of north and dips 60° to the northwest. The joints are irregular, the most pronounced set running with the strike of the formation and dipping at right angles to the beds. In places fair sized stone could be obtained, but there would be enormous waste in conducting operations for dimension blocks alone.

The total output is used for lime-making. Formerly the stone was burned in kilns at the foot of the mountain; at present it is shipped in the raw state. Gravity trams connect the quarry with the wharf. Twenty-five men are employed.[1]

The other openings along this coast, which have been worked on a very small scale for the making of lime, are now all idle. The more important owners at the present date are:—

Kenneth McPhie, Marble mountain.
John McPhie, "
Hugh Campbell, "
Christopher McCrae, "
A. A. McLean, "

George River Area.

"On the southeastern slope of the Boisdale hills there ranges a narrow zone of rocks, seldom exceeding half a mile in width, and allied in geological position and mineralogical characters to the limestones of New Campbellton, already described in the Report for 1874-75, in which mention is also made of a paper by Dr. Honeyman on the George River series.

"They consist of highly crystalline limestone and dolomite, containing serpentine, talc, mica, tremolite, plumbago, galena, hematite, magnetite and other minerals; interstratified with felsite, syenite, diorite, mica schist, quartzite, and quartzose conglomerate, and dipping steeply to the south of east. The colour is variable but chiefly bluish. This formation is probably Laurentian."[2]

[1] For a full description of plant see Report on the Mining and Metallurgical Industries of Canada, Dept. of Mines.
[2] Geol. Sur. Can., Rep. 1875-6, pp. 381-382.

The band of rock referred to in the above quotation is well exposed in the gorge of the George river a short distance above the railway at Scotch Lake station. Several attemps to work the white bands for marble have been made but apparently without success. At the present time flux is being obtained for both the Dominion Coal and Steel Co. and for the Nova Scotia Coal and Steel Co.

Dominion Coal and Steel Co., Wm. Routledge, contractor, Scotch Lake, N.S.

The operations of this company have exposed a splendid section in which the formation may be studied and from which deductions may be drawn as to the possibilities of the deposit as a producer of marble. (Plate XXXIX.)

The hill rises 676 feet above tide water. The main opening is at an elevation of 400 feet above the river and extends nearly due east and west along the hillside. Including the contiguous quarry of the Nova Scotia company, the total length of the excavation is nearly quarter of a mile.

On examining the face of the quarry, one is impressed by the lack of definite bedding or jointing throughout the length of the exposure. The only approach to regularity is shown by a system of joints, which strike about northwest and dip 70° to the southwest. These joints are, however, wavy, variable, and discontinuous. A second set, approximately at right angles, is even less distinct, and is generally to be recognized merely by the occasional parallelism of irregular and ill defined cracks.

The general aspect of the quarry face is light coloured; but very characteristic bluish, irregular bands appear at intervals and constitute the most striking peculiarity of the deposit.

This blue material (538) generally takes the form of a thin parting layer between neighbouring sheets of marble, and is often slickensided, indicating considerable movement in the whole mass. In places the blue material is associated with a yellow and the two frequently impregnate the rock on both sides of the parting plan. The general mass of the stone may be considered as presenting two types, a light bluish variety with grey and blue dots (540) and a white variety with yellow dots (541). There is, however, no sharp distinction between them. In certain parts of the quarry, particularly towards the west end, the yellow serpentine (542) occurs in considerable masses, free, or mixed with the limestone. At this point also a dyke of the eruptive described below as No. 543 cuts through the limestone formation.

Eastward from the quarry several openings have been made at different times, both on the hillside and on the top of the ridge. Specimens obtained from these old workings indicate that the stone is much the same as at the quarry, but that in places it is somewhat finer in grain. On the other hand there seems to be more slate and other impurities interbanded with the limestone. (544).

Making due allowance for the fact that the face of the quarry has been much shattered by the use of explosives, we cannot but conclude that the whole formation is much broken, and that the extraction of blocks of sufficient size for sawing into slabs would be attended by an enormous waste; nevertheless small pieces of stone of considerable beauty could be obtained.

Compared with the Marble Mountain deposit, the George River stone is lighter in colour, more serpentinous and more shattered; there is a marked absence of the dark blue type of stone so characteristic at Marble mountain.

The stone : No. 538.—A hard, dark, bluish-green serpentine of foliated and broken character lying in the parting planes between the blocks of marble.

No. 540.—A medium to fine grained crystalline limestone dotted with small aggregations of the blue material described above. The colour of the limestone is very light blue, or, in places. quite white. Besides the blue dots, small clouds of yellow serpentine are to be seen, as well as specks of a dirty brown colour. Even in the hand specimen this variety gives little promise as a decorative material.

No. 541.--A white, medium grained crystalline limestone with scattered dots of yellow serpentine. The specimen is much cleaner in appearance than No. 540, and would make a more desirable decorative material if it could be procured in pieces of sufficient size and of uniform structure.

No. 542.—Serpentine, varying in colour from bright yellow to olive green: it shows a banded structure in different shades and is sometimes invaded by stringers of white marble. This material can be procured in small pieces only.

No. 543.—Intrusive dyke-rock, probably a porphry. The stone is in a bad state of preservation and was not examined microscopically.

No. 544.—A very fine grained, white marble with clouds and veins of pink and green. This variety is much finer in grain than any seen in the large quarries: it would be a very desirable material if it could be obtained in quantity.

The average of a large number of analyses of George River stone is as follows:—

Silica, per cent	2·00
Oxides of iron and aluminium, per cent	0·50
Calcium carbonate, per cent	77·47
Magnesium carbonate, per cent	20·00[1]

The quarry is connected by a spur with the Intercolonial railway at Scotch lake, and is equipped with a modern quarrying and crushing plant. Sixty-five men are employed and about 300 tons a day are shipped to the furnaces at Sydney. The quarry is operated under contract for the owners by Mr. Wm. Routledge, who also performs similar work for the Nova Scotia Coal and Steel Co. on the adjoining property to the east.

[1] Geol. Sur. Can., Rep. 1895, p. 110 A.

Crystalline limestone, George River quarries, Cape Breton county, N.S.

An attempt was made by a Halifax company to quarry marble at a point one and a half miles up the river from the big quarry, and Joseph Peebit opened a small pit, with the same object, about one quarter mile north of the present workings.

Eskasoni Area.

The deposit of marble near Eskasoni, on the north shore of the east bay of Great Bras d'Or, is thus described by Fletcher:—

"In apparent unconformity with, and bounded on both sides by coarse syenitic and granitic rocks, the George River limestone runs in a band a quarter of a mile wide, from the eastern line of the Indian reserve towards Indian brook. Schistose, compact felsite, and quartzite, with light and light grey crystalline limestone, ranging in texture from compact to coarsely crystalline, and containing small vugs and veins, are again met with. A marble of considerable range of colour and texture, but generally white, with brown, blue, greenish, and canary-yellow streaks, susceptible also of a fine polish, has been quarried to a very limited extent on the hill near Bown's. It seems to be interstratified with a three feet bed of red syenite."[1]

Bown and Harrington, Eskasoni, N.S.

Messrs. Bown and Harrington control about 700 acres of land on the marble belt behind Eskasoni. Excavations have been made on the top of a hill, which rises about 600 feet above the lake. The whole of this hill is either wooded or covered with drift to such an extent that exposures are not frequent or sufficiently continuous to enable one to form an opinion as to the compactness of the stone. Forty years ago some small pits were made and specimens were secured for exhibition purposes, which received diplomas at the Paris exhibition of 1900.

Ten years ago Mr. C. A. Meissner examined the property for the Dominion Coal and Steel Company and sank a number of test-pits to ascertain the suitability of the stone for use in the steel plant. As the company did not proceed with development it is to be concluded, either that his report was unfavourable, or that a satisfactory business arrangement could not be effected. Mr. Fletcher states:—"Although the developments failed to discover limestone suitable to supplement that at present obtained in large quantity for the furnaces from the Marble mountain of West bay, yet they afforded interesting contacts with the surrounding felsitic, gneissic, and syenitic rocks."[2]

A number of these pits were examined, but they are all of too limited extent and too superficial to show much light on the character of the beds. As far as could be seen, there is no body of marble, capable of economic

[1] Geol. Sur. Can., Rep. 1876-77, p. 427.
[2] Geol. Sur. Can., Rep. 1902-3, p. 395 A.

exploitation as a decorative stone. Although some handsome material undoubtedly occurs, it does not seem to be sufficiently massive to permit of its extraction in large blocks. Whether or not workable bodies occur remains for more serious exploration to reveal.

The first pit is a small trench on the top of the hill; in it the variety described below as No. 533 is seen. The formation strikes 10° north of west with a steep but indeterminable dip. There is no evidence that the stone is sufficiently solid to work, but, of course, only the upper shattered portion is visible. About 300 yards to the west is another exposure and a small opening. Here the main mass is whitish grey and coarse in grain with coarse grained blue bands (536.) Narrow bands of a fine grained and yellow banded variety (534) are included in the coarser stone. The strike and dip is the same as in the first opening and there is the same lack of evidence of solidity. One hundred yards to the southwest is a third exposure, showing bands of medium grained, whitish stone with spots (535).

The stone: No. 536.—This example is a medium to fine grained crystalline limestone with a finely clouded white and blue appearance. In addition, it is marked by scattered lines and dots of a green colour. Polished specimens produce a decidedly pleasing effect. On treatment with carbonic acid and oxygen the bluish clouds are less apparent, the surface is etched and the dark green lines stand out more prominently.

The physical properties are as follows:—

Specific gravity	2·831
Weight per cubic foot, lbs	176·165
Pore space, per cent	0·319
Ratio of absorption per cent	0·113
Coefficient of saturation, one hour	0·88
" " two hours	1·00
Crushing strength, lbs. per sq. in	28208·
" " dry after freezing	26301·
Loss on treatment with carbonic acid and oxygen, grams per sq. in	0·0462
Transverse strength, lbs. per sq. in	2892·
Chiselling factor, grams	3·8
Drilling factor	10·

This stone is heavier, stronger, and harder than the other crystalline limestones tested. These features are doubtless due to its dolomitic character as shown in the following analysis by H. A. Leverin:—

Insoluble matter, per cent	2·44
Alumina	0·14
Ferrous oxide	0·90
Ferric oxide	0·14
Calcium carbonate	61·96
Magnesium carbonate	34·36

No. 533.—A medium grained crystalline dolomite with a cast of green in the general colour. In places this greenish tint gives place to a more distinct yellow, owing to the occurrence of yellow serpentine intimately mingled with the dolomite. In addition, the rock-mass is traversed by many stringers and clouds of a dark blue-grey colour in which flakes of glistening hematite (specular iron ore) may be seen. This darker material also occurs in the form of isolated dots. The specimen resembles some of the varieties from George river.

No. 534.—Medium to fine grained crystalline limestone (dolomite) interbanded with yellow serpentine. This material is very handsome when polished and would be a valuable marble if it could be procured in large blocks.

No. 535.—This example is decidedly fine in grain, with a prevailing light sea-green tint, which is relieved, however, by clouds and bands of pink and darker green. It constitutes a very handsome and delicately tinted marble, suitable for decorative purposes of the highest order.

No. 537.—Somewhat coarser in grain than No. 535. The general base is whiter and the cloudings are of yellow, lavender, and green.

Whycocomagh Area.

The Whycocomagh marbles are exposed on the hill across the Skye river to the west of Whycocomagh. The whole of this hill is mapped by Fletcher as belonging to the George River series, but it is, by no means, all limestone. The series is made up of the usual admixture of felsites, syenites, and other rocks interlaminated with the limestone. Dr. Honeyman has fully described the marbles of this district.

As in the case of the Eskasoni deposits, the hill at Whycocomagh is well covered with soil and timber, so that outcrops are few and not continuous. Behind the Indian houses on the reserve, some outcrops may be seen in the beds of several small streams. The most abundant limestone as revealed in several of these outcrops is a whitish, somewhat schistose variety, highly pyritous in places (517). With this is associated a greenish-white type (516) and small quantities of pinkish and otherwise clouded material. The formation strikes northwest and dips northeast at varying angles. As far as could be observed in these creeks, the bedding is too thin and the stone too variable to be of economic value.

Hugh McDougall, Whycocomagh, N.S.

About a mile to the northward of the exposures described above the formation is well exposed on the property of Mr. McDougall. Here the general strike seems to be more nearly north and south, and the limestone band is of greater width. The stone is a medium grained, greyish-white variety, with red, pink, and green clouded bands. No work has been done to reveal the character of the jointing, but an inspection of the surface shows the stone to be less shattered than in many of these marble belts.

Daniel and Angus McDonald, Whycocomagh, N.S.

To the northward of the exposure on McDougall's property, across Indian river, a small quarry has been opened in the limestone belt by the Messrs. McDonald. The excavation is about 50 feet square and of slight depth, but it serves excellently to illustrate the fracturing of the formation in this area. The formation strikes 10° east of south and dips east at about 80°. A strong system of joints runs with the strike but dips 80° to the west: the stone is therefore cut into Vs by the bedding and this system of joints. A second set strikes 40° west of south with a dip of 75° to the south-east, and is much more marked in some parts of the quarry than in others. Both sets are often closely set so that large stone cannot be obtained, at least with the quarry in its present state of development. The general average of the stone is a bluish-white clouded type of coarse grain (520). The green material frequently forms distinct parting planes along which the stone breaks easily. In parts of the quarry the marble is traversed in all directions by fine veinlets of reddish calcite (521).

The stone: No. 516.—A medium to fine grained, white crystalline limestone clouded with brownish green and charged with considerable pyrite: it is not a promising material.

No. 517.—A medium grained example showing intimate cloudings of pink and greenish-grey. A large amount of pyrite is present rendering the material of little value.

No. 518.—Like No. 517 but with a stronger contrast between the pink and the green portions. The pyrite is less abundant so that the stone might be used for purposes of interior decoration.

No. 519.—A fine grained, white and greyish clouded type, with considerable iron pyrites.

No. 520.—A decidedly coarse grained crystalline limestone, with a tinge of blue which is not uniformly distributed but which occurs in ill defined, irregular clouds. A few scattered grains of pyrite and crystals of brownish shining mica occur thoughout the mass.

No. 521.—A dirty white to pinkish, medium grained crystalline limestone traversed by fine veinlets of reddish calcite. The colour of the base is not clean and it is very doubtful if any pieces of considerable size could be obtained. The stone has a strong tendency to break along the veinlets. The red-veined stone from Ryan's quarry in the St. John area described as No. 425, page 170, is very like the present example.

No attempt has been made to employ this stone for decorative purposes. The total output is shipped to the works of the Brandram-Henderson

Company of Halifax, where it is used in the preparation of certain of their products. The haul from the quarry to tide water is about two and a half miles.

The numerous localities at which marble is known to occur in the Craignish hills have already been partially listed. For a more complete account of these occurrences, the writer is referred to the literature cited. The writer has seen a very handsome specimen of dark grey marble, finely veined with white, which is said to have been produced at a point midway between River Denys station and Judique.

Summary—The Marbles of Cape Breton.

The George River series presents numerous outcrops of crystalline limestones, which, in places, are of the necessary fineness of grain and beauty to constitute decorative material of high order. All attempts to utilize these deposits on a commercial scale have failed, owing chiefly to the difficulty of obtaining blocks of sufficient size. The excessive fracturing to which this ancient series or rocks has been subjected seems to have universally shattered the stone beyond the possibility of economic quarrying.

Enormous quantities of crystalline limestone are obtained for flux for the iron furnaces, more particularly at Marble mountain and George river.

THE METAMORPHIC MARBLES OF SILURIAN, DEVONIAN, AND CARBONIFEROUS AGE.

Sedimentary limestones of Silurian, Devonian. and Carboniferous age have been altered into marble by the heat from injected masses of eruptives at a number of places in both provinces. As no serious attempt has ever been made to work these deposits, they can scarcely be considered of present economic importance. The following brief account of the more important localities is compiled from reports by officers of the Geological Survey of Canada, supplemented, in one or two cases, by observations by the writer.

NEW BRUNSWICK

Petite Roche, Restigouche county.—"About half a mile north of Petite Roche station, one of these outcrops seen in a pit shows the limestone altered to a crystalline marble, but still retaining traces of crinoid stems. Crystalline limestones are more plainly seen on a road running just a short distance below Elm Tree crossing. Here, about three-fourths of a mile beyond the railway, quite extensive beds of marble, whitish-grey in colour, are found in immediate proximity to large masses of diorite, but in all cases, so far as the surface quarries have exposed the rock, it is extensively shattered, and does not give much promise of workable beds. The alteration is also quite local, and the crystalline portion changes quite abruptly into ordinary grey fossiliferous limestone."[1]

Tobique Valley, Victoria county.—"Limestones of Lower Carboniferous age occurring about half a mile below these beds (Blue mountain) on the river, are quite hard and crystalline, but show no disturbance. Red and greenish-grey in colour, often prettily marbled, and hard enough to take a good polish, these limestones would probably afford handsome marbles for ornamental purposes."[2]

Hampstead, Queens county.—"Where igneous rocks are associated, as at Quaco, and Hampstead, Queens county, with limestones, the latter have been more or less completely converted into marble."[3]

A narrow belt of Carboniferous limestone crops out near the road about four miles north of Hampstead and also appears between the road and the river. The stone is of a reddish semi-crystalline character, and is associated with sandstones and shales. Many years ago Sir Leonard Tilley made an attempt to work this deposit, and several test pits were sunk before the work was abandoned. These pits are now filled with débris and overgrown with vegetation. As far as can be determined, the stone is very limited in amount and excessively fractured. Its economic possibilities are entirely problematical.

The stone: No. 434.—The general mass of the stone is a fine grained, greyish-pink crystalline limestone of mottled aspect, i.e. the pink is not uniformly distributed but is more evident in some parts than in others. Coarser grained veinlets of white calcite traverse the pinkish groundmass in all directions. The general effect is pleasing but the pink portions are rather too dead for a decorative stone. Other examples present a deeper red, and still others show a brecciated structure with angular fragments of a light colour embedded in the red matrix.

Across the river, at Rush hill, the same deposit is said to occur in a wider band.

Bay of Fundy shore.—Crystalline limestones associated with serpentine, and forming, in many cases, a handsome verde-antique, occur at many points along the Bay of Fundy shore. The age of these deposits has been much questioned and the matter is not yet definitely settled. Formerly they were ascribed to the Huronian of the Archaean age, but Ells is inclined to place them very largely in the Silurian. Whatever their geological age, there can be little doubt that the serpentine limestone of St. John, regarded by Dr. Matthew as older than the heavy beds at the Narrows, belongs to the same series. Although many museum specimens have been obtained from the different localities of occurrence of these serpentine marbles, I have been unable to learn of any attempt to exploit

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[1] Geol. Sur. Can., Rep. 1879–80, p. 19 D.
[2] Geol. Sur. Can., Rep. 1886, pp. 6–7 N.
[3] Geol. Sur. Can., Rep. 1900, p. 18 M.

them on a commercial scale. The more important localities are given below:—

Pisarinco, Musquash, Fryes island, Lepreau, L'Etang, Deer island, Campobello, Kents island off south shore of Grand Manan, Dipper harbour.

The general description of the stones given by Dr. Bailey is as follows:—"In tint they vary from pure white to cream-colour, reddish, greyish or greenish, the latter tint due to associated pale green serpentine, constituting verde-antique. In texture they similarly gradate from kinds which are almost cryptocrystalline to others which are coarsely saccharoidal. Many of them are not without beauty, and are susceptible of a fine polish, but they are apt to be much shattered by the shearing strains to which they have been subjected, and this has greatly interfered with their being turned to useful account. Small quarries have at times been opened, but no extensive or continuous work has yet been undertaken......Hand specimens (serpentine marble) are often quite handsome, but large blocks free from cracks are not easily obtainable."[1]

The specimen from St. John described on page 164 may be regarded as typical of all these deposits and may serve as a supplement to the excellent account given by Dr. Bailey. Readers interested in the discussion as to the geological age of the marbles are referred to "The Geology and Mineral Resources of New Brunswick," by Dr. R. W. Ells. A summary of his conclusions is given on page 47 of this work.[2]

NOVA SCOTIA.

Salmon Creek.—"At Stephen McLean's, near Salmon creek, a cliff of bluish-grey, somewhat crystalline, Devonian limestone was quarried for marbles in a deep excavation, but soon abandoned."[3]

Hattie's millstream, Antigonish, Antigonish county.—"The crystalline limestone from Hattie's millstream on the west side of South River lake, may be from a large, homogeneous vein. It is white, finely crystalline, pure and good, like the finer varieties of Marble mountain and George river. The mixed, impure, crystalline limestone of Livingstone brook, is probably a vein."[4]

East River of Pictou and Frasers mountain, Pictou county.—"Professor How[5] describes a greenish coloured marble from the East river of Pictou, and a grey, patterned, concretionary variety from Frasers mountain, which exhibits in a polished specimen 'concentric waved bands in separate sets whose outlines somewhat resemble expanded flowers,......it would make fine inlaid work.' The quantity is said to be considerable, but not all equally beautiful."[6]

[1] Geol. Sur. Can., Rep. 1897, p. 108 M.
[2] Geol. Sur. Can., Publication No. 983, 1907.
[3] Geo.. Sur. Can., Rep. 1877–78, p. 30 F.
[4] Geol. Sur. Can., Rep. 1886, p. 126 P.
[5] Mineralogy of Nova Scotia, p. 158.
[6] Geol. Sur. Can., Rep. 1886, p. 126 P.

North River of Five Islands, Colchester county.—"At the top of the fall......is a whitish, compact crystalline limestone or marble, spotted with grey, greenish, and yellowish, whiteweathering, fibrous serpentine, perhaps in a vein."[1]

"Crystalline limestone occurs at several points, more particularly in rear of Five islands on the North river, and, between Londonderry mines and Point-au-Pic. At the former locality the marble is found in the stream about two miles from the mouth and 330 paces north of the main fall which marks the boundary line between the Pre-Cambrian and the iron ore belt. The rock, much of which is beautifully white and crystalline, is associated with red syenite, green feldspathic schist, and hard slates. Small dykes and veins of diorite have so shattered it as to render the ledge practically useless for obtaining large blocks. A short distance farther up stream the marble is greenish-grey and serpentinous, and in places traces of abestos are found. The width of this ledge is from ten to twelve feet, but it has not been traced beyond the bed of the river. The marble of this place occurs associated with green talco-feldspathic schist, probably as an integral portion of that belt.

"About four miles west of Londonderry mines, on the property of D. and A. Morrison, Cumberland road, and about two miles from the new mines, large outcrops of white marble resembling much of that in the vicinity of St. John, N.B., are seen. It occurs on the south flank of the mountain apparently overlying the schists. A large quantity was taken out some years ago for use at the iron works and is yet lying along the tramway to the new mines. It would, undoubtedly, make a fine quality of lime, but little use has as yet been made of it for that purpose."[2]

The above accounts of the Five islands stone would indicate that it is too much broken to serve as a source of building or ornamental marble. Although ascribed to the Pre-Cambrian in the reports cited, later observations by the same author tend to show that the marble is an altered Devonian limestone.

Mill Creek, Five Islands, N.S.—In 1877 an attempt was made to quarry marble at this point on an outcrop which is described as being about 100 feet wide and as inclining to the northward at an angle of 80°. The hanging wall is a graphitic shale carrying a little copper pyrites, and the foot-wall is a decomposed basic eruptive. The surface of the outcrop was found to be so shattered that a drift was run in for 60 or 70 feet and some blocks extracted by plug and feathers work. Unbroken stone was obtained in pieces 5 feet long and from 2 to 3 feet square.

The stone: This material has not been examined by the writer: it is described as being of a uniform, salmon-pink colour and even texture. Some test blocks were sent to Truro for dressing, but they were found to be too hard for ordinary marble-working tools. Attempts at polishing were

[1] Geol. Sur. Can., Rep. 1890–91, p. 160 P.
[2] Geol. Sur. Can., Rep. 1885, p. 60 E.

not successful, as grains of flint, detached in the operation, were whirled around by the buffer, thus rendering impossible the production of a smooth surface.

Kirks Hill, Parrsboro, Cumberland county.—"This is an exceedingly fine grained marble, susceptible of a high polish, and if found in sufficient quantity and free from shakes, would make ornamental stone. The deposit has not been worked and the sample is from the surface."[1]

This deposit represents Devonian limestone which has been metamorphosed by injected granite of the Cobequid mountains. The outcrops are situated on the property of Mr. Robie Kirkpatrick, Kirks hill. The belt of marble is very little exposed and does not appear to be more than 12 feet in width with a northerly strike. The whole of the visible outcrop is invaded by the eruptive to such an extent that, as far as the present exposure is concerned, there is no hope of obtaining large pieces. The stone is a reddish marble, of considerable beauty, and is described in detail below.

The stone: No. 490.—The groundmass of the hand specimen consists of a pure white and exceedingly fine grained marble; it is traversed by a few lines of a delicate pink or green colour, and is dotted with light green blotches. These green blotches have a tendency to weather out, rendering the stone cavernous, but this peculiarity would doubtless disappear with depth. The beauty of the small specimens fully warrants a search for larger bodies of the rock, but, as stated above, the present outcrop does not present economic possibilities.

Walton, Hants county.—"The unusual colours and brecciated character of this stone has attracted the attention of all who have seen it in the polished state. If it proves to be in sufficient quantity and unshattered it would doubtless find a ready sale. The deposit was owned by the late G. W. Churchill, of Hantsport, but little or no work has been done to develop it."[2]

The deposit referred to by Mr. Piers outcrops in a little ravine on the west side of the river opposite Walton. The talus on the hill side permits the rock to be seen at one or two points only, so that little can be said as to the economic possibilities of the marble. The chief opening was made on the top of the hill, but it is now filled with debris and overgrown with vegetation. The upper rock seems to be a coarse limestone breccia or conglomerate, beneath which occurs a red marble filled with small wavy veins and vugs (485). Nothing can be seen of the formation at this point, but a short distance down the hill the stone is seen to strike 40° west of north and to dip 23° to the northeast. The stone here is thin-bedded, for the most part, but a bed of 10 inches in thickness was observed (486).

The stone: No. 485.—A dull red, medium to fine grained, crystalline marble of mottled appearance, traversed by fine veinlets of white calcite and presenting a number of open cavities, lined with crystals of calcite.

[1] H. Piers, Economic Minerals of Nova Scotia, King's Printer, Halifax, 1906.
[2] H. Piers, Economic Minerals of Nova Scotia, p. 45, King's Printer, Halifax, 1906.

The general aspect is brighter and the colour deeper than that of the specimen from near Hampstead described as No. 434 on page 188.

No. 486.—This specimen is of rather finer appearance but it does not differ materially from No. 485.

While it is impossible to speak with any certainty as to the economic possibilities of a deposit so little exposed, it may be said that the thin-bedding and the fractured nature of the surface rock does not argue well for profitable exploitation. It must be admitted, however, that further development might reveal beds of a workable character, which would yield a unique type of red, veined and brecciated marble.

Across the river from the Churchill property, on the farm of Benjamin McCullough, a similar stone in thin beds crops out at a lower level.

CHAPTER VIII.

Gypsum and Anhydrite.

Gypsum is the crystallized sulphate of calcium containing 20·9 per cent of water: anhydrite is crystallized sulphate of calcium without water and is commonly known as hard plaster. Both of these minerals, when finely crystallized and of good colour, have a value as decorative materials.

The Carboniferous rocks of the Maritime Provinces are rich in deposits of gypsum, which have been very extensively worked for the production of plaster. The Mines Branch has recently issued a monograph on the gypsum of the Maritime Provinces[1]; in consequence, it would be superfluous here to do more than call attention to certain rather important deposits from the present point of view. As far as I am aware there is only one locality—Hillsborough, New Brunswick—which has yielded decorative gypsum on a commerical scale. It is quite possible, however, that many of the larger deposits may produce material suitable for ornamental purposes.

Owing to its softness and the rapidity with which it succumbs to the weather, gypsum is not adapted to any sort of outdoor ornamentation. On the other hand, the fineness of grain, and the ease with which it may be turned or chiselled, renders the stone particularly desirable for certain purposes of interior decoration. Attempts have been made to render the stone harder by chemical means so that it will receive a more brilliant polish and retain the finish for a longer time. One of the most important of these processes consists in first heating the nearly completed object to a temperature just sufficient to bring about incipient dehydration and then soaking it in a solution of aluminium sulphate. On again heating the stone is rendered hard enough to receive a polish equal to that of fine grades of marble. The finish thus obtained seems to be permanent and to be unaffected by ordinary, indoor, changes of moisture or temperature.

Albert Manufacturing Co., Hillsborough, N.B., G. Tomkins, president, New York, C. J. Osman, manager, Hillsborough, N.B.

This company operates several very large quarries near Hillsborough, of which the most important from the present point of view is that known as the Sayres. This quarry is worked by tunnels driven into the side of a hill in beds of gypsum 87 feet thick (the total thickness of the formation is probably much greater). The main tunnel has been advanced for a distance of 1,200 feet. The formation strikes north and south and dips west into the hill at about 10°. The mass of the formation is made

[1] Gypsum Deposits of the Maritime Provinces, Jennison.

up of three types of stone—common grey gypsum, white gypsum and anhydrite (hard plaster). These three types of rock do not lie in regular beds but rather in lenticular masses, so that no general succession of beds can be given. It is estimated that the fine white stone constitutes about 10 per cent of the entire series. In places, more particularly near the joint planes, the white stone is converted into a beautiful pink variety, which can be obtained in pieces of sufficient size for the manufacture of small objects (440). The stone at present exposed at the head of the main tunnel shows about 12 feet of white gypsum (438), separated into two beds by a foot of anhydrite (439). The best bed of white is said to occur towards the top of the series. The jointing is quite irregular, so that large, flawless blocks are difficult to obtain. Perfectly clear and flawless pieces of 24 inches square can be secured, and even larger pieces with but few imperfections.

The stone: No. 438.—This stone is a pure white, fine grained gypsum, excellently adapted for the purposes to which alabaster is commonly applied. The material is soft and easily carved, yet it is capable of retaining the finest detail of sculpturing.

The physical properties of this stone were determined in the same way as those of the other materials tested. There is no doubt, however, that some modifications in the method of procedure are necessary to give accurate results, as the drying for 36 hours, at a temperature of 110° C., induced some dehydration of the gypsum, thereby decreasing the dry weight and increasing the weight of the sample after soaking. That the figures given below are not exactly correct may be seen from the fact that the true specific gravity of pure gypsum such as this seems to be is 2·314—2·328 whereas the figures obtained are 2·7176. It may be concluded therefore that the results of all the tests as to porosity, absorption, etc., have been interfered with by the chemical reaction between the thoroughly dried sample and water.

The figures as obtained are, however, included in the list given below:—

Specific gravity	2·7176
Weight per cubic foot, lbs	168·088
Pore space, per cent	0·967
Ratio of absorption, per cent	0·359
Coefficient of saturation, one hour	0·97
" " two hours	0·97
Crushing strength, lbs. per sq. in	9412·
" " wet after freezing, lbs. per sq. in	6922·
Transverse strength, lbs. per sq. in	436·
Chiselling factor, grams	8·8
Drilling factor, mm	28·

The chiselling factor must not be taken in direct comparison with the factors for the sandstones as a measure of the relative ease of cutting.

The figure given is exactly as obtained: its lowness is due to the crumbling of the gypsum under the tool whereby the edge was kept from direct contact with the test slab.

No. 439.—This rock is the so-called *hard plaster* and consists of fine grained bluish anhydrite cut by little seams and stringers of white gypsum. When cut and polished the appearance is sufficiently attractive to justify the use of the stone for purposes of interior decoration. It is doubtful, however, if a sufficiently dry and uniform atmosphere for the preservation of this stone would be normally maintained in any building in Canada.

Contrary to expectations, the behaviour of this example when thoroughly dried and then saturated with water was more erratic than that of the pure gypsum, as the test cube so rapidly disintegrated that further operations were rendered impossible.

The following constants may, however, be relied on:—

Crushing strength, lbs. per sq. in.	16052·
" " wet, lbs. per sq. in.	4938·
" " wet after freezing	nil.
Transverse strength, lbs. per sq. in.	1627·
Chiselling factor, grams	11·4
Drilling factor, mm.	17·

The higher chiselling factor as compared with gypsum is due to chipping and the lower drilling factor is due to the superior hardness of the stone.

No. 440.—This pink gypsum resembles the white variety in the fineness of the grain and differs only in presenting the light pink hue shown in Plate XLV, No. 16. When cut and polished, a semi-translucent effect is produced, which, together with a somewhat clouded pink and white appearance, is decidedly attractive.

The ordinary method of mining shatters the stone to such an extent that it is useless for purposes of decoration. In order to obtain unbroken blocks, the company at one time adopted the system of mining described below, but during the past two years none has been quarried. Having encountered a mass of white gypsum at a convenient place in the face of the workings, a tunnel 25 feet wide and 7 feet high was driven into the overlying stone. The floor was then cut into blocks 5 feet by 4 feet by a series of channel-cuts which were generally extended to a depth of 7 feet. The blocks were then raised by plug and feathers inserted in a line of holes 4 inches apart and 4 feet down on the face. Many of the blocks thus set free were found to be severely checked, while others were comparatively free from imperfections. For drilling, the Howell mining drill was employed and was operated by hand power: two men can sink a 5 foot hole with this apparatus in 15 minutes. For channelling, a small bar-channeller using a three bit drill was found to be quite serviceable.

Blocks of gypsum thus prepared were formerly shipped to New York, and to Chester, Penn. Mr. Osman informs me that too low a price was obtained for this material to justify further production, and in consequence operations were suspended. At the present time, however, he considers that a rate of $10 per ton f.o.b. Hillsborough, would be sufficient to put the stone on the market with a reasonable profit to the company.

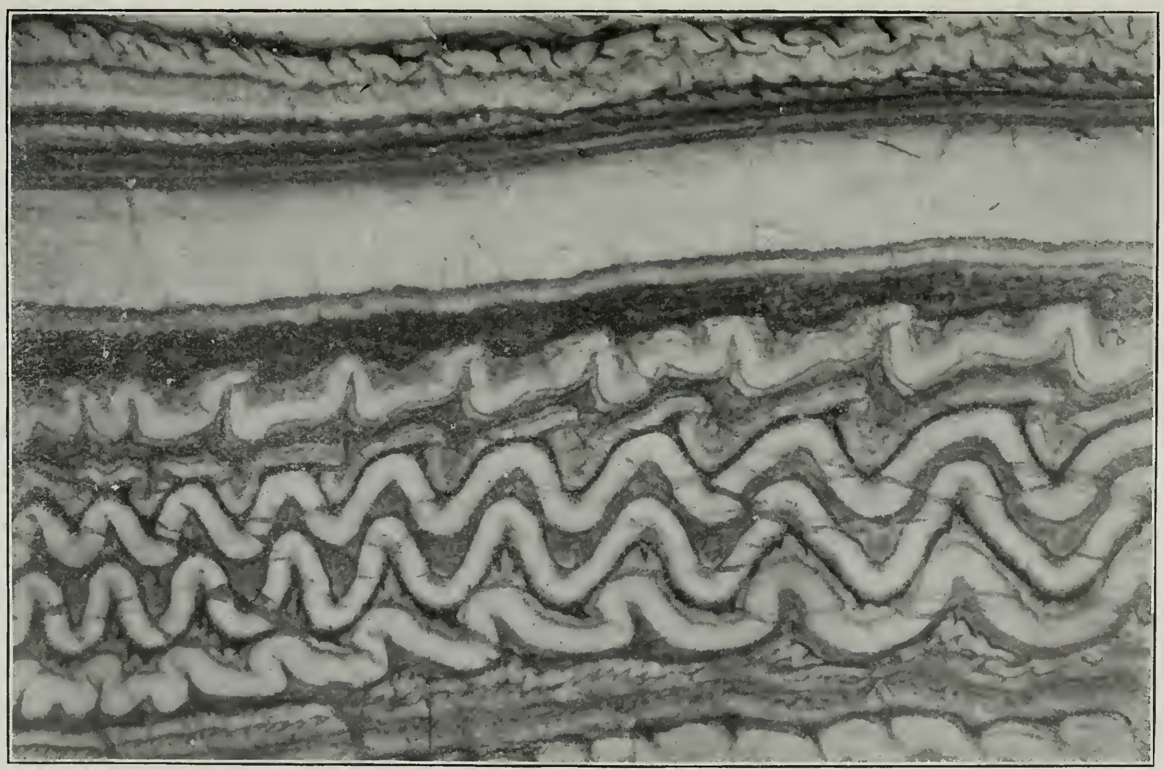
Gypsum, being suitable only for interior work of a fine character, is not demanded in such large dimensions as marble. There is no doubt that large quantities of white stone of sufficient size for the purposes to which gypsum is adapted could be obtained in this quarry. It is very regrettable to see such handsome material shattered by powder and eventually converted into plaster. The exponents of "Conservation of National Ressources" would do well to direct their attention to this matter.

The Smith, the Steeves, and the Whitehead are other large quarries operated by the company, but none of these show the fine white gypsum of the Sayres quarry. The output is a banded grey type, which can be procured in large blocks, and which is not entirely without value as a decorative stone. In the Smith quarry there is occasionally encountered a peculiarly attractive crumpled band shown in Plate XL. This would make a highly desirable material for special decoration, but unfortunately it is obtained in small amount only.

The present output of gypsum of all kinds from these quarries is 100,000 tons a year. The company's mill at Hillsborough was recently destroyed by fire, but a larger building is now in course of erection. Besides the extensive mining plants, the company operates 10 miles of track with 2 locomotives and 150 cars.

Wentworth Gypsum Company, Windsor N.S., Geo. R. King, president, New York.

The very large quarry of this company is situated near Windsor, in Hants county, Nova Scotia. The present face is fully 50 feet high, and presents a somewhat greyish gypsum (487) which may be regarded as the average of the quarry. The formation is strongly jointed east and west with minor cracks in other directions, but, in places, blocks of large size without flaws can be obtained with ease. Two years ago thirty blocks of this stone, measuring from 4 to 5 feet long and $2\frac{1}{2}$ feet square were shipped to New York for purposes of decoration. In places, particularly towards the top, the stone is of a whiter colour (489), but it is doubtful if large uniform blocks of this type could be quarried. On the floor of the upper bench of the excavation is a band of anhydrite 8 feet thick which could be quarried in blocks of large size. Although it is not employed for decorative purposes it is nevertheless a stone of considerable beauty and must be included among the decorative materials of Nova Scotia (488).



Crenulated gypsum, Sayres quarry, Albert Manufacturing Co., Hillsborough, Albert county, N.B.

The stone: No. 487.—A fine grained, white gypsum, clouded throughout with greyish matter of an argillaceous nature. The compact nature and the fine grain of this stone make its use as a decorative substance for indoor use quite possible.

No. 488.—Crystalline anhydrite of a bluish colour and fine crystalline structure. In places the stone is traversed by brownish bands, and it is intersected at intervals by veinlets of gypsum. The polished surface is very attractive, presenting a light, bluish, semi-transparent appearance. The stone is more uniform than the anhydrite of a similar appearance from the Hillsborough quarries, but, in view of the results of tests on this latter stone (page 195) the great susceptibility to injury by water is not to be disregarded.

No. 489.—Like No. 487 but of a whiter colour and less distinctly clouded with grey. The grain is exceedingly fine and uniform.

Geo. W. Churchill Estate, Ezra Churchill, manager, Walton, N.S., Albert Parsons, local manager for the lessees, J. B. King and Co. of New York.

This is another of the large gypsum quarries of Nova Scotia. While furnishing excellent material for plaster, it is of less value from the present point of view, as the stone is all of the common grey banded type and is much cut by irregular joints.

The stone: No. 484.—Fine grained white gypsum, irregularly clouded and banded with grey. In places, crystals of selenite are imbedded in the general mass. The stone seems too soft and friable for our present purposes and its appearance is not particularly attractive.

A deposit of anhydrite, also belonging to the Churchill estate, is situated at Cheverie. The stone is grey and white banded and can be procured in large pieces. It is stated that some large blocks were quarried here and were employed for decorative purposes. The locality was not visited.

As far as the writer is aware, the numerous other gypsum quarries and the very large number of prospects do not present any particular reasons for investigation for the purposes of this report. Two others only were visited—one at McKinnon harbour, Victoria county, Cape Breton, and the other near Brierly brook, in Antigonish county. The McKinnon harbour quarries belong to the Albert Manufacturing Company of Hillsborough, and are not at present in operation. The stone is of the ordinary, grey banded type and is badly shattered. No. 525 described below is an average sample. On the north side of St. Andrew channel, near Iona, are extensive exposures of gypsum, which are of a generally whiter aspect and which may possibly yield decorative material in the future.

The stone near Brierly brook occurs in cliffs nearly 100 feet high on the property of Alexander McDonald. The gypsum is of the ordinary banded type and presents no examples of decorative value (503.)

Some of the numerous gypsum deposits on the North river of Antigonish are said to produce a fine grained, white gypsum of alabaster grade.

A fine crystallized selenite occurs at Elmsdale in Hants county, and at Canfield creek near Upper Pugwash in Cumberland county.

The stone: No. 503.—Soft, friable, white gypsum with irregular grey bands: it is not promising for the present purposes.

No. 525.—A somewhat harder and more compact type than No. 503, but it does not seem to possess any properties to particularly recommend it as an ornamental material.

CHAPTER IX.

Slate.

Extensive areas of slate occur in both Nova Scotia and New Brunswick in those regions where the clay sediments of Cambrian, Cambro-Silurian, and Devonian age have been subjected to severe metamorphism. There is a great difference, however, between formations of slate in a geological sense and belts capable of economic exploitation for the production of roofing slate.

Although this material is commonly regarded as a rough substance, it is nevertheless a very tender one, and is very susceptible to destruction under the action of the weather. On this account, very little is to be learned of the possibilities of a prospect from an examination of the unworked outcrop. The ability to cleave, which is one of the chief attributes of roofing slate, is so seriously affected by even a short exposure to the weather that the blocks of slate have to be carefully kept wet until they are split to the required thickness. It is apparent, therefore, that little, if any, additional information could be obtained by an examination of the reported localities of occurrence. Further, as there has been no production for many years, the subject scarcely falls within the limit of this report. Nevertheless, as there are at least possibilities for the production of this material, it seems advisable to give a summary of the more important occurrences.

NEW BRUNSWICK.

Concerning the slate of this Province, Dr. Bailey wrote as follows in 1899:—

"No slate quarries have as yet been opened in New Brunswick, but probably rather because of the very limited demand for the material than from the inability of the Province to produce it. Slate is in fact a very common rock in New Brunswick, and although nothing has been done in the way of testing its quality, it can hardly be doubted that localities could be found in which it would satisfy all requirements.

"Among the districts which may be especially referred to as likely to furnish good slates, is that of northern Charlotte county, in the parishes of St. James and Dumbarton, the southern part of Queens, in Petersville and Hampstead, the Tobique valley in Victoria, and portions of Madawaska, Gloucester, and Restigouche counties. It is stated that the Court House at Bathurst is roofed with slate from the Tattagouche river." [1]

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[1] Geol. Sur. Can., Rep. 1897, pp. 114–115 M.

Dr. Ells, writing in 1907, was less optimistic, as he states:—

"No beds of slate, of value sufficient to warrant the expense of opening, have as yet been found in the Province, nor is there any indication that such beds exist, though the slate formation as a whole is of large extent. The great cost attendant on opening a quarry of slate, even in very favourable circumstances, and the comparatively small demand for the manufactured article, are such as to render competition with the large quarries of eastern Quebec or of Wales practically impossible." [1]

NOVA SCOTIA.

The status of the roofing slate industry in this Province is summed up by Mr. Piers of the Provincial Museum in the following manner:—

"Nova Scotia abounds in slates of supposed Cambrian, Silurian, and Devonian age. In some places they have qualities which suit them for architectural use, while in many localities they deserve to be tested for the purpose. So far the only quarries that have been operated to any extent are at East Gore in Hants county."[2]

Mr. Piers mentions the following properties:—

James Murray, South Lochaber, Guysborough county.
..........Kellough, East Gore, Hants county.
James Barron, East Gore, Hants county.

The first of these locations is a prospect only: the latter two have produced a small amount of roofing slate but they have long been idle.

Concerning the slate of the Guysborough river, Fletcher states:—

"On the north branch of Guysborough river, above the Afton road, is a quarry of dark, bluish-grey Devonian argillite, evenly bedded but having also an oblique, imperfect slaty cleavage. The shales do not always break out smoothly, and the adherence of the different layers to one another is very strong. In Shaws and Aikens brooks similar slates have been quarried, but no satisfactory roofing slate seems to have been discovered."[3]

A small amount of slate was quarried some years ago in the Oldham district in Halifax county, concerning which Mr. Faribault says:—

"Good paving slates and a little roofing slate were quarried in this belt at Beaver Bank station, where the stratification is horizontal and the cleavage perpendicular to it, making the splitting very easy."[4]

With regard to the slates of southwestern Nova Scotia, Dr. Bailey makes the following comment:—

"In a country in which argillites are of such common occurrence as in southwestern Nova Scotia, it may reasonably be supposed that some of these would be suitable for roofing or writing purposes. No attempt

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[1] Geol. Sur. Can., Pub. No. 583, p. 126, 1907.
[2] Economic Minerals of Nova Scotia, H. Piers, p. 60, King's Printer, Halifax, 1906.
[3] Geol. Sur. Can., Rep. 1886, p. 128 P.
[4] Geol. Sur. Can., Rep. 1892-3, p. 139 S.

has, however, as yet been made to discover any such beds, still less to open up any quarries therein. In the case of the black slates of Division IV of the Cambrian system, the amount of pyrites with which these are charged would seriously interfere with their value, but the underlying blue and ribboned slates are free from this disadvantage, while their low inclination in many instances, together with their highly pronounced cleavage, would seem to recommend their use. Rocks of this character occur in the northern part of Queen's county, about Fairy lake in Annapolis county, as well as in different parts of Digby county. Slates of more recent age occur in the Bear river and Nictaux-Torbrook basins, in Annapolis county."[1]

[1] Geol. Sur. Can., Rep. 1896, p. 150 M.

CHAPTER X.

Decorative Stones of Volcanic Origin.

The volcanic rocks are frequently of exceedingly fine grain, of attractive colour and possessed of a degree of hardness which renders them susceptible of a high polish. When these properties are enhanced by a porphyritic or by a brecciated structure, very handsome stones result. There are several areas in the Maritime Provinces in which rocks of this type are developed and to which reference has frequently been made in the literature of the subject. The writer has not been able to learn of any attempt to utilize these materials on a commercial scale, but the fact that examples are to be found in museums, not only in the Maritime Provinces but in other parts of the country, indicates the interest which they have aroused in the minds of different observers. For the purposes of this report it was not thought necessary to visit all the reported localities of occurrence, many of which are difficult of access. A few only of the more important areas were visited, with the object of securing specimens which must be regarded as typical of the different kinds of stone. The rocks of the areas not visited probably differ in detail only and are sufficiently described by quotations from the reports of the original observers.

Those localities which were examined are described first, and to this description is appended a list of occurrences, which is, by no means, complete, but which contains reference to the more important areas in which the decorative character of the stone has attracted the attention of the author cited.

Scatari Island, Cape Breton County, N.S.

The beautiful felsite breccias of Scatari island probably deserve the highest rank in this class of decorative stones. The crystalline area of the Atlantic coast of Cape Breton county and the island of Scatari present many exposures of felsites the distribution of which is fully described in the Report by Fletcher on the Louisburg sheet.[1] It is to be inferred from this report that numerous localities along these coasts are capable of yielding handsome varieties of felsites. The north shore of Scatari island eastward from the western light is however especially mentioned and is referred to in the economic part of the report cited in these words:—"The felsite-breccias, near the west light of Scatari, yield a great variety of bright coloured pebbles, and a polished block is on exhibition at the Provincial Museum, Halifax. But the planes of joints and cleavage,

[1] Geol. Sur. Can., Rep. 1887–78, pp. 6·7 F.

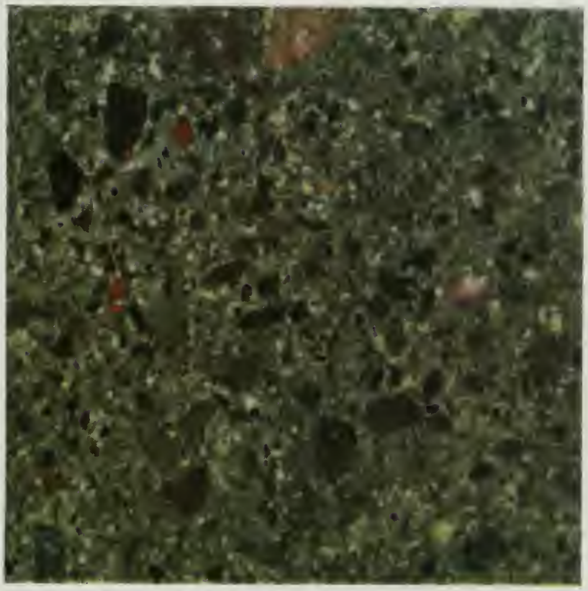
combined with those of bedding, break the rock, and apparently render it unfit for the uses to which, on account of its great beauty, it might otherwise be applied."[1]

Immediately at the west light is an unattractive dark grey rock with bands of dull-coloured reddish felsite. Proceeding eastward along the north shore, these give place to handsome felsite-breccias, striking a little north of east and dipping either vertically or at a high angle to the northward. In many places the stone is very thin bedded, but in other parts the width of the individual beds is much greater. The non-brecciated portions occur in bands sometimes 10 feet thick, of a dark chocolate colour, which however gradates into a much lighter coloured type, of no particular beauty, and which weathers more rapidly to a white, dull material. Inter-banded with the felsites are belts of bright coloured breccias of considerable beauty. While the varieties of these rocks are innumerable, they may be regarded as belonging to two general types—one with a red base and the other with a green base. Besides the variations in colour, the grain of the rock shows transitions from very coarse to very fine examples. In places, narrow red bands appear which are almost jaspery in colour and hardness. These rocks continue for a mile along the shore and crop out at intervals beyond (see Fletcher's report). The whole of the coast is strewn with a wonderful profusion of varicoloured pebbles, which when wet, present a most extraordinary display of colour.

On the south coast, the rock first encountered is light in colour and schistose in structure; farther east, light coloured greenish and reddish felsites and felsite-breccias occupy the coast. While constituting beautiful rocks in themselves they are pale and unattractive when compared with the highly colored examples from the north shore.

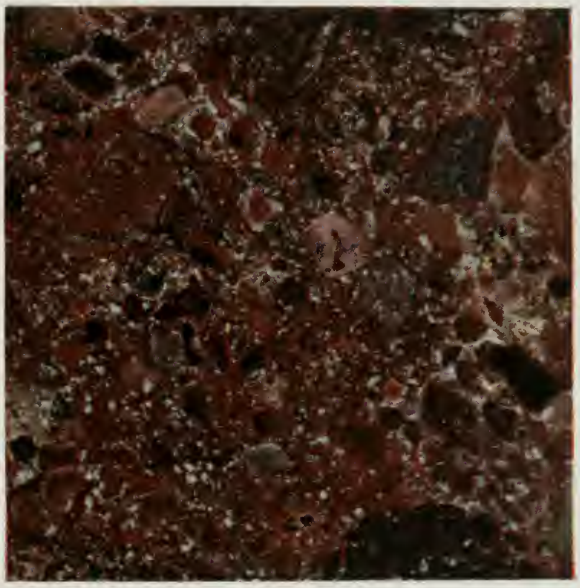
All the rock presents much thin bedding and is cut by numerous joints in a north and south direction. In places these joints are so close together that all the stone is reduced to small angular fragments. There are, however, many places where much larger material could be obtained, but I think that blocks 2 feet square would be the maximum size possible from the surface rock. It must be remembered that this coast is exposed to violent storms, so that it is reasonable to believe that surface agencies have had much to do with the shattering of the stone. While it would be unwise to hold out any hope of the economic extraction of large blocks suitable for panelling, etc., there is no doubt that pieces of sufficient size could be obtained for the manufacture of clock cases, bases of statuettes, tiles for fireplaces, and for numerous other purposes of a similar kind. It must not be overlooked also that a great deal of waste would be entailed in the production of marketable material and that the product could not be cheaply placed on the market. The hardness, the susceptibility to polishing, and the extraordinary beauty of the stone, however, should more than balance the considerable cost of production. The amount available is enormous.

[1] *Ibid*, p. 30 F.



SCATARI ISLAND GREEN FELSITE-BRECCIA.

PLATE XLII.



SCATARI ISLAND RED FELSITE-BRECCIA.

Similar but less attractive material was observed at Moque head, Burke point, and along the road from Mainadieu to Catalogne. For numerous other localities the reader is referred to the report already cited.

The stone: No. 646.—The matrix of all these stones consists of a hard volcanic glass in which minute crystals have been developed by secondary crystallization (devitrification). Scattered through the glassy matrix are larger crystals of orthoclase and some quartz still in a good state of preservation. The colour of this matrix varies from a very light tint to a deep purplish red or to vivid green. The rock is, therefore, to be regarded as a devitrified rhyolite, and is generally referred to as felsite although this latter term is sometimes applied to dyke rocks having the general chemical nature of granite. Many of the examples collected are therefore red or green felsites of considerable beauty. More striking, however, are those varieties which have arisen by the breaking up of the original felsites and the cementation of the resulting fragments in fresh flows of lava (felsite breccia). It is evident, therefore, that two general types of these breccias may occur—red fragments in a green matrix and green fragments in a red matrix. It is also evident that all sorts of fragments may mingle in a single example; in consequence, the actual varieties are almost as many as the pebbles, and are much too numerous to justify a description of each. Typical red and green felsite breccias from Scatari are shown in Plates XLI and XLII. The considerable beauty of these rocks, in some cases is further enhanced by the occurrence of secondary stringers and blotches of milk-white quartz.

Browns Mountain, Antigonish County, N.S.

The Cambro-Silurian areas in Pictou and Antigonish county are invaded by many eruptive masses of syenites, felsites, and other rocks of a similar character. Fletcher states that many of these rocks are suitable for ornamental purposes but that none of them had been utilized. At Browns mountain, in Antigonish county, however, a small quarry was opened in what Fletcher describes as a grey and reddish, pink weathering grit and syenite, jointed and full of quartz veins. The pits were opened in the side of the mountain in what is now an abandoned field. Little is to be seen of the formation, but the main rock is a whitish and pink-veined quartzite of no particular value: in places it fades into a greenish clouded variety. Running through the formation in a direction approximately northeast and southwest are bands of red to chocolate-coloured felsite, which show an indistinct porphyritic structure in places, and which are traversed in all directions by fine veinlets of white quartz. This material when polished is a handsome and attractive stone, but there is no evidence that it can be obtained in quantity. The small pits are now filled with debris, and although the whole band must be several hundred yards wide, the red material seems to be confined to narrow strips. It is not now possible to speak of the extent of these strips or of the amount of fracturing which they have suffered.

The stone: No. 500.—A hard, dull red felsite with blotches of dirty green and fine lines of white quartz.

No. 501.—Like the above but showing larger veinlets and blotches of white quartz.

No. 502.—Very bright red felsite with sharply defined bands of white quartz arranged in concentric and wavy lines around certain centres. Some of the bright red matter is jaspery in character and may represent secondary deposition. Small objects of considerable beauty could be prepared from this material.

Lachorba, Antigonish County, N.S.

On the property of Mr. T. J. Sears at Lachorba, there occurs a fine grained compact, bright red felsite, which presents possibilities as a decorative stone.

Chamcook Lake, Charlotte County, N.B.

Dr. Bailey recorded the occurrence of "fine grained felsite or orthophyre" on the lower part of Frye and Glenelg roads and on the eastern side of Chamcook lake in his report to the Geological Survey for the year 1870-71.[1] In his later report on the Mineral Resources of New Brunswick,[2] he gives a description of these stones from the economic point of view, which is reproduced in full below:—

"In the hills around Passamaquoddy bay, the upper portion of the Silurian system is marked by the occurence of extensive sheets of fine grained rock, consisting to a large extent of feldspar, with porphyritic crystals of the same mineral, but having associated with the feldspars more or less of finely disseminated quartz. It is probable that among these rocks, all of which are ancient volcanic overflows, quartz-porphyries and rhyolites are included. In many instances the beds are of very fine texture, and readily take a high polish, while their colour, varying from a pale salmon-red to a deep brownish-red, diversified by the occurrence of numerous small feldspar crystals disseminated through the mass, is such as to make them very attractive. In some instances, in addition to minute crystals, the rock is further characterized by what would appear to have been lines of flow, producing a delicately banded and wavy structure, suggestive of some varieties of polished wood.

"Some of these beds are very favourably situated for quarrying and shipment, being (as at Chamcook lake) directly on a branch line of the Canadian Pacific railway, or (as at MacMaster island) close to navigable

[1] Geol. Sur. Can., Rep. 1870–71, pp. 151–2.
[2] Geol. Sur. Can., Rep. 1897, p. 108 M.

waters. That they have not, up to this time, been regarded as worthy of attention, seems to be largely due to the fact that, as seen near the surface, they are freely intersected by divisional planes, and blocks of suitable size are not easily obtainable; but the interior of these blocks is often of a very firm texture, and it is not at all improbable that were excavations made sufficiently deep to get beyond the reach of the frost, the objection referred to might be greatly if not wholly removed. At all events there would seem to be no good reason why small blocks of the rock should not be used, in the form of tablets, etc., in connexion with the red granites of St. George, with the colour of which they would completely harmonize."

To this excellent description there is little to be added. The red rock is exposed for nearly half a mile along the shore of Chamcook lake; it constitutes the hill between the lake and Frye road and also outcrops on MacMaster island and on the Piskahegan river. On the lake, the formation is very strongly jointed in two directions, 30° east of south and 15° east of north, with vertical dip. Sheeting planes also appear, inclining at from 15° to 25° to the south. Most of these joints are closely spaced, with a maximum separation of about 2 feet. I am inclined to believe that these fractures are formational and that they would, therefore, extend to great depths. In addition, all the stone shows a tendency to break diagonally into small pieces. To such an extent is this tendency developed that it is difficult to secure even a fair sized hand specimen, as examples, apparently sound, break up readily when struck by the hammer. It is quite possible that this minor fracturing is due to surface agencies and that more solid material may be encountered at depth. On the whole, however, I am inclined to believe that the stone could not be secured in sufficiently large pieces to render it of economic value. The material itself is not to be compared either in beauty or in size with the breccias from Scatari island. A short description of a typical example is given below:—

The stone: No. 419.—A hard brittle volcanic rock of dull red to chocolate colour with scattered crystals of a lighter and brighter red, which occur in individuals not more than a couple of millimetres in length. The stone is susceptible of a high polish, and the surface shows the small crystals in a very distinct contrast despite the slight difference in colour between them and the matrix.

The reported occurrences of felsites, andesites, porphyrites, rhyolites, and related rocks, many of which have a possible value as decorative materials, are very numerous,. Some of the more important of these, with brief notes from the original description, are given below:—

NEW BRUNSWICK.

Carleton County.—

The northeast and southeast branches of the Beccaguimic river—G.S.C., Rep. 1882–84, p. 26 G.

Mapleton and Lawrence peak, Beccaguimic river—G.S.C., Rep. 1885, p. 28 G.

Charlotte County.—

Bocabec, Digdequash, Magaguadavic, Lake Utopia, Troaks mountain, Mascarene shore, Western isles—G.S.C., Rep. 1870–71, p. 236.

Kings County.—

South stream of Hammond river, etc.—G.S.C., Rep. 1877–78, p. 7 DD.

Greenwich township—G.S.C., Rep. 1871–72, p. 68.

Bostwicks brook—G.S.C., Rep. 1877–78, p. 4 E.

Queens and Sunbury Counties.—

Piskahegan river, Shin creek, etc.—G.S.C., Rep. 1875–76, pp. 350-352.

Cranberry lake, Harvey station, Littles mills, Listers mills, Shin creek, Piskahegan river, etc.—G.S.C., Rep. 1872–73, pp. 185–186.

Richmond County.—

Red islands—G.S.C., Rep. 1900, pp. 22–23 R.

Victoria County.—

Otelloch and Blue mountain—G.S.C., Rep. 1886, pp. 6–7 N.

Tobique river, Nictor lake—G.S.C., Rep. 1904, p. 278 A.

Nictor lake, Armstrong brook—G.S.C., 1902–3, p. 389 A.

Tobique and Nipisiguit rivers—G.S.C., Rep. 1879–80, p. 36 D.

York County.—

Cranberry lake, Harvey station, etc.—G.S.C., Rep. 1872–73, p. 184. See also Queens and Sunbury counties above.

NOVA SCOTIA.

Annapolis County.—

Nictaux mountain at Clements—G.S.C., Rep. 1904, p. 303 A.

Antigonish and Pictou Counties, etc.—

Murdoch lake, Blue mountains—G.S.C., Rep. 1890–91, p. 147 P.

Cape Breton, Richmond, etc.—

Boisdale hills, Mira hills, Coxheath hills, East Bay hills—G.S.C., Rep. 1876–77, p. 405.

Salmon river, Kelvin brook, Loch Lomond, Framboise, Blue mountains, Coxheath, East bay of Bras d'Or, Scatari island, Moque head, Neil cove, Mainadieu, Clarke road, Louisburg, Little Loran, Cape Breton, Belfry lakes, Fourchu, etc. "In beauty and variety of colour the compact and fragmentary, porphyritic felsites on the coast near Murdoch Matheson's and towards Grand river may vie with those of Louisburg and Scatari."—G.S.C., Rep. 1877–78, pp. 7, 10 F.

Inverness and Victoria Counties.—

Craignish hills and North mountain—G.S.C., Rep. 1879–80, pp. 10, 14–17 F.

Middle river, Margaree, Sugarloaf, Whycocomagh, Mullach, Bucklaw, Lake Ainslie, Mabou—G.S.C., Rep. 1882–84, pp. 6–24 H.

CHAPTER XI.

Miscellaneous Building and Ornamental Stones.

BUILDING STONE.

Of building stone, there remains to be mentioned the metamorphosed slate which has been quarried for many years near Halifax and of which many of the older buildings in the city were built. This material is known locally as ironstone: it represents an original clay sediment which has been altered by the heat emanating from the intrusion of the great masses of granite in the vicinity. A second stone, which scarcely falls under the category of ordinary building material, is a hard quartzose sandstone from St. John, N.B.

Hart and Co., Halifax, N.S., Edward Keefe, manager, Halifax.
(King's quarry.)

This quarry is located on the west side of the Northwest Arm at Halifax, directly opposite the point on the east side. The hill rises to an elevation of a hundred or more feet above the water and has yielded stone for fully a hundred years. In this time a very large amount of material has been removed at several different points. The old workings are of irregular shape but they are seldom more than 20 feet deep. The quarry now in operation shows a face of 20 feet and has been worked over a space about 200 feet square.

The formation strikes 15° east of north and dips northward at 30°. The main joints strike 35° north of west, dip 65° to the southwest and occur at intervals of fron 2 to 12 feet. A second set of joints strikes 30° east of south and dips 65° to the southwest. A third set, of more irregular character, strikes almost due south. It will be observed that the sets of joints are far from being at right angles and that they do not conform with the direction of the formation; in consequence, a large amount of small and angular material is produced. Some friable bands occur in the formation, but most of the output can be utilized. Stone 4 feet thick is obtainable, but such heavy blocks are not shipped, the practice being to split them into sizes suitable for building. Building blocks are readily prepared running from 4 to 10 inches in thickness.

The stone: No. 477.—Viewed in the rough, this stone would be regarded as a brownish-black, fine grained material of unattractive appearance: it is shown in Plate XLV, No. 14. When polished, however, a rather handsome banded structure is seen on the vertical faces, while the faces parallel to the bedding present a uniform spotted aspect. Under the microscope, the rock is seen to consist of very fine grains of quartz and some feldspar intermingled with numerous flakes of both white mica (muscovite) and black mica (biotite). An appreciable amount of iron pyrites is present in grains up to two or three millimetres in diameter. The stone would be described as a spotted slate; it represents a stage in the metamorphism of ordinary slate which has been brought about by contact with igneous rocks. The corrosion test produced very little effect as even the pyrite was practically unaltered under the treatment. Time and weather, however, cannot fail to bring about the oxidation of this constituent, with the inevitable production of yellowish-brown stains.

The physical properties are as follows:—

Specific gravity	2·794
Weight per cubic foot, lbs.	174·067
Pore space, per cent	0·201
Ratio of absorption, per cent	0·072
Coefficient of saturation, one hour	0·20
" " two hours	0·24
Crushing strength, lbs. per sq. in.	31470·
" " wet, lbs. per sq. in.	32165·
" " wet after freezing, lbs. per sq. in.	(25532·)?[1]
Gain on treatment with carbonic acid and oxygen, grams per sq. in.	0·000517
Transverse strength, lbs. per sq. in.	5415·
Drilling factor, mm.	1·4

The high transverse and crushing strength of this stone and its low porosity and coefficient of saturation recommend it for use as a structural material. The low drilling factor, as well as the general appearance, are, however, not likely to encourage its use for any of the finer purposes.

At the present time only four men are employed in the quarry, but in the days of government construction at Halifax 160 men were engaged, and the output was as high as 100 tons a day. The output in 1910 was about 600 tons. The stone is valued at $2 a ton for select building blocks on the wharf. From the present quarry there is about a quarter of a mile haul to the wharf, whence shipping facilities are all that could be desired.

This stone has been largely used in the construction of government works near Halifax, and is still employed for rough building and foundations as well as for structures of more pretentious character. It is being used for the lower 70 feet of the new Memorial Tower, and it may be seen in All Saints' cathedral, the Wellington Bank, and St. Paul's schoolhouse in Halifax. Many of the Government buildings are constructed entirely of this stone, for example; the Signal Hill buildings, George Island fort, Fort Clarence, and the Ordnance walls and stores.

[1] This result is certainly too low. The cube broke from one side. There is probably very little difference between the crushing strength of the three samples.

Not only in the quarry under description, but throughout a large extent of country on the Atlantic seaboard of Nova Scotia this type of stone is to be observed.

A hard quartzose sandstone is quarried from the base of the St. John formation in St. John city for use in constructing foundations, etc. The stone occurs in a narrow belt of about 50 feet in width, striking northeast; it is thin bedded and much shattered, but pieces a foot thick may be obtained.

DECORATIVE STONE.

A number of substances occur in the Maritime Provinces which may be classed as decorative stones but which are more properly to be described as semi-precious gem stones, as they occur in pieces much too small for purposes of architectural decoration. It is very questionable if any of these materials present possibilities of economic exploitation, nevertheless the more important occurrences are briefly referred to below.

Agate.

Handsome agates have been found in the region of the Triassic traps, more particularly along the Digby coast in Nova Scotia. The stones have been formed in cavities in the trap and have been set free by the disintegration of the rock: in consequence, they are found in the form of pebbles along the shore. An excellent summary of the occurrences is given by Mr. George F. Kuntz, as follows:—

"Handsome agate and chalcedony in nodules and veins are of frequent occurrence on the south shore of the Bay of Fundy, between Digby and Scots bay, N.S. Large masses of agate have frequently been found on this coast. Gesner mentions a mass of 40 lbs. weight made up of curved layers of white, semi-transparent chalcedony and red carnelian, forming a fine sardonyx. A mass showing distinct parallel zones of cacholong, white chalcedony, and red carnelian, was found a few miles east of Cape Split, N.S. When polished it resembles an aggregation of circular eyes, and hence the name eye-stone, or eye agate applied to it.

" At Scots bay, N.S., large surfaces of rocks are studded with these minerals. Fine specimens are also found at Blomidon, and at Partridge island, N.S. Fine agates and carnelians occur at Digby neck, six miles east of Sandy cove, Woodworths cove, west of Scots bay, and at Cape Blomidon, N.S.

"Fine agates, chalcedony, and carnelians are also found in New Brunswick, at Darling lake, at Hampton, near the mouth of the Washademoak river, at Dalhousie, and on the Tobique river, in Victoria county.

"Beautiful moss agates are found at Two Islands, Cumberland county, and near Cape Split, Partridge island, also at Scots bay, Kings county, N.S., exceptionally fine at the latter locality."[1]

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[1] Geol. Sur. Can., Rep. 1887–88, pp. 71–72 S.

Readers desirous of further information as to these localities are referred to the following reports of the Geological Survey:—

Sandy cove, St. Marys bay, Cape Blomidon, Cape Split, Scots bay, Two Islands—G. S. C., Rep. 1888–89, p. 15 T.

Five Islands, Two Islands, Wassons bluff, Partridge island, Cape Sharp, Spencers island, Cape d'Or—G.S.C., Rep. 1890–91, p. 55 AA.

Same localities—G.S.C., Rep. 1892–93, p. 21 Q.

Johnsons and Nichols mines, Digby Neck, N.S.—G.S.C., Rep. 1894, p. 98 A, p. 100 A.

Johnsons mine, Petite passage, Gullivers cove—G.S.C., Rep. 1896, p. 147, M.

See also G.S.C., Rep. 1901, pp. 211-215 A; Rep. 1902, p. 399 A.

See also Dawson, Acadian Geology, pp. 86-115.

Amethyst.

This mineral occurs at many of the localities mentioned above for agate. In the article already cited, Kuntz says:—

"In Nova Scotia, however, fine amethysts occur in bands, veins, and geodes at Partridge island, Cumberland county, Nova Scotia, surfaces a foot square being covered with splendid purple crystals an inch across. Dr. Gesner mentions a geode that would hold about two gallons, found at Cape Sharp, nearly opposite Blomidon, N.S. Another, lining walls of chalcedony, with concentric bandings, was found at Sandy cove, Digby county, N.S., and weighed 40 lbs. De Monts is said to have taken crystals from Partridge island to Henry IV of France, whom they greatly pleased, and a crystal from Blomidon was among the French crown jewels twenty years ago. A bushel of crystals was obtained by the late Dr. Webster, of Kentville, N.S., in digging a single well. Dr. Gesner also states that he had seen a band of amethyst, some feet in length and perhaps two inches thick, about a mile east of Halls harbour, N.S. Other localities are the south of Nichols mountain, Cape d'Or, Mink cove, Scots bay, in Nova Scotia, and Little Dipper harbour, and Nerepis in New Brunswick, and other localities along the Bay of Fundy.[1]

Amethysts associated with agates occur in the trap rocks at Dalhousie in New Brunswick.[2]

Further notes on the Bay of Fundy region may be found in the reports of the Geological Survey as below:—

Rep. 1885, p. 61 E.

Rep. 1890-91, p. 55 AA.

Rep. 1892-93, p. 21 Q.

Rep. 1897, p. 126 M.

Rep. 1901, pp. 214-216 A.

Rep. 1903, p. 294 A.

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[1] Geol. Sur. Can., Rep. 1887-88, p. 70 S.
[2] Geol. Sur. Can., Rep. 1879-80, p. 39 D.

Chalcedony, Carnelian, and Jasper.

The above minerals, and also smoky quartz, impure cairngorm stone and other varieties of coloured silica occur with the agate and amethyst in the trappean region of the Bay of Fundy. According to Dr. Dawson, opal also occurs sparingly. The chalcedony varies from white to red and passes into carnelian and jasper: a blue variety is thus referred to by Kuntz:—

"An unique blue chalcedony, rich brownish green by transmitted light, is mentioned by How, from Cape Blomidon, N.S."

An important occurrence of chalcedony has long been known on Washademoak lake, Queens county, N.B.: it is thus described by Bailey and Matthews:—

"In connection with the red sandstones and shales of the Lower Carboniferous formation, there are, at numerous places, irregular layers and concretionary masses of red jasper, carnelian, and chalcedony. At Lower Clones there is a close-grained, brick-red petrosilex resembling jasper, porphyritic with crystals of calcite. On the shore of Washademoak lake, between Belyeas and Tafts coves, limestones associated with red shales of the Lower Carboniferous formation have been described as containing nodules and layers—and at one point a bed two feet thick—of chalcedonic quartz. Much of this rock is very beautiful, its colour varying from cream colour, through pink, to a rich red, these shades being sometimes distributed in bands. Pebbles derived from there, or similar beds, are common in some of the conglomerates of the Coal Measures and are abundant in the beaches bordering the shores of Grand lake."[1]

The abundance of these masses along the shore of Washademoak lake is undoubted: a boat could be filled in a few hours with pieces ranging from a few inches up to more than two feet in length. Much of this material is very handsome in shades of white, cream, pink, and dark red: it is, however, much cut up by cracks and flaws so that perfectly solid specimens of any considerable size are hard to obtain. As a semi-precious stone for the making of cheaper types of jewelry or for the manufacture of small ornamental objects it has a positive value. I fear, however, that the almost universal checking would detract from its value for such purposes as properly fall within the range of this report.

Dysyntribite, Talc, and Pyrophyllite.

"Associated with the felsites of Frenchmans barn and Arisaig pier, is a soft unctuous rock, of yellow, orange, red, green, grey, and other finely mottled colours, belonging to the agalmotolite, parophite and dysyntribite group of minerals, said by Dr. Honeyman to be twelve feet thick, traceable for a great distance, but passing on the strike from a massive rock into slates. It is susceptible of a high polish, but broken

[1] Geol. Sur. Can., Rep. 1872–73, p. 229.

by cleavage joints, and tarnishes easily: has been quarried to some extent as an ornamental stone, and might also probably be used for anti-friction purposes and pottery making."[1]

Talc occurs at the so-called "Soapstone mine," Brigand brook, about three miles from Whycocomagh, Inverness county, N.S. "This deposit was worked about 1896 by R. P. Fraser and also possibly by others. The stone was obtained from a shaft on the side of the road, and a quantity of material extracted. It is now unworked."[2]

The variety known as pyrophyllite occurs on Soapstone brook, Landing cove, Gabarus bay, Cape Breton county, N.S. The deposit has been tested but it has not yet been worked commercially.

Summary—Miscellaneous Decorative Materials.

The rarer decorative substances of the Maritime Provinces fall into two classes:—

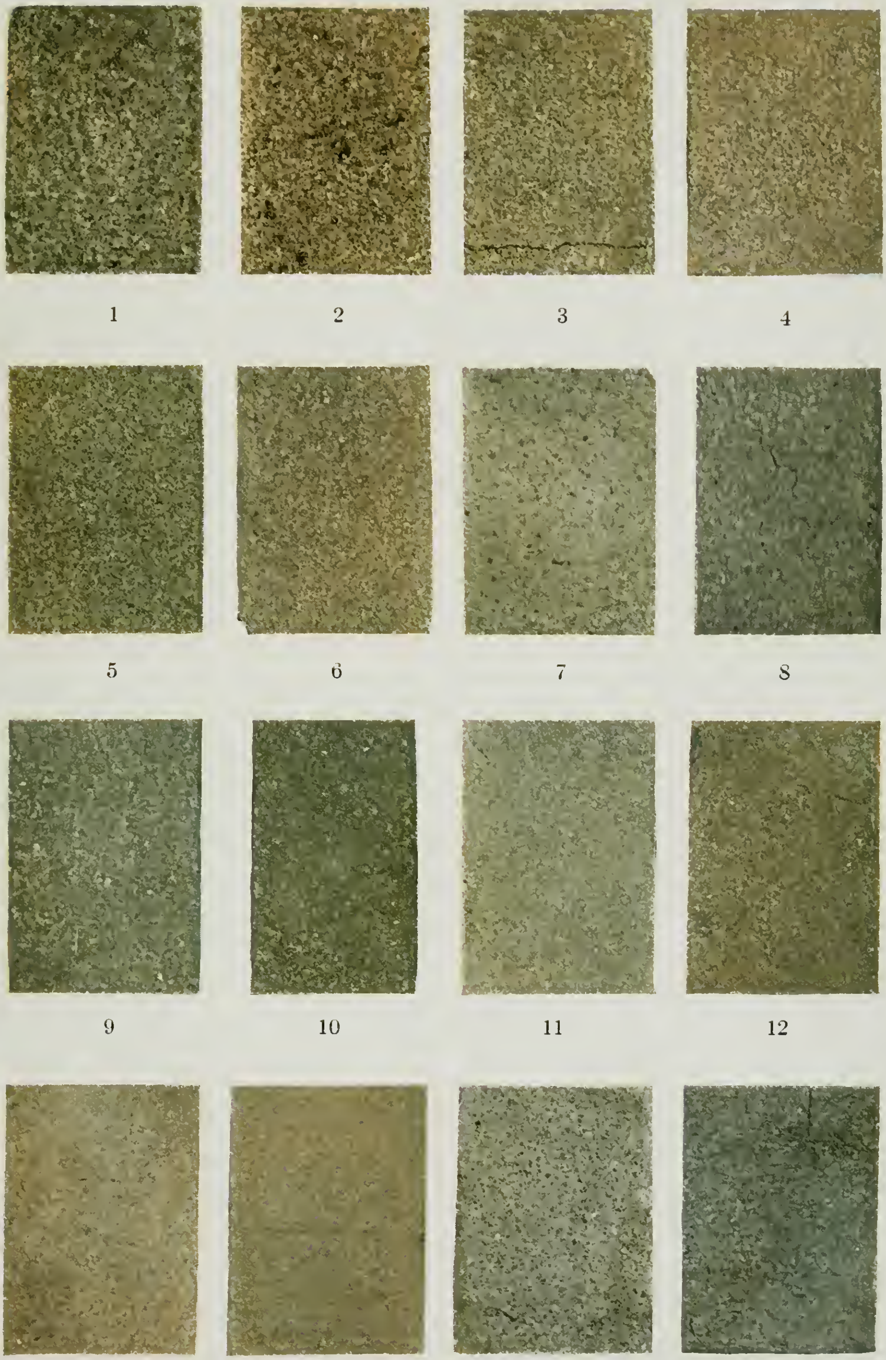
(1) Varieties of silica, including coloured quartz as amethyst, smoky quartz, etc., and the so-called cryptocrystalline varieties as carnelian, jasper, chalcedony, and agate. The chief localities are the Fundy shore of Nova Scotia, Grand Manan island, Washademoak lake, Queens county, N.B., and the vicinity of Dalhousie, N.B. While many of these substances rank as semi-precious stones and have a certain value as such, their manner of occurrence does not favour a commercial industry.

(2) The soft magnesian materials such as talc, dysyntribite, etc., are known to occur at a few points in Antigonish, Cape Breton and Inverness counties, N.S. They have never been exploited on a commercial scale.

[1] Geol. Sur. Can., Rep. 1886, p. 128 P.
[2] Econ. Min., N. S., H. Piers, p. 50, Halifax, 1906.

Plate XLIII.

No. 1—No. 468, Sandstone, Buctouche, Kent county, N.B.
" 2—No. 565, Sandstone (pulp stone), Quarryville, Northumberland county, N.B.
" 3—No. 564, Sandstone (building stone), Quarryville, Northumberland county, N.B.
" 4—No. 451, Sandstone, Rockport, Westmorland county, N.B.
" 5—No. 561, Sandstone, French Fort Cove quarries, Newcastle, Northumberland county, N.B.
" 6—No. 444, Sandstone, Downey quarry, Curryville, Albert county, N.B.
" 7—No. 527, Sandstone, Forks Bridge, near Sydney, N.S.
" 8—No. 569, Sandstone, Grande Anse, Gloucester county, N.B.
" 9—No. 466, Sandstone, Smith's quarry, Shediac, Westmorland county, N.B.
" 10—No. 469, Sandstone, Notre Dame, Kent county, N.B.
" 11—No. 555, Sandstone, Adam Hill's quarry, near Newcastle, Northumberland county, N.B.
" 12—No. 461, Sandstone (grey type), Wallace, Cumberland county, N.S.
" 13—No. 550, Sandstone, McMillan's quarry, Judique, Inverness county, N.S.
" 14—No. 443, Sandstone, Mary point, Albert county, N.B.
" 15—No. 472, Sandstone, Pictou Quarry Co., Pictou, Pictou county, N.S.
" 16—No. 462, Sandstone (blue type), Wallace, Cumberland county, N.S.



OLIVE-GREEN SANDSTONES.

Plate XLIV.

No. 1—No. 464, Sandstone, Batte quarries, Wallace Bridge, Cumberland county, N.S.
" 2—No. 495, Sandstone (grey) Eightmile brook, Pictou county, N.S.
" 3—No. 498, Sandstone, Gammon and Weir's quarry, New Glasgow, Pictou county, N.S.
" 4—No. 449, Sandstone, Beaumont quarries, Westmorland county, N.B.
" 5—No. 567, Sandstone, Read Stone Co., Stonehaven, Gloucester county, N.B.
" 6—No. 522, Sandstone, Stewartdale, Inverness county, N.S.
" 7—No. 459, Sandstone, Amherst Red Stone Quarry Co., Amherst, Cumberland county, N.S.
" 8—No. 452, Sandstone, Sackville Freestone Co., Sackville, Westmorland county, N.B.
" 9—No. 494, Sandstone, Swan's quarry, Charlottetown, P.E.I.
" 10—No. 492, Sandstone, McNab's quarry, River John, Pictou county, N.S.
" 11—No. 547, Sandstone, McMillan's quarry, Judique, Inverness county, N.S.
" 12—No. 450, Sandstone, Read quarry, Wood point, Westmorland county, N.B.
" 13—No. 453, Sandstone, Cape Bald, Westmorland county, N.B.
" 14—No. 442, Sandstone, Mary point, Albert county, N.B.
" 15—No. 507, Sandstone, Monk Head, Antigonish county, N.S.
" 16—No. 495, Sandstone (brown) Eightmile brook, Pictou county, N.S.

Plate XLIV.

No. 1—No. 464, Sandstone, Batte quarries, Wallace Bridge, Cumberland county, N.S.
" 2—No. 495, Sandstone (grey) Eightmile brook, Pictou county, N.S.
" 3—No. 498, Sandstone, Gammon and Weir's quarry, New Glasgow, Pictou county, N.S.
" 4—No. 449, Sandstone, Beaumont quarries, Westmorland county, N.B.
" 5—No. 567, Sandstone, Read Stone Co., Stonehaven, Gloucester county, N.B.
" 6—No. 522, Sandstone, Stewartdale, Inverness county, N.S.
" 7—No. 459, Sandstone, Amherst Red Stone Quarry Co., Amherst, Cumberland county, N.S.
" 8—No. 452, Sandstone, Sackville Freestone Co., Sackville, Westmorland county, N.B.
" 9—No. 494, Sandstone, Swan's quarry, Charlottetown, P.E.I.
" 10—No. 492, Sandstone, McNab's quarry, River John, Pictou county, N.S.
" 11—No. 547, Sandstone, McMillan's quarry, Judique, Inverness county, N.S.
" 12—No. 450, Sandstone, Read quarry, Wood point, Westmorland county, N.B.
" 13—No. 453, Sandstone, Cape Bald, Westmorland county, N.B.
" 14—No. 442, Sandstone, Mary point, Albert county, N.B.
" 15—No. 507, Sandstone, Monk Head, Antigonish county, N.S.
" 16—No. 495, Sandstone (brown) Eightmile brook, Pictou county, N.S.

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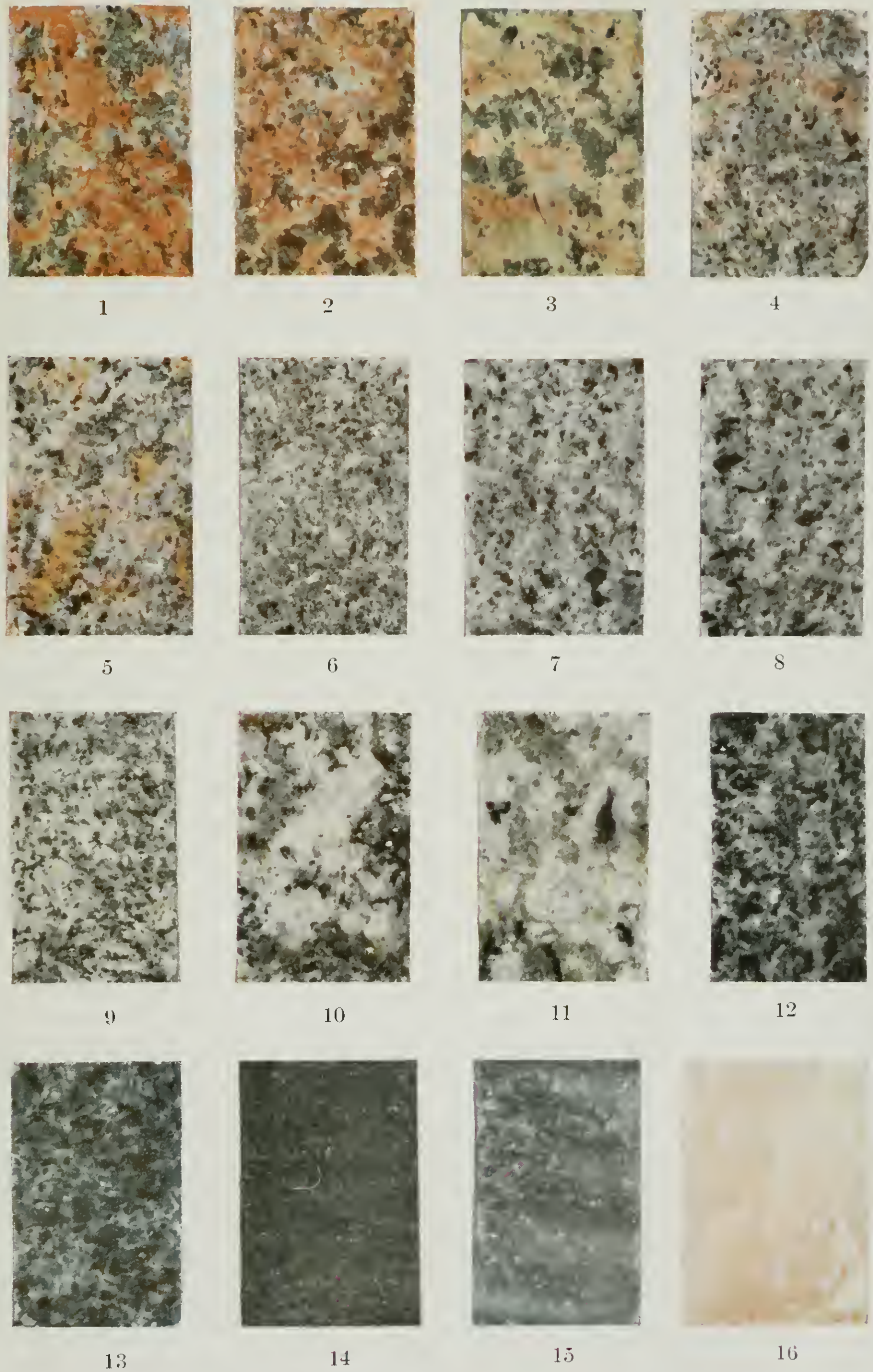
SANDSTONES.

PLATE XLV.

No. 1—No. 403, Red granite, St. George, Charlotte county, N.B.
" 2—No. 400, Pink granite, St. George, Charlotte county, N.B.
" 3—No. 410, Light granite, St. George, Charlotte county, N.B.
" 4—No. 566, Granite, Connolly's quarry, Bathurst, Gloucester county, N.B.
" 5—No. 430, Granite, Mount Gypsy, Hampstead, Queens county, N.B.
" 6—No. 431, Granite, monumental type, D. Mooney and Sons, Hampstead, Queens county, N.B.
" 7—No. 483, Granite, Rice quarry, Nictaux, Annapolis county, N.S.
" 8—No. 482, Granite, Middleton Granite and Marble Co., Nictaux, Annapolis county, N.B.
" 9—No. 478, Granite, Shelburne Granite Co., Shelburne, Shelburne county, N.S.
" 10—No. 473, Granite, Yeadon quarry, Halifax, Halifax county, N.S.
" 11—No. 475, Granite, Terence bay, Halifax county, N.S.
" 12—No. 404, Black granite (Glenley), Bocabec, Charlotte county, N.B.
" 13—No. 406, Black granite (Stewart greenstone), Bocabec, Charlotte county, N.B.
" 14—No. 477, Metamorphosed slate, King's quarry, Halifax, Halifax county, N.S.
" 15—No. 429, Crystalline limestone, Purdee and Green's quarry, St. John, St. John county, N.B.
" 16—No. 440, Pink gypsum, Sayres quarry, Albert Manufacturing Co., Hillsborough, Albert county, N.B.

PLATE XLV.



GRANITES.

APPENDICES.

Table I.

The Crushing Strength of Typical Building Stones from the Maritime Provinces.

OLIVE-GREEN AND GREY SANDSTONES.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.[1]	Remarks.
		New Brunswick.			
Albert	Curryville	Levi Downey	444	13,814	Sudden collapse. Thin, vertical prisms.
Albert	Mary point	Walter Roberts	443	17,817	Sudden collapse. Prisms.
Gloucester	Grande Anse		569	15,577	Sudden collapse. Small fragments.
Gloucester	Stonehaven	Read Stone Co	567	11,112	Sudden collapse. Lower wedge.
Gloucester	Stonehaven	Read Stone Co	567	14,382	Riehle machine, Toronto.
Kent	Buctouche	Miss Deacon	468	8,869	Sudden collapse. Lower pyramid.
Kent	Notre Dame	Hall and Irving	469	11,240	Sudden collapse. Thin upper wedges.
Northumberland	Quarryville	Miramichi Quarry Co	564	10,944	Sudden collapse. Vertical wedges.
Northumberland	Quarryville	Miramichi Quarry Co	564	(10,832)	Sudden collapse. Lower wedges, Riehle machine, Toronto.
Northumberland	Quarryville	Miramichi Quarry Co	565	9,350	Sudden collapse. Thin upper wedges.
Northumberland	French fort	C. E. Fish	561	(9,791)	Upper pyramid. Riehle machine.
Northumberland	Newcastle	Adam Hill	555	11,891	Slight previous crack. Upper pyramid. Much fine waste.
Westmorland	Beaumont	Dorchester Stone Works	449	17,800	Sudden collapse. Small lower pyramid.
Westmorland	Shediac	E. G. Smith	466	12,566	Sudden collapse. Thin wedges.
Westmorland	Rockport	Read Stone Co	451	10,585	Sudden collapse. Upper pyramid.

[1]Unless otherwise stated, the tests were made with a 100 ton hydraulic Wicksteed machine, McGill University, Montreal.

OLIVE-GREEN AND GREY SANDSTONES—*Continued.*

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		Nova Scotia.			
Cape Breton	Forks bridge	Dr. A. S. Kendall	527	12,208	Sudden collapse. Small lower wedge.
Cumberland	Wallace	Wallace Stone Co	461	13,681	Sharp explosion. Irregular wedges.
Cumberland	Wallace	Wallace Stone Co	462	15,633	Sudden collapse. Small upper pyramid.
Cumberland	Wallace	Wallace Stone Co	462	17,680	Sudden collapse. Prisms. Riehle machine, Toronto.
Cumberland	Wallace bridge	Batte	464	11,775	Sudden collapse. Thin upper wedges.
Inverness	Judique	Angus McMillan	550	(12,670)	Upper wedges. Result is probably a little too low. Riehle machine, Toronto.
Pictou	Eightmile creek	W. R. McKenzie	495	16,888	Sudden collapse. Thin wedges.
Pictou	New Glasgow	Gammon and Weir	498	17,893	Sudden explosion. Good lower pyramid.
Pictou[1]	New Glasgow	Gammon and Weir	498	16,300	Fine lines appeared before collapse. Much shattered.
Pictou	Pictou	Pictou Quarry Co	472	10,348	Sudden collapse. Much shattered.
Victoria	Boularderie island	Duncan Grant	530	16,894	Sudden collapse. Lower wedge.

RED AND BROWN SANDSTONES.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		New Brunswick.			
Albert	Mary point	Walter Roberts	442	14,675	Sudden collapse. Irregular upper pyramid.
Westmorland	Cape Bald	Cape Bald Freestone Co.	453	7,623	Small lower pyramid.
Westmorland	Sackville	Sackville Freestone Co.	452	11,899	Sudden collapse. Upper pyramid.
Westmorland	Wood point	Read Stone Co	450	10,560	Sudden collapse. Upper pyramid.
		Nova Scotia.			
Antigonish	Monk head		507	(8,185)	Riehle machine, Toronto. Result is probably a little too low.
Cumberland	Amherst	Amherst Red Stone QuarryCo	459	11,122	Sudden explosion. Good upper pyramid.
Inverness	Judique	Angus McMillan	547	14,744	Cracked slightly before ultimate load. Irregular wedges.
Inverness	Stewartdale	John McDonald	522	9,056	Sudden collapse. Series of narrow wedges.
Pictou	River John	H. McNab	492	15,147	Sudden collapse. Upper pyramid.
		Prince Edward Island.			
Queens	Charlottetown	H. Swan	494	8,126	Sudden collapse. Imperfect lower pyramid.

GRANITES.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		New Brunswick.			
Charlotte	St. George	O'Brien and Baldwin	400	30,702	Splintered on one side slightly before collapse. Small fragments.
Charlotte	St. George	Epps, Dodds and Co	403	27,266	Slight splintering before collapse. Small lower wedge.
Charlotte	St. George	Milne, Coutts	410	31,863	Sudden collapse. Small fragments.
Gloucester	Bathurst	Edward Connolly	566	28,446	One corner parted before collapse. Small lower pyramid.
Queens	Spoon island	D. Mooney and Son	430	35,063	Cracked slightly before collapse. Small fragments only.
Queens	Spoon island	D. Mooney and Son	431	34,993	Chipped at sides before collapse. Small lower cone.
		Nova Scotia.			
Cape Breton	Barrachois	Cape Breton Red Granite Co.	529	48,984	Cracked a little at considerable interval before ultimate load. Fragments only. Sharp explosion.
Annapolis	Nictaux	Middleton Granite and Marble Co	482	34,058	Cracked slightly before ultimate load. Fragments only.
Annapolis	Nictaux	Thelbert Rice	483	32,607	Exploded. No previous crack. Small lower cone.
Halifax	Halifax	Isaac Yeadon	473	25,959	Cracked just before ultimate load. Small fragments only.
Halifax	Terence bay	....	475	25,893	Two corners parted before ultimate load. Fragments only.
Shelburne	Shelburne	Shelburne Granite Co	478	28,440	Chipped at corners a little before ultimate load.

BASIC IGNEOUS ROCKS.

SO-CALLED BLACK GRANITES.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		New Brunswick.			
Charlotte	Bocabec	Epps, Dodds and Co	404	38,906	Chipped slightly before ultimate load. Small fragments.
Charlotte	Bocabec	Epps, Dodds and Co	405	50,246	Sudden collapse. Small fragments.
Charlotte	Bocabec	Stuart	406	39,928	Cracked slightly before ultimate load. Small fragments.

CRYSTALLINE LIMESTONES.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		New Brunswick.			
St. John	St. John	L. Rokes	423	17,583	Sudden collapse. Reduced to fine fragments.
St. John	St. John	Purdee and Green	429	16,000	Sudden collapse. Upper cone.
		Nova Scotia.			
Cape Breton	Eskasoni	Bown and Harrington	536	28,208	Sudden collapse. Fine fragments.
Inverness	Marble Mountain	Dominion Steel and Coal Co.	512	18,197	Sudden collapse. Upper wedge.

LIMESTONE.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		Nova Scotia.			
Antigonish	Brierly brook	Alex. McDonald	505	29,419	Sudden collapse. Small upper pyramid.

METAMORPHOSED SLATE.

County.	Locality.	Owner.	No.	Crushing strength lbs per sq. in.	Remarks.
Halifax	Halifax	Hart and Co	477	31,470	Sudden collapse. Vertical prisms.

GYPSUM AND ANHYDRITE.

County.	Locality.	Owner.	No.	Crushing strength lbs. per sq. in.	Remarks.
		New Brunswick.			
Albert	Hillsborough	Albert Mfg. Co.			
....	....	....	438 gypsum	9,412	Sudden collapse. Much powder and thin wedges.
....	....	....	439 anhydrite	16,052	Cracked before collapse. Irregular fragments.

TABLE II.

The Transverse Strength of Typical Building Stones from the Maritime Provinces.

OLIVE-GREEN AND GREY SANDSTONES.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick.			
Albert	Curryville	Levi Downey	444	1,189	Yielded without sound. Fracture somewhat irregular on centre.
Albert	Mary point	Walter Roberts	443	1,638	Yielded without sound. Fracture straight above, irregular below.
Gloucester	Grand Anse		569	856	Yielded without sound. Fracture even on centre.
Gloucester	Stonehaven	Read Stone Co	567	1,441	Yielded without sound. Fracture $\frac{1}{8}$ in. from centre, even above, irregular below.
Kent	Buctouche	Miss Deacon	468	809	Yielded without sound. Fracture slightly undulating on centre.
Kent	Notre Dame	Hall and Irving	469	1,453	Yielded without sound. Fracture undulating, across centre.
Northumberland	Quarryville	Miramichi Quarry Co	564	1,330	Yielded without sound. Fracture straight and even, $\frac{1}{4}$ in. from centre at one side, on centre at other.
Northumberland	Quarryville	Miramichi Quarry Co	565	1,207	Yielded without sound. Fracture straight above, irregular below, $\frac{1}{8}$ in. from centre at one side, on centre at other.
Northumberland	Newcastle	Adam Hill	555	892*	Yielded without sound. Fracture straight and even on centre.
Northumberland	French fort	C. E. Fish	561	1,361	Yielded without sound. Fracture even, close to centre.

OLIVE-GREEN AND GREY SANDSTONES—*Continued.*

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick—*Con.*			
Westmorland	Beaumont	Dorchester Stone Works	449	1,447	Yielded without sound. Fracture straight above, irregular below ⅛ in. from centre at one end and ¼ in. from centre at the other.
Westmorland	Shediac	E. G. Smith	466	955	Yielded without sound. Fracture straight and even ¼ in. from centre.
Westmorland	Rockport	Read Stone Co	451	908	Yielded without sound. Fracture irregular on centre.
		Nova Scotia.			
Cape Breton	Forks bridge	A. S. Kendall	527	1,609	Yielded without sound. Fracture smooth and even on centre.
Cumberland	Wallace	Wallace Stone Co	461	1,838	Yielded without sound. Fracture straight and even but diagonal across centre at 15°.
Cumberland	Wallace	Wallace Stone Co	462	1,534	Yielded without sound. Fracture on centre, straight above but slightly irregular below.
Cumberland	Wallace bridge	Batte	464	1,401	Yielded without sound. Fracture straight, ¼ in. from centre, slightly irregular below.
Inverness	Judique	Angus McMillan	550	1,542	Yielded without sound. Fracture straight and even near centre.
Pictou	Eightmile creek	W. R. McKenzie	495	1,701	Yielded without sound. Fracture even, on centre at one side and ¼ in. from centre at the other.
Pictou	New Glasgow	Gammon and Weir	498	1,537	Yielded without sound. Fracture even, slightly inclined on centre.
Pictou	Pictou	Pictou Quarry Co	472	869	Yielded without sound. Fracture slanting and undulating, slightly off centre.

RED AND BROWN SANDSTONES.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick.			
Albert	Mary point	Walter Roberts	442	1,532	Yielded without sound.
Westmorland	Cape Bald	Cape Bald Freestone Co	453	539	Yielded w thout sound. Fracture straight on centre.
Westmorland	Sackville	Sackville Freestone Co	452	1,016*	Yielded without sound. Fracture straight $\frac{3}{8}$ in. from centre.
Westmorland	Wood point	Read Stone Co	450	1,037	Yielded without sound. Fracture somewhat irregular on centre.
		Nova Scotia.			
Antigonish	Monk head		507	637*	Yielded without sound. Failed at bedding plane 1 in. from centre.
Cumberland	Amherst	Amherst Red Stone QuarryCo	459	551	Yielded without sound. Fracture straight and even on centre.
Inverness	Judique	Angus McMillan	547	1,249	Yielded without sound. Fracture somewhat irregular on centre.
Inverness	Stewartdale	John McDonald	522	480	Yielded without sound. Fracture straight and even on centre.
Pictou	River John	H. McNab	492	1,490	Yielded without sound. Fracture straight and even but $\frac{1}{4}$ in. from centre at one side.
		Prince Edward Island.			
Queens	Charlottetown	Henry Swan	494	865	Yielded without sound. Fracture even above, irregular below.

GRANITES.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick.			
Charlotte	St. George (pink)	O'Brien and Baldwin	400	1,910	Snapped. Fracture straight on centre; even above, irregular below.
Charlotte	St. George (red)	Epps, Dodds and Co.	403	2,479	Snapped. Fracture irregular, on centre at one side, $\frac{1}{4}$ in. off on other.
Charlotte	St. George (light)	Milne, Coutts and Co.	410	2,309	Snapped. Fracture very irregular, on centre at one side, $\frac{1}{2}$ in. off on other.
Gloucester	Bathurst	Edward Connolly	566	2,149	Yielded without sound. Fracture irregular, $\frac{1}{4}$ in. from centre on one side and $\frac{1}{2}$ in. from centre on the other.
Queens	Spoon island	D. Mooney and Son	430	2,331	Snapped. Fracture straight on centre, uneven.
Queens	Spoon island	D. Mooney and Son	431	2,655	Snapped. Fracture straight but uneven.
		Nova Scotia.			
Cape Breton	Barrachois	Cape Breton Red Granite Co.	529	3,751	Snapped. Fracture smooth, on centre at one side, $\frac{1}{8}$ in. off on the other.
Annapolis	Nictaux	Middleton Granite and Marble Co.	482	3,572	Snapped. Fracture straight on centre.
Annapolis	Nictaux	Thelbert Rice	483	3,710	Snapped. Fracture slightly inclined on centre.
Halifax	Halifax	Isaac Yeadon	473	2,439	Yielded without sound. Fracture uneven, on centre at one side, $\frac{1}{4}$ in. from centre on the other.
Halifax	Terence bay	....	475	2,269	Yielded without sound. Fracture rough and uneven, $\frac{1}{4}$ in. from centre.
Shelburne	Shelburne	Shelburne Granite Co.	478	3,950	Snapped. Fracture straight and even on centre.

BASIC IGNEOUS ROCKS.

SO-CALLED BLACK GRANITES.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick.			
Charlotte	Bocabec (dark grey)	Epps, Dodds and Co.	404	3,545	Snapped. Fracture straight above, irregular below, on centre at one side and $\frac{1}{4}$ in. off at the other.
Charlotte	Bocabec (black)	Epps, Dodds and Co.	405	5,064	Snapped sharply. Fracture slightly irregular on centre.
Charlotte	Bocabec	Stuart	406	4,543	Snapped. Fracture irregular on centre.

CRYSTALLINE LIMESTONES.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick.			
St. John	St. John	Rokes	423	3,399	Failed along flaw at 45° to the edges of the strip and one inch from centre at nearest side.
St. John	St. John	Purdee and Green	429	2,232*	Straight break along bedding plane $\frac{3}{8}$ in. from centre.

CRYSTALLINE LIMESTONES—*Continued.*

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		Nova Scotia.			
Cape Breton..........	Eskasoni.................	Bown and Harrington.......	536	2,892	Snapped. Fracture even above, irregular below, $\frac{1}{8}$ in. from centre.

METAMORPHOSED SLATE.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		Nova Scotia.			
Halifax................	Halifax..................	Hart and Co..............	477	5,415	Snapped suddenly. Fracture straight on centre but a little uneven.

County.	Locality.	Owner.	No.	Modulus of rupture lbs. per sq. in.	Remarks.
		New Brunswick.		*	
Albert	Hillsborough	Albert Manufacturing Co'y (gypsum).	438	436	Yielded without sound. Fracture slightly undulating.
Albert	Hillsborough	Albert Manufacturing Co'y (anhydrite).	439	1,627	Snapped suddenly. Fracture very irregular, $\frac{5}{8}$ in. from centre at one side and $\frac{3}{4}$ in. from centre at the other.

*In these cases the strips were cut across the bedding of the stone: properly prepared specimens parallel to the bedding would doubtless give higher results.

TABLE III.

The Comparative Crushing Strength of dry and wet samples and of the wet samples after being frozen forty times, with remarks on the visible effects of freezing.*

OLIVE-GREEN AND GREY SANDSTONE.

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed	Wet, Riehle.	Wet and frozen, Riehle.			
New Brunswick.							
Curryville..........	444	13,814	6,586	5,425	7,228	1,161	Stood well, but developed dark iron staining in irregular bands.
Mary point........	443	17,817	9,099	5,728	8,718	3,371	Stood well. Edges sharp, but black lines intensified.
Grande Anse.	569	15,577	7,002	3,188	8,575	3,814	Corners rounded and cracks developed.
Stonehaven........	567	11,112	6,740	8,123	4,372	....	No apparent disintegration, but the sample became darker and the bedding laminæ stood out more distinctly.
	....	14,382	7,667	....	6,715	....	It is unusually difficult to obtain duplicate results with this stone.
Buctouche..........	468	8,869	4,923	2,689	3,946	2,234	Became very soft and disintegrated considerably at corners and edges.
Notre Dame........	469	11,240	4,775	3,482	6,455	1,293	Stood well; showed no visible effect of freezing.
Quarryville..........	564	10,944	8,123	6,431	2,821	1,692	Showed very slight effect on corners only.
"	564	10,832	8,123	6,431	2,709	1,692	
"	565	9,350	6,029	3,045	3,321	2,984	Edges and corners distinctly rounded.
French fort........	561	9,791	5,868	3,616	3,923	2,252	Corners only slightly disintegrated.
Newcastle..........	555	11,891	7,652	....	4,239	....	The frozen sample showed slight disintegration at corners; it was dried before being crushed and gave 9,087 lbs. per sq. in.
Beaumont..........	449	17,800	8,418?	5,920	9,382	2,498?	Stood well, but developed a darker colour with cloudy stains. The wet and frozen tests were not very satisfactory, as the cubes broke out on one side, particularly in the case of the wet sample.
Shediac............	466	12,566	5,377	5,148	7,229	189	Darkened slightly and disintegrated a little at corners.
Rockport..........	451	10,585	6,083	4,826	4,502	1,257	Corners slightly rounded.

OLIVE-GREEN AND GREY SANDSTONE—*Continued.*

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed	Wet, Riehle.	Wet and frozen, Riehle.			
Nova Scotia.							
Forks bridge.......	527	12,208	5,796	4,829	6,412	967	No visible effects of freezing.
Wallace...........	462	15,633	12,235	7,451?	3,398	4,784?	The stone stood well, but became darker in colour. The test on the frozen cube was unsatisfactory, as the break began at one side and ran across the cube, giving a result which is doubtless too low.
....	......	17,680	....	....	5,445	4,784	
Wallace...........	461	13,681	10,075	8,754	3,606	1,321	Corners slightly rounded.
Wallace bridge.....	464	11,775	5,747	....	6,028		
Judique...........	550	15,670	....	11,518	....	....	No apparent effect.
New Glasgow......	498	16,300	10,905	8,337	5,395	2,568	Very little effect.
P.ctou............	472	10,348	5,555	3,463	4,793	2,092	Very little effect.
Boularderie id......	530	16,894	....	....	....	....	The frozen cube stood well, but developed bad stains; it was crushed dry, giving 11,143 lbs. per sq. in.

*Owing to an accident to the Riehle machine with which the wet and the wet and frozen samples were broken, it was found necessary to crush the dry samples in a Wicksteed machine. The results are, therefore, in some instances, not as strictly comparable as could be wished. It is probable that any error lies in the direction of too low results from the Riehle machine.

RED AND BROWN SANDSTONES.

Locality.	No.	Crushing strength, lbs. per sq. in. Dry, Wicksteed.	Wet, Riehle.	Wet and frozen, Riehle.	Difference dry and wet.	Difference wet and frozen.	Remarks.
New Brunswick.							
Mary point	442	14,675	7,602	4,904	7,073	2,698	Stood well, the corners only slightly affected.
Cape Bald	453	7,623	3,691	2,656	3,932	1,035	Disintegrated badly, particularly on bedding planes, became soft and crumbly.
Sackville	452	11,899	6,083	3,856	5,816	2,227	Stood well on the edges across the bedding; but the edges parallel to the bedding showed slight disintegration and an intensification of the laminar structure.
Wood point	450	10,560	5,441	445	5,119	4,996	Badly disintegrated. Nearly one-quarter of the cube fell away. The remainder soft and crumbly.
Nova Scotia.							
Monk head	507	8,185	6,459	5,475	1,726	984	Slight exfoliation on bedding, but surprisingly little effect for a stone of its appearance.
Amherst	459	11,122	6,938	4,000	4,184	2,938	Disintegrated on bedding planes; corners and angles distinctly affected.
Judique	547	14,744	8,536	....	6,208	....	The frozen cube showed no injury; it was crushed dry giving 10,129 lbs. per sq. in.
Stewartdale	522	9,056	5,362	4,834	3,694	528	Edges evenly but slightly rounded.
River John	492	15,147	8,678	8,717	6,469	....	Exfoliated slightly on bedding faces. While the result in the case of the wet cube is contradictory, it is within the limit of error, as this stone, like the similar ones, 522 and 494, is little injured by frost, but is much softened by the presence of water.

RED AND BROWN SANDSTONES—*Continued.*

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed	Wet, Riehle.	Wet and frozen, Riehle.			
Prince Edward Island.							
Charlottetown....	494	8,126	1,962	1,903	6,164	59	A thin layer of soft material appeared over the whole surface, but no serious falling away was perceived.

GRANITES.

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed.	Wet, Riehle.	Wet and frozen, Riehle.			
New Brunswick.							
St. George	400	30,702	28,068	22,582	2,634	5,486	No apparent effect.
"	403	27,266	26,660	19,845	606	6,815	" "
"	410	31,863	29,450	24,974	2,413	4,476	" "
Bathurst	566	28,446	27,014	25,005	1,432	2,009	" "
Spoon island	431	34,993	....	....	....	....	The frozen cube was crushed dry, giving 30,700 lbs. per sq. in.
Nova Scotia.							
Barrachois	529	48,984	....	....	....	....	The frozen cube was crushed dry, but as it sheared off from one side, the result (31,229) is doubtless much too low and is not recorded.
Nictaux	482	34,058	34,300	34,000	....	300	No effect.
"	483	32,607	28,050	27,588	4,557	462	No effect.
Halifax	473	25,959	23,458	22,762	2,501	696	No effect.
Terence bay	475	25,893	....	....	....	....	The frozen cube was crushed dry, giving 23,382 lbs. per sq. in.
Shelburne	478	28,440	26,940	25,538	1,500	1,402	No effect.

BASIC IGNEOUS ROCKS.

(BLACK GRANITES.)

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed	Wet, Riehle.	Wet and frozen, Riehle.			
New Brunswick.							
Bocabec...........	404	38,906	35,620	34,000	3,286	1,620	No effect.
"	405	50,246	46,400	46,511	3,846	....	No effect.
"	406	39,928	....	....	....	....	Both wet and frozen cubes were crushed, but owing to side breaking the results are disproportionately low and are not recorded.

METAMORPHOSED SLATE.

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed	Wet, Riehle.	Wet and frozen, Riehle.			
Nova Scotia.							
Halifax...........	477	31,470	32,165	25,532	....	....	The result in the case of the frozen cube is low, owing to side breaking.

CRYSTALLINE LIMESTONES.

Locality.	No.	Crushing strength, lbs. per sq. in.			Difference dry and wet.	Difference wet and frozen.	Remarks.
		Dry, Wicksteed	Wet, Riehle.	Wet and frozen, Riehle.			
New Brunswick.							
St. John	423	17,583	....	....	....	....	The frozen cube showed rounded edges; it was crushed dry, giving 13,618 lbs. per sq. in.
"	429	16,000	12,913	10,207	3,087	2,706	Showed a slight rounding of the edges.

TABLE IV.

The Specific Gravity, Weight per cubic foot, Percentage of Pore Space, and Ratio of Absorption of Typical Building Stones from the Maritime Provinces.

OLIVE-GREEN AND GREY SANDSTONES.

County.	Locality.	Owner.	No.	Specific Gravity.	Weight, lbs. per cu. ft.	Pore space per cent.	Ratio of absorption.
		New Brunswick.					
Albert	Curryville	Levi Downey	444	2·659	147·586	11·686	4·976
Albert	Mary point	Walter Roberts	443	2·665	144·387	13·271	5·749
Gloucester	Grande Anse		569	2·67	140·075	15·96	7·083
Gloucester	Stonehaven	Read Stone Co.	567	2·64	147·456	10·527	4·456
Kent	Buctouche	Deacon	468	2·693	137·03	18·489	8·423
Kent	Notre Dame	Hall and Irving	469	2·691	145·621	13·91	6·004
Northumberland	Quarryville	Miramichi Quarry Co.	564	2·666	147·27	11·51	5·55
Northumberland	Quarryville	Miramichi Quarry Co.	565	2·683	139·183	16·90	7·57
Northumberland	Newcastle	Adam Hill	555	2·663	141·253	15·031	6·604
Northumberland	French fort	C. E. Fish	561	2·684	139·25	16·89	7·574
Westmorland	Beaumont	Dorchester Stone Works	449	2·657	146·795	10·897	4·604
Westmorland	Shediac	E. G. Smith	466	2·686	139·898	16·572	7·395
Westmorland	Rockport	Read Stone Co.	451	2·688	137·409	18·063	8·203
		Nova Scotia.					
Cape Breton	Forks bridge	A. S. Kendall	527	2·657	148·215	10·642	4·485
Cumberland	Wallace	Wallace Stone Co.	461	2·687	144·808	13·688	5·902
Cumberland	Wallace	Wallace Stone Co.	462	2·687	145·869	13·038	5·58
Cumberland	Wallace bridge	Batte	464	2·678	139·81	16·39	7·32
Inverness	Judique	Angus McMillan	550	2·654	144·816	12·592	5·428
Pictou	Eight Mile creek	W. R. McKenzie	495	2·69	142·418	15·19	6·66
Pictou	New Glasgow	Gammon and Weir	498	2·656	146·139	11·860	5·006
Pictou	Pictou	Pictou Quarry Co.	472	2·687	141·652	15·552	6·853
Victoria	Boularderie island	Duncan Grant	530	2·591	143·972	10·989	4·765

RED AND BROWN SANDSTONES.

County.	Locality.	Owner.	No.	Specific Gravity.	Weight, lbs. per cu. ft.	Pore space per cent.	Ratio of absorption.
		New Brunswick.					
Albert	Mary point	Walter Roberts	442	2·666	144·834	12·975	5·596
Westmorland	Cape Bald	Cape Bald Freestone Co	453	2·687	135·132	19·434	8·977
Westmorland	Sackville	Sackville Freestone Co	452	2·711	145·743	13·882	5·946
Westmorland	Wood point	Read Stone Co	450	2·702	140·285	16·139	7·123
		Nova Scotia.					
Antigonish	Monk head		507	2·65	136·002	17·689	8·11
Cumberland	Amherst	Amherst Red Stone Quarry Co	459	2·700	142·93	15·20	6·849
Inverness	Judique	Angus McMillan	547	2·659	137·98	16·814	7·598
Inverness	Stewartdale	John McDonald	522	2·659	131·86	20·562	9·735
Pictou	River John	H. McNab	492	2·688	146·041	12·962	5·54
		Prince Edward Island.					
Queens	Charlottetown	Henry Swan	494	2·72	131·009	22·845	10·886

GRANITES.

County.	Locality.	Owner.	No.	Specific Gravity.	Weight, lbs. per cu. ft.	Pore space per cent.	Ratio of absorption.
		New Brunswick.					
Charlotte	St. George (pink)	O'Brien and Baldwin	400	2·626	163·086	0·515	0·197
Charlotte	St. George (red)	Epps, Dodds and Co	404	2·614	161·51	1·024	0·396
Charlotte	St. George (light)	Milne, Coutts and Co	410	2·621	152·442	0·719	0·298
Gloucester	Bathurst	Edward Connolly	566	2·654	163·9	0·711	0·27
Queens	Spoon island	D. Mooney and Son	430	2·698	167·642	0·466	0·173
Queens	Spoon island	D. Mooney and Son	431	2·699	167·786	0·435	0·128
		Nova Scotia.					
Cape Breton	Barrachois	Cape Breton Red Granite Co	529	2·656	165·374	0·259	0·098
Annapolis	Nictaux	Middleton Granite and Marble Co.	482	2·695	167·628	0·368	0·137
Annapolis	Nictaux	Thelbert Rice	483	2·692	167·503	0·326	0·121
Halifax	Halifax	Isaac Yeadon	473	2·702	167·757	0·544	0·208
Halifax	Terence bay		475	2·657	164·948	0·553	0·209
Shelburne	Shelburne	Shelburne Granite Co	478	2·688	167·016	0·468	0·172

BASIC IGNEOUS ROCKS.

SO-CALLED BLACK GRANITES.

County.	Locality.	Owner.	No.	Specific Gravity.	Weight, lbs. per cu. ft.	Pore space per cent.	Ratio of absorption.
		New Brunswick.					
Charlotte	Bocabec (dark grey)	Epps, Dodds and Co	404	2·924	181·557	0·535	0·224
Charlotte	Bocabec (black)	Epps, Dodds and Co	405	2·918	181·703	0·25	0·085
Charlotte	Bocabec	Stewart	406	2·958	184·132	0·29	0·098

CRYSTALLINE LIMESTONES.

County.	Locality.	Owner.	No.	Specific Gravity.	Weight, lbs. per cu. ft.	Pore space per cent.	Ratio of absorption.
		New Brunswick.					
St. John	St. John	Rokes	423	2·722	169·49	0·255	0·094
St. John	St. John	Purdee and Green	429	2·715	169·146	0·201	0·074
		Nova Scotia.					
Cape Breton	Eskasoni	Bown and Harrington	536	2·831	176·165	0·319	0·113
Inverness	Marble mountain	Dominion	512	2·72	169·65	0·087	0·032

LIMESTONE.

		Nova Scotia.					
Antigonish	Brierly brook	Alex. McDonald	505	2·715	167·859	0·961	0·357

METAMORPHOSED SLATE.

		Nova Scotia.					
Halifax	Halifax	Hart and Co	477	2·794	174·067	0·201	0·072

TABLE V.

The Coefficient of Saturation of Building Stone from the Maritime Provinces.

This factor is obtained by dividing the weight of water absorbed by a specimen in one hour or in two hours by the total amount of water it can be made to absorb. It is considered that a stone is in great danger of injury by frost only when this factor exceeds 0·8.

OLIVE–GREEN AND GREY SANDSTONES.

New Brunswick.

Locality.	No.	Coefficient of Saturation.		
		One hour.	Two hours.	Thirty-eight hours.
Curryville	444	0·64	0·73	
Mary point	443	0·60	0·61	
Grande Anse	569	0·67	0·68	
Stonehaven	567	0·58	0·70	
Buctouche	468	0·60	0·604	
Notre Dame	469	0·58	0·68	
Quarryville	564	0·63	0·64	
French fort	561	0·61	0·65	
Newcastle	555	0·57	0·72	
Beaumont	449	0·58	0·68	
Shediac	466	0·62	0·64	
Rockport	451	0·60	0·61	

Nova Scotia.

Locality.	No.	One hour.	Two hours.	Thirty-eight hours.
Forks bridge	527	0·50	0·63	
Wallace	461	0·61	0·63	
Wallace	462	0·62	0·63	
Wallace bridge	464	0·59	0·60	0·62
Judique	550	0·10	0·14	
Eightmile creek	495	0·58	0·63	0·66
New Glasgow	498	0·68	0·72	
Pictou	472	0·65	0·72	
Boularderie	530	0·60	0·78	

RED AND BROWN SANDSTONES.

Locality.	No.	Coefficient of Saturation. One hour.	Two hours.	Thirty-eight hours.
New Brunswick.				
Mary point	442	0·62	0·72	
Cape Bald	453	0·58	0·59	
Sackville	452	0·54	0·65	
Sackville	452	0·47	0·58	0·66
Wood point	450	0·60	0·62	
Nova Scotia.				
Monk head	507	0·58	0·59	
Amherst	459	0·47	0·59	
Judique	547	0·02	0·03	
Stewartdale	522	0·56	0·57	
River John	492	0·42	0·61	
Prince Edward Island.				
Charlottetown	494	0·63	0·64	

GRANITES.

Locality.	No.	Coefficient of Saturation. One hour.	Two hours.	Thirty-eight hours.
New Brunswick.				
St. George	400	0·58	0·69	
St. George	403	0·46	0·48	
St. George	410	0·58	0·59	
Bathurst	566	0·47	0·63	
Spoon island	430	0·71	0·71	
Spoon island	431	0·67	0·71	
Nova Scotia.				
Barrachois	529	0·37	0·50	
Nictaux	482	0·57	0·68	
Nictaux	483	0·47	0·60	
Halifax	473	0·56	0·65	0·79
Terence bay	475	0·50	0·64	
Shelburne	478	0·46	0·60	

BLACK GRANITES.

Locality.	No.	Coefficient of Saturation. One hour.	Two hours.	Thirty-eight hours.
New Brunswick.				
Bocabec	404	0·45	0·66	
Bocabec	405	0·38	0·51	
Bocabec	406	0·30	0·39	

CRYSTALLINE LIMESTONES.

Locality.	No.	Coefficient of Saturation. One hour.	Two hours.	Thirty-eight hours.
New Brunswick.				
St. John	423	0·96	1·00	
St. John	429	1·00	1·00	
Nova Scotia.				
Eskasoni	536	0·88	1·00	
Marble mountain	512	0·87	1·00	

METAMORPHOSED SLATE.

Locality.	No.	Coefficient of Saturation. One hour.	Two hours.	Thirty-eight hours.
Nova Scotia.				
Halifax	477	0·20	0·24	

GYPSUM AND ANHYDRITE.

It was found impossible to conduct this experiment on these stones as chemical changes due to the action of water gave contradictory results. In the case of gypsum the coefficient in both instances was 0·97; in the case of anhydrite the changes were so great that the figures obtained are not worth recording.

TABLE VI.

The Changes in Weight and Colour produced by subjecting the Stone to the action of Carbonic Acid and Oxygen in water for twenty-one days.

OLIVE-GREEN AND GREY SANDSTONES.

Locality.	No.	Change in Weight Grams per sq. in. Loss.	Gain.	Colour Changes.
New Brunswick.				
Curryville	444	0·00515	....	Becomes distinctly more yellow.
Mary point	443	0·0062	....	Distinctly more yellow and somewhat muddy.
Grande Anse	569	0·00284	....	No change.
Stonehaven	567	0·00278	....	No change.
Buctouche	468	0·00454	....	Less distinctly green.
Notre Dame	469	0·0164	....	Less greenish.
Quarryville	564	....	0·00453	Much less greenish.
"	565	....	0·00447	Less greenish and more grey.
French fort	561	....	0·00221	Distinctly less greenish.
Newcastle	555	....	0·00439	Less green and more grey.
Beaumont	449	0·00343.		No change.
Shediac	466	0·008	....	Very little change.
Rockport	451	0·00265	....	Very little change.
Nova Scotia.				
Forks bridge	527	....	0·00367	Very little change.
Wallace	461	0·0057	....	Distinctly more yellowish.
Wallace	462	0·00164	....	Slightly more yellow and a little cloudy.
Wallace bridge	464	0·00213	....	Lighter and slightly yellow.
Judique	550	....	0·00248	The slight pink cast is lost.
New Glasgow	498	0·00811	....	Less clean grey; the greenish cast is dulled.
Pictou	472	0·0148	....	Spotted effect is increased.

RED AND BROWN SANDSTONES.

Locality.	No.	Change in Weight Grams per sq. in. Loss.	Gain.	Colour Changes.
New Brunswick.				
Mary point..........	442	0·00447	....	Slightly redder.
Cape Bald..........	453	0·0033	....	No marked change.
Sackville..........	452	0·00213	....	No marked change.
Wood point..........	450	0·00396	....	Very little change.
Nova Scotia.				
Monk head..........	507	....	0·00174	The differently coloured bands are less distinct and the whole tone is decidedly redder.
Amherst..........	459	0·00454	....	No marked change.
Judique..........	547	....	0·0016	Slightly redder.
Stewartdale..........	522	0·00008	....	Absolutely no change in colour.
River John..........	492	0·0048	....	The red is slightly less brilliant, with a shade of yellow.
Prince Edward Island.				
Charlottetown......	494	0·0133	....	The red is slightly dulled and rendered more yellowish.

GRANITES.

Locality.	No.	Change in Weight Grams per sq. in. Loss.	Gain.	Colour Changes.
New Brunswick.				
St. George..........	400	0·00123	....	Feldspars slightly pitted and dulled.
St. George..........	403	0·0083	....	Feldspars slightly pitted and with a cast of yellow.
St. George..........	410	0·00087	....	Feldspars are slightly redder.
Bathurst..........	566	....	0·00133	No apparent change.
Spoon island..........	430	0·00161	....	No change.
Spoon island..........	431	0·00225	....	Slightly dulled.
Nova Scotia.				
Barrachois..........	529	....	0·00172	No change.
Nictaux..........	482	....	0·00081	No change.
Nictaux..........	483	0·000000	0·00000	No change.
Halifax..........	473	0·000349	....	No change.
Terence bay..........	475	0·000705	....	The feldspars are duller and whiter with yellow stains.
Shelburne..........	478	0·00277	....	The ferro-magnesian constituent is pitted distinctly.

BLACK GRANITES.

Locality.	No.	Change in Weight Grams per sq. in. Loss.	Gain.	Colour Changes.
		New Brunswick.		
Bocabec............	404	0·006071	....	Distinctly pitted in the black minerals.
Bocabec...........	405	0·001231	....	Distinctly pitted in the black minerals with accentuation of the same.
Bocabec...........	406	0·000382	....	Black minerals distinctly dulled and rendered decidedly green.

METAMORPHOSED SLATE.

Locality.	No.	Change in Weight Grams per sq. in. Loss.	Gain.	Colour Changes.
		Nova Scotia.		
Halifax.............	477	....	0·000517	No apparent change.

CRYSTALLINE LIMESTONES.

Locality.	No.	Change in Weight Grams per sq. in. Loss.	Gain.	Colour Changes.
		New Brunswick.		
St. John............	423	0·2477	....	Etched all over. Fine white lines. Rough and dull.
St. John............	429	0·24507	....	Etched all over. Fine white lines. Rough and dull.
		Nova Scotia.		
Eskasoni...........	536	0·0462	....	Less blue. Etched. Dark lines more pronounced.

TABLE VII.

The Chiselling Factor and the Drilling Factor of Typical Building Stones from the Maritime Provinces.

OLIVE-GREEN AND GREY SANDSTONES.

County.	Locality.	Owner.	No.	Chiselling factor, loss in grams per 3 in. per 10 sec. See page 5.	——	Drilling factor, depth of drill-hole, mm. per 30 sec. See page 6.
		New Brunswick.				
Albert	Curryville	Levi Downey	444	8·4	Good even track	16·4
Albert	Mary point	Walter Roberts	443	5·2	Good track, slightly uneven	18·
Gloucester	Grande Anse		569	5·1	Uneven track	21·
Gloucester	Stonehaven	Read Quarry Co	567	7·3	Good track	20·
Kent	Buctouche	Miss Deacon	468	5·9	Good track	18·
Kent	Notre Dame	Hall and Irving	469	7·4	Uneven track	17·6
Northumberland	Quarryville	Miramichi Quarry Co	564	6·9	Uneven track	17·6
Northumberland	Quarryville	Miramichi Quarry Co	565	9·6	Good track, some side chips	17·2
Northumberland	Newcastle	Adam Hill	555	5·8	Uneven track	18·
Northumberland	French fort	C. E. Fish	561	6·9	Uneven track	25·2
Westmorland	Beaumont	Dorchester Stone Works	449	5·0	Cuts hard, no chipping	11·0?
Westmorland	Shediac	E. G. Smith	466	6·7	Somewhat uneven track	17·
Westmorland	Rockport	Read Stone Co	451	6·3	Uneven track	18·
		Nova Scotia.				
Cape Breton	Forks bridge	A. S. Kendall	527	6·8	Good even track	15·
Cumberland	Wallace	Wallace Stone Co	461	5·9	Uneven track	12·
Cumberland	Wallace	Wallace Stone Co	462	4·6	Slightly uneven	14·
Cumberland	Wallace bridge	Batte	464	10·0	Uneven, chipped at sides	13·5
Inverness	Judique	Angus McMillan	550	1·9	Even track	9·6
Pictou	Eightmile creek	W. R. McKenzie	495	4·5	Good even track	12·8
Pictou	New Glasgow	Gammon and Weir	498	5·7	Very uneven track	12·
Pictou	Pictou	Pictou Quarry Co	472	5·7	Somewhat uneven	22·?
Victoria	Boularderie island	Duncan Grant	530			

		New Brunswick.				
Albert	Mary point	Walter Roberts	442	3·5	Somewhat uneven	13·
Westmorland	Cape Bald	Cape Bald Freestone Co.	453	10·	Very uneven, broke	....
Westmorland	Sackville	Sackville Freestone Co.	452	5·2	Good track, no chips	15·5
Westmorland	Wood point	Read Stone Co	450	11·1	Irregular track	19·
		Nova Scotia.				
Antigonish	Monk head		507	7·5	Cross grain, broke	20·0
Cumberland	Amherst	Amherst Red Stone QuarryCo	459	4·8	Good track, slightly uneven.	19·5
Inverness	Judique	Angus McMillan	547	3·6	Even track, no chipping	11·2
Inverness	Stewartdale	John McDonald	522	14·6	Very uneven	25·5
Pictou	River John	H. McNab	492	19·6	Uneven, large chips from the sides. Probably low as sample broke.	22·
		Prince Edward Island.				
Queens	Charlottetown	Henry Swan	494	15·2	Uneven, large chips from the sides.	41·1

GRANITES.*

County.	Locality.	Owner.	No.	—	Drilling factor, depth of drill-hole in mm. per 30 sec.
		New Brunswick.			
Charlotte	St. George (pink)	O'Brien and Baldwin	400		3·00
Charlotte	St. George (red)	Epps, Dodds and Co.	403		4·6
Charlotte	St. George (light)	Milne, Coutts and Co.	410		3·9
Gloucester	Bathurst	Edward Connolly	566		3·3
Queens	Spoon island	D. Mooney and Son	430		3·1
Queens	Spoon island	D. Mooney and Son	431		5·0
		Nova Scotia.			
Cape Breton	Barrachois	Cape Breton Red Granite Co.	529		1·4
Annapolis	Nictaux	Middleton Granite and Marble Co.	482		4·2
Annapolis	Nictaux	Thelbert Rice	483		3·6
Halifax	Halifax	Isaac Yeadon	473		3·3
Halifax	Terence bay		475		3·7
Shelburne	Shelburne	Shelburne Granite Co.	478		2·00

*In the case of granite and all the harder rocks the chiselling factor is insignificant and is therefore omitted.

BASIC IGNEOUS ROCKS.

SO-CALLED BLACK GRANITES.

County.	Locality.	Owner.	No.	——	Drilling factor, depth of drill-hole in mm. per 30 sec.
		New Brunswick.			
Charlotte	Bocabec	Epps, Dodds and Co	404	(dark grey)	5·5
Charlotte	Bocabec	Epps, Dodds and Co	405	(black)	3·5
Charlotte	Bocabec	Stewart	406	(Stewart greenstone)	1·4

METAMORPHOSED SLATE.

County.	Locality.	Owner.	No.		Drilling factor, depth of drill-hole in mm. per 30 sec.
		Nova Scotia.			
Halifax	Halifax	Hart and Co	477		1·4

CRYSTALLINE LIMESTONES.

County.	Locality.	Owner.	No.	Chiselling factor, loss in grams per 3in. per 10 sec.	——	Drilling factor, depth of drill-hole mm. per 30 sec.
		New Brunswick.				
St. John	St. John	Rokes	423	9·8	Even track	7·8
St. John	St. John	Purdee and Green	429	4·7	Cross grain, uneven	10·8
		Nova Scotia.				
Cape Breton	Eskasoni	Bown and Harrington	536	3·8	Good even track	10·0

GYPSUM AND ANHYDRITE.

County.	Locality.	Owner.	No.	Chiselling factor, loss in grams per 3in. per 10 sec.		Drilling factor, depth of drill-hole, mm. per 30 sec.
		New Brunswick.				
Albert	Hillsborough	Albert Manufacturing Co.	438 (gypsum)	8·8	Crumbled under the chisel, the result should be higher.	28·0
Albert	Hillsborough	Albert Manufacturing Co.	439 (anhydrite)	11·4	Even track, broke	17·0

TABLE VIII.

Table showing the Factor of Toughness as determined by the Page Impact Machine (See pages 7 and 8).

OLIVE-GREEN SANDSTONES.

Stone.	No.	Factor	Remarks.
Smith's quarry, Shediac.......	466	6	Three specimens gave the same result. One broke into two vertical sections, one into three sections, and one into five sections.
Wallace quarries.............	462	6	Three specimens gave the same result. One broke into two vertical sections, and the others into three.
Miramichi Quarry Co.........	565	5	Broke into three unequal sections.

RED SANDSTONES.

Stone.	No.	Factor.	Remarks.
Sackville red sandstone........	452	7	The specimens broke into two equal vertical sections.
Wood Point brown sandstone..	450	4	Broke into two vertical sections, with irregular fracture.
Prince Edward Island red......	494	4	Broke into two irregular halves.

GRANITES.

Stone.	No.	Factor.	Remarks.
St. George pink granite.......	400	8	Broke irregularly into two halves.
St. George red granite.........	403	8	Two specimens gave the same result and each broke into three irregular vertical sections.
Spoon island granite...........	431	12	Broke into three vertical sections irregularly.
Terence bay granite..........	475	9	Broke into three irregular vertical sections of almost the same shape as 431.
Shelburne granite	478	12	Broke into two equal halves.

BLACK GRANITES.

Stone.	No.	Factor.	Remarks.
Bocabec, Townsend mountain.	405	18	Broke into three unequal vertical sections.
Bocabec, Glenley............	404	9	Broke into two almost equal sections.
Bocabec, Stewart............	406	5	Broke into two almost equal halves. This result is remarkable in view of the other physical properties of this stone.

METAMORPHOSED SLATE.

Stone.	No.	Factor.	Remarks.
Halifax metamorphic slate.....	477	24	Broke into three symmetrical sections.

TABLE IX.

Table illustrating the Agreement between the Drilling Factor and the Boring Factor of certain Stones. (See page 6.)

Stone.	No.	Drilling factor.	Boring factor.
Crystalline limestone, St. John....................	423	7·8	406
Wallace sandstone..................................	462	14·	215
Sackville red sandstone............................	452	15·5	148
Miramichi sandstone................................	565	17·4	130
Wood Point brown sandstone.........................	450	19·	112
Prince Edward Island sandstone.....................	494	41·	82

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TABLE X.

Statistics.

The report of the Chief of the Division of Mineral Resources and Statistics gives the following as the production of building and ornamental stone in Canada during the year 1909:—

SANDSTONE.

Province.	Building and ornamental	Crushed	Paving	Rubble	Total
	$	$	$	$	$
Nova Scotia	15,050	800	....	6,000	21,850
New Brunswick	25,784	....	....	4,825	30,609
Ontario	29,584	2,563	17,774	12,903	62,824
Alberta	87,450	....	....	2,933	90,380
British Columbia	168,338	....	....	175	168,513
Total	326,206	3,363	17,774	26,836	374,179

LIMESTONE.

Province.	Building and ornamental	Crushed	Curbstone, paving	Rubble	Furnace	Flux	Total
	$	$	$	$	Tons	$	$
Nova Scotia	2,025	....	....	....	319,795	150,897	161,922
New Brunswick	30	....	....	....	....	....	30
Quebec	456,338	257,185	154,259	94,221	20,500	10,250	972,253
Ontario	78,823	297,589	169	66,885	427,422	196,208	639,674
Manitoba	224,605	54,575	62	49,312	....	....	328,554
British Columbia	....	....	....	....	74,515	37,258	37,258
Total	761,821	609,349	154,490	210,418	842,232	403,613	2,139,691

GRANITE.

Province.	Building	Monumental or ornamental	Curbing or Paving	Rubble	Crushed	Total
	$	$	$	$	$	$
Nova Scotia	458	2,508	2,846	....	....	5,832
New Brunswick	3,378	7,038	450	675	....	11,451
Ontario	....	2,700	36,500	....	3,500	42,700
Quebec	139,634	58,845	56,167	20	2,430	257,096
Manitoba	....	....	....	....	3,345	3,345
British Columbia	16,000	2,500	11,000	62,510	44,300	134,310
Total	159,470	73,611	106,963	63,205	51,575	454,824

MARBLE.

Ontario	$ 3,441
Quebec	130,000
British Columbia	25,000

The following statement of production is compiled from information given the writer by operators, from estimates, and from indirect evidence. In some cases the values are given at the quarry, and in others f.o.b. railway or vessels. Further, the division of the total production into the three classes is very largely an estimate. It will be understood, therefore, that this statement is not of the nature of sworn trade returns, but merely a general estimate of the probable production during the year 1911.

SANDSTONE

(Building Stone only).

Province.	Owner.	Scabbled blocks.		Rough stone.		Rubble.		Total.
		cu. ft.	$	Tons.	$	Tons.	$	$
New Brunswick	Miramichi Quarry Co.	30,000	12,000	1,000	2,500			14,500
"	Adam Hill			2,500	6,250			6,250
"	Hall and Irving			1,500	3,500			3,500
"	Cape Bald Freestone Co.			250	500			500
"	Dr. Smith			590	3,600	1,000	1,000	4,600
"	Beaumont quarries			1,000	3,000			3,000
"	Read Stone Co.	1,500	200					200
"	Sackville Freestone Co.	75,000	30,000	5,000	12,000			42,000
Nova Scotia	Amherst Red Stone Co.	30,000	12,000	2,000	1,400	4,000	4,000	17,400
"	Wallace Co.	75,000	40,000			5,000	5,000	45,000
"	River John			1,000	2,000			2,000
"	Pictou	15,000	6,000	1,000	3,900	1,000	2,000	11,900
"	New Glasgow			200	1,000			1,000
		226,500	100,200	16,040	39,650	11,000	12,000	151,850

GRANITE.

Province.	Locality.	Cubic feet.	Tons.	Value.
				$
New Brunswick	St. George	9,000		10,000
"	Spoon island	4,800	5,000	13,600
"	St. Stephen (Ledge)	750		600
"	" (Ridge)	60		60
"	McAdam		500	2,500
Nova Scotia	Nictaux	12,000		12,000
"	Halifax		5,000	25,000
	Total	26,610	10,500	63,760

BLACK GRANITE.

New Brunswick	Bocabec	1,400		1,700
"	St. Stephen	50		60
		1,450		1,760

METAMORPHOSED SLATE.

Nova Scotia	Halifax		600	1,200

CRYSTALLINE LIMESTONE.

New Brunswick	St. John		1,000	500

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CANADA

DEPARTMENT OF MINES

HON. LOUIS CODERRE, MINISTER; R. W. BROCK, DEPUTY MINISTER;

MINES BRANCH

EUGENE HAANEL, PH.D., DIRECTOR.

REPORTS AND MAPS OF ECONOMIC INTEREST

PUBLISHED BY THE

MINES BRANCH.

REPORTS.

1. Mining Conditions in the Klondike, Yukon. Report on—by Eugene Haanel, Ph.D., 1902.

†2. Great Landslide at Frank, Alta. Report on—by R. G. McConnell and R. W. Brock, M.A., 1903.

†3. Investigation of the different electro-thermic processes for the smelting of iron ores, and the making of steel, in operation in Europe. Report of Special Commission—by Dr. Haanel, 1904.

†4. Rapport de la Commission nommée pour étudier les divers procédés électro-thermiques pour la réduction des minerais de fer et la fabrication de l'acier employés en Europe—by Dr. Haanel. (French Edition), 1905.

5. On the location and examination of magnetic ore deposits by magnetometric measurements—by Dr. Haanel, 1904.

†7. Limestones, and the Lime Industry of Manitoba. Preliminary Report on—by J. W. Wells, 1905.

†8. Clays and Shales of Manitoba: Their Industrial Value. Preliminary Report on—by J. W. Wells, 1905.

†9. Hydraulic Cements (Raw Materials) in Manitoba: Manufacture and Uses of. Preliminary Report on—by J. W. Wells, 1905.

†10. Mica: Its Occurrence, Exploitation, and Uses—by Fritz Cirkel, M.E., 1905. (See No. 118.

†11. Asbestos: Its Occurrence, Exploitation, and Uses—by Fritz Cirkel, 1905. (See No. 69.)

†12. Zinc Resources of British Columbia and the Conditions affecting their Exploitation. Report of the Commission appointed to investigate—by W. R. Ingalls, 1905.

†16. *Experiments made at Sault Ste. Marie, under Government auspices, in the smelting of Canadian iron ores by the electro-thermic process. Final Report on—by Dr. Haanel, 1907.

†17. Mines of the Silver-Cobalt Ores of the Cobalt district: Their Present and Prospective Output. Report on—by Dr. Haanel, 1907.

†18. Graphite: Its Properties, Occurrence, Refining, and Uses—by Fritz Cirkel, 1907.

†19. Peat and Lignite: Their Manufacture and Uses in Europe—by Erik Nystrom, M.E., 1908.

†20. Iron Ore Deposits of Nova Scotia. Report on (Part I)—by Dr. J. E. Woodman.

*A few copies of the Preliminary Report, 1906, are still available.
†Publications marked thus † are out of print.

†21. Summary Report of Mines Branch, 1907-8.

22. Iron Ore Deposits of Thunder Bay and Rainy River districts. Report on—by F. Hille, M.E.

†23. Iron Ore Deposits, along the Ottawa (Quebec side) and Gatineau rivers. Report on—by Fritz Cirkel.

24. General Report on the Mining and Metallurgical Industries of Canada, 1907-8.

25. The Tungsten Ores of Canada. Report on—by Dr. T. L. Walker.

26. The Mineral Production of Canada, 1906. Annual Report on—by John McLeish, B.A.

26a. French translation: The Mineral Production of Canada, 1906. Annual Report on—by John McLeish.

27. The Mineral Production of Canada, 1907. Preliminary Report on—by John McLeish.

†27a. The Mineral Production of Canada, 1908. Preliminary Report on—by John McLeish.

†28. Summary Report of Mines Branch, 1908.

†28a. French translation: Summary Report of Mines Branch, 1908.

29. Chrome Iron Ore Deposits of the Eastern Townships. Monograph on—by Fritz Cirkel. (Supplementary Section: Experiments with Chromite at McGill University—by Dr J. B. Porter.)

30. Investigation of the Peat Bogs and Peat Fuel Industry of Canada, 1908. Bulletin No. 1—by Erik Nystrom and A. Anrep, Peat Expert.

32. Investigation of Electric Shaft Furnace, Sweden. Report on—by Dr. Haanel.

47. Iron Ore Deposits of Vancouver and Texada islands. Report on—by Einar Lindeman, M.E.

†55. Report on the Bituminous, or Oil-shales of New Brunswick and Nova Scotia; also on the Oil-shale industry of Scotland—by Dr. R. W. Ells.

58. The Mineral Production of Canada, 1907 and 1908. Annual Report on—by John McLeish.

Note.—*The following preliminary bulletins were published prior to the issuance of the Annual Report for 1907–8.*

†31. Production of Cement in Canada, 1908.

42. Production of Iron and Steel in Canada during the Calendar Years 1907 and 1908

43. Production of Chromite in Canada during the Calendar Years 1907 and 1908.

44. Production of Asbestos in Canada during the Calendar Years 1907 and 1908.

†45. Production of Coal, Coke, and Peat in Canada during the Calendar Years 1907 and 1908.

46. Production of Natural Gas and Petroleum in Canada during the Calendar Years 1907 and 1908.

59. Chemical Analyses of Special Economic Importance made in the Laboratories of the Department of Mines, 1906-7-8. Report on—by F. G. Wait, M.A , F.C.S. (With Appendix on the Commercial Methods and Apparatus for the Analysis of Oil-shales—by H. A. Leverin, Ch. E.).

Schedule of Charges for Chemical Analyses and Assays.

†62. Mineral Production of Canada, 1909. Preliminary Report on—by John McLeish.

63. Summary Report of Mines Branch, 1909.

67. Iron Ore Deposits of the Bristol Mine, Pontiac county, Quebec. Bulletin No. 2—by Einar Lindeman and Geo. C. Mackenzie, B.Sc.

†68. Recent Advances in the Construction of Electric Furnaces for the Production of Pig Iron, Steel, and Zinc. Bulletin No. 3—by Dr. Haanel.

69. Chrysotile-Asbestos: Its Occurrence, Exploitation, Milling, and Uses. Report on—by Fritz Cirkel. (Second Edition, enlarged.)

---

†Publications marked thus † are out of print.

†71. Investigation of the Peat Bogs and Peat Industry of Canada, 1909-10; to which is appended Mr. Alf. Larson's Paper on Dr. M. Ekenberg's Wet-Carbonizing Process; from Teknisk Tidskrift, No. 12, December 26, 1908—translation by Mr. A. v. Anrep, Jr.; also a translation of Lieut. Ekelund's Pamphlet entitled 'A Solution of the Peat Problem,' 1909, describing the Ekelund Process for the Manufacture of Peat Powder, by Harold A. Leverin, Ch.E. Bulletin No. 4—by A. v. Anrep (Second Edition, enlarged).

81. French Translation: Chrysotile-Asbestos: Its Occurrence, Exploitation, Milling, and Uses. Report on—by Fritz Cirkel.

82. Magnetic Concentration Experiments. Bulletin No. 5—by Geo. C. Mackenzie.

83. An investigation of the Coals of Canada with reference to their Economic Qualities: as conducted at McGill University under the authority of the Dominion Government. Report on—by J. B. Porter, E.M., D.Sc., R. J. Durley, Ma.E., and others—
Vol. I—Coal Washing and Coking Tests.
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Appendix V
Chemical Tests.

†84. Gypsum Deposits of the Maritime Provinces of Canada—including the Magdalen Islands. Report on—by W. F. Jennison, M.E. (See No. 245.)

88. The Mineral Production of Canada, 1909. Annual Report on—by John McLeish.

NOTE.—*The following preliminary bulletins were published prior to the issuance of the Annual Report for 1909.*

†79. Production of Iron and Steel in Canada during the Calendar Year 1909.

†80. Production of Coal and Coke in Canada during the Calendar Year 1909.

85. Production of Cement, Lime, Clay Products, Stone, and other Structural Materials during the Calendar Year 1909.

89. Reprint of Presidential address delivered before the American Peat Society at Ottawa, July 25, 1910. By Dr. Haanel.

90. Proceedings of Conference on Explosives.

92. Investigation of the Explosives Industry in the Dominion of Canada, 1910. Report on—by Capt. Arthur Desborough. (Second Edition.)

93. Molybdenum Ores of Canada. Report on—by Professor T. L. Walker, Ph.D.

100. The Building and Ornamental Stones of Canada, Vol. I. Report on—by Professor W. A. Parks, Ph. D.

100a. French translation: The Building and Ornamental Stones of Canada, Vol. I. Report on—by W. A. Parks.

102. Mineral Production of Canada, 1910. Preliminary Report on—by John McLeish.

†103. Summary Report of Mines Branch, 1910.

104. Catalogue of Publications of Mines Branch, from 1902 to 1911; containing Tables of Contents and List of Maps, etc.

105. Austin Brook Iron-bearing district. Report on—by E. Lindeman.

110. Western Portion of Torbrook Iron Ore Deposits, Annapolis county, N.S. Bulletin No. 7—by Howells Fréchette, M.Sc.

111. Diamond Drilling at Point Mamainse, Ont. Bulletin No. 6—by A. C. Lane, Ph.D., with Introductory by A. W. G. Wilson, Ph.D.

†Publications marked thus † are out of print.

118. Mica: Its Occurrence, Exploitation, and Uses. Report on—by Hugh S. de Schmid, M.E.

142. Summary Report of Mines Branch, 1911.

143. The Mineral Production of Canada, 1910. Annual Report on—by John McLeish.

Note.—*The following preliminary Bulletins were published prior to the issuance of the Annual Report for 1910.*

†114. Production of Cement, Lime, Clay Products, Stone, and other Structural Materials in Canada, 1910.

†115. Production of Iron and Steel in Canada during the Calendar Year 1910.

†116. Production of Coal and Coke in Canada during the Calendar Year 1910.

†117. General Summary of the Mineral Production of Canada during the Calendar Year 1910.

145. Magnetic Iron Sands of Natashkwan, Saguenay county, Que. Report on—by Geo. C. Mackenzie.

†150. The Mineral Production of Canada, 1911. Preliminary Report on—by John McLeish.

151. Investigation of the Peat Bogs and Peat Industry of Canada, 1910–11. Bulletin No. 8—by A. v. Anrep.

154. The Utilization of Peat Fuel for the Production of Power, being a record of experiments conducted at the Fuel Testing Station, Ottawa, 1910–11. Report on—by B. F. Haanel, B.Sc.

155. French translation: The Utilization of Peat Fuel for the Production of Power, being a Record of Experiments conducted at the Fuel Testing Station, Ottawa, 1910–11. Report on—by B. F. Haanel.

156. French translation: The Tungsten Ores of Canada. Report on—by Dr. T. L. Walker.

167. Pyrites in Canada: Its Occurrence, Exploitation, Dressing, and Uses. Report on—by A. W. G. Wilson.

170. The Nickel Industry: with Special Reference to the Sudbury region, Ont. Report on—by Professor A. P. Coleman, Ph.D.

184. Magnetite Occurrences along the Central Ontario Railway. Report on—by E. Lindeman.

196. French translation: Investigation of the Peat Bogs and Peat Industry of Canada, 1909–10; to which is appended Mr. Alf. Larson's paper on Dr. M. Ekenburg's Wet-Carbonizing Process: from Teknisk Tidskrift, No. 12, December 26, 1908—translation by Mr. A. v. Anrep; also a translation of Lieut. Ekelund's Pamphlet entitled "A Solution of the Peat Problem," 1909, describing the Ekelund Process for the Manufacture of Peat Powder, by Harold A. Leverin Ch. E. Bulletin No. 4—by A. v. Anrep. (Second Edition, enlarged.)

197. French translation: Molybdenum Ores of Canada. Report on—by Dr. T. L. Walker.

198. French translation: Peat and Lignite: Their Manufacture and Uses in Europe—by Erik Nystrom, M.E., 1908.

201. The Mineral Production of Canada during the Calendar Year 1911. Annual Report on—by John McLeish.

Note.—*The following preliminary Bulletins were published prior to the issuance of the Annual Report for 1911.*

181. Production of Cement, Lime, Clay Products, Stone, and other Structural Materials in Canada during the Calendar Year 1911. Bulletin on—by John McLeish.

†182. Production of Iron and Steel in Canada during the Calendar Year 1911. Bulletin on—by John McLeish.

183. General Summary of the Mineral Production in Canada during the Calendar Year 1911. Bulletin on—by John McLeish.

199. Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and other Metals of Canada, during the Calendar Year 1911. Bulletin on—by John McLeish.

200. The Production of Coal and Coke in Canada during the Calendar Year 1911. Bulletin on—by John McLeish.

†Publications marked thus † are out of print.

202. French translation: Graphite: Its Properties, Occurrence, Refining, and Uses—by Fritz Cirkel, 1907.

203. Building Stones of Canada—Vol. II: Building and Ornamental Stones of the Maritime Provinces. Report on—by W. A. Parks.

216. Mineral Production of Canada, 1912. Preliminary Report on—by John McLeish.

224. Summary Report of the Mines Branch, 1912.

226. French translation: Chrome Iron Ore Deposits of the Eastern Townships. Monograph on—by Fritz Cirkel. (Supplementary Section: Experiments with Chromite at McGill University—by Dr. J. B. Porter.)

227. Sections of the Sydney Coal Fields—by J. G. S. Hudson.

†229. Summary Report of the Petroleum and Natural Gas Resources of Canada, 1912—by F. G. Clapp. (See No. 224.)

230. Economic Minerals and the Mining Industry of Canada.

231. French translation: Economic Minerals and the Mining Industry of Canada.

233. French translation: Gypsum Deposits of the Maritime Provinces of Canada—including the Magdalen Islands. Report on—by W. F. Jennison.

262. The Mineral Production of Canada during the Calendar Year 1912. Annual Report on—by John McLeish.

Note.—*The following preliminary Bulletins were published prior to the issuance of the Annual Report for 1912.*

238. General Summary of the Mineral Production of Canada, during the Calendar Year 1912 Bulletin on—by John McLeish.

247. Production of Iron and Steel in Canada during the Calendar Year 1912. Bulletin on—by John McLeish.

256. Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and other Metals of Canada, during the Calendar Year 1912—by C. T. Cartwright, B.Sc.

257. Production of Cement, Lime, Clay Products, Stone, and other Structural Materials during the Calendar Year 1912. Report on—by John McLeish.

258. Production of Coal and Coke in Canada, during the Calendar Year 1912. Bulletin on—by John McLeish.

Note.—*Lists of manufacturers of clay products, stone quarry operators, and operators of lime-kilns, are prepared annually by the Division of Mineral Resources and Statistics, and copies may be had on application.*

IN THE PRESS.

56. French translation: Bituminous or Oil-shales of New Brunswick and Nova Scotia; also on the Oil-shale Industry of Scotland—by R. W. Ells.

149. French translation: Magnetic Iron Sands of Natashkwan, Saguenay county, Que. Report on—by Geo. C. Mackenzie.

180. French translation: Investigation of the Peat Bogs, and Peat Industry of Canada, 1910-11. Bulletin No. 8—by A. v. Anrep.

209. The Copper Smelting Industry of Canada. Report on—by A. W. G. Wilson.

222. Lode Mining in Yukon: An Investigation of the Quartz Deposits of the Klondike Division. Report on—by T. A. MacLean, B.A.Sc.

245. Gypsum in Canada: Its Occurrence, Exploitation, and Technology. Report on—by L. H. Cole.

254. Calabogie Iron-Bearing District. Report on—by E. Lindeman.

259. Preparation of Metallic Cobalt by Reduction of the Oxide. Report on—by H. T. Kalmus B.Sc., Ph.D.

† Publications marked thus † are out of print.

263. French translation: Recent Advances in the Construction of Electric Furnaces for the Production of Pig Iron, Steel, and Zinc. Bulletin No. 3—by Dr. Haanel.

264. French translation: Mica: Its Occurrence, Exploitation, and Uses. Report on—by Hugh S. de Schmid.

265. French translation: Annual Mineral Production of Canada, 1911. Report on—by John McLeish.

MAPS.

†6. Magnetometric Survey, Vertical Intensity: Calabogie Mine, Bagot township, Renfrew county, Ontario—by E. Nystrom, 1904. Scale 60 feet=1 inch. Summary report, 1905. (See Map No. 249.)

†13. Magnetometric Survey of the Belmont Iron Mines, Belmont township, Peterborough county, Ontario—by B. F. Haanel, 1905. Scale 60 feet=1 inch. Summary report, 1905. (See Map No. 186.)

†14. Magnetometric Survey of the Wilbur Mine, Lavant township, Lanark county, Ontario—by B. F. Haanel, 1905. Scale 60 feet=1 inch. Summary report, 1905.

†33. Magnetometric Survey, Vertical Intensity: Lot 1, Concession VI, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909. Scale 60 feet=1 inch.

†34. Magnetometric Survey, Vertical Intensity: Lots 2 and 3, Concession VI, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909. Scale 60 feet = 1 inch.

†35. Magnetometric Survey, Vertical Intensity: Lots 10, 11, and 12, Concession IX, and Lots 11 and 12, Concession VIII, Mayo township, Hastings county, Ontario—by Howells Fréchette, 1909. Scale 60 feet=1 inch.

*36. Survey of Mer Bleue Peat Bog, Gloucester township, Carleton county, and Cumberland township, Russell county, Ontario—by Erik Nystrom, and A. v. Anrep. (Accompanying report No. 30.)

*37. Survey of Alfred Peat Bog, Alfred and Caledonia townships, Prescott county, Ontario—by Erik Nystrom, and A. v. Anrep. (Accompanying report No. 30.)

*38. Survey of Welland Peat Bog, Wainfleet and Humberstone townships, Welland county, Ontario —by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*39. Survey of Newington Peat Bog, Osnabruck, Roxborough, and Cornwall townships, Stormont county, Ontario—by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*40. Survey of Perth Peat Bog, Drummond township, Lanark county, Ontario —by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*41. Survey of Victoria Road Peat Bog, Bexley and Carden townships, Victoria county, Ontario —by Erik Nystrom and A. v. Anrep. (Accompanying report No. 30.)

*48. Magnetometric Survey of Iron Crown claim at Klaanch river, Vancouver island, B.C.—by E. Lindeman. Scale 60 feet=1 inch. (Accompanying report No. 47.)

*49. Magnetometric Survey of Western Steel Iron claim, at Sechart, Vancouver island, B.C.—by E. Lindeman. Scale 60 feet=1 inch. (Accompanying report No. 47.)

*53. Iron Ore Occurrences, Ottawa and Pontiac counties, Quebec, 1908—by J. White and Fritz Cirkel. (Accompanying report No. 23.)

*54. Iron Ore Occurrences, Argenteuil county, Quebec, 1908—by Fritz Cirkel. (Accompanying report No. 23).

†57. The Productive Chrome Iron Ore District of Quebec—by Fritz Cirkel. (Accompanying report No. 29.)

†60. Magnetometric Survey of the Bristol Mine, Pontiac county, Quebec—by E. Lindeman. Scale 200 feet=1 inch. (Accompanying report No. 67.)

*61. Topographical Map of Bristol Mine, Pontiac county, Quebec—by E. Lindeman. Scale 200 feet=1 inch. (Accompanying report No. 67.)

Note.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

†64. Index Map of Nova Scotia: Gypsum—by W. F. Jennison.
†65. Index Map of New Brunswick: Gypsum—by W. F. Jennison. (Accompanying report No.84)
†66. Map of Magdalen Islands: Gypsum—by W. F. Jennison.

†70. Magnetometric Survey of Northeast Arm Iron Range, Lake Timagami, Nipissing district, Ontario—by E. Lindeman. Scale 200 feet=1 inch. (Accompanying report No. 63.)

†72. Brunner Peat Bog, Ontario—by A. v. Anrep.
†73. Komoka Peat Bog, Ontario—by A. v. Anrep. (Accompanying report No. 71.)
†74. Brockville Peat Bog, Ontario—by A. v. Anrep.

†75. Rondeau Peat Bog, Ontario—by A. v. Anrep.
†76. Alfred Peat Bog, Ontario—by A. v. Anrep. Accompanying report No. 71
†77. Alfred Peat Bog, Ontario: Main Ditch profile—by A. v. Anrep.

†78. Map of Asbestos Region, Province of Quebec, 1910—by Fritz Cirkel. Scale 1 mile=1 inch (Accompanying report No. 69.)

†94. Map showing Cobalt, Gowganda, Shiningtree, and Porcupine districts—by L. H. Cole, B.Sc. (Accompanying Summary report, 1910.)

*95. General Map of Canada, showing Coal Fields. (Accompanying report No. 83—by Dr. J. B. Porter.)

*96. General Map of Coal Fields of Nova Scotia and New Brunswick. (Accompanying report No. 83—by Dr. J. B. Porter.)

*97. General Map showing Coal Fields in Alberta, Saskatchewan, and Manitoba. (Accompanying report No. 83—by Dr. J. B. Porter.)

*98. General Map of Coal Fields in British Columbia. (Accompanying report No. 83—by Dr. J. B. Porter.)

*99. General Map of Coal Field in Yukon Territory. (Accompanying report No. 83—by Dr. J. B. Porter.)

†106. Geological Map of Austin Brook Iron Bearing district, Bathurst township, Gloucester county, N.B.—by E. Lindeman. Scale 400 feet=1 inch. (Accompanying report No. 105.)

†107. Magnetometric Survey, Vertical Intensity: Austin Brook Iron Bearing District—by E. Lindeman. Scale 400 feet=1 inch. (Accompanying report No. 105.)

*108. Index Map showing Iron Bearing Area at Austin Brook—by E. Lindeman. (Accompanying report No. 105.)

*112. Sketch plan showing Geology of Point Mamainse, Ont.—by Professor A. C. Lane. Scale, 4,000 feet=1 inch. (Accompanying report No. 111.)

†113. Holland Peat Bog, Ontario—by A. v. Anrep. (Accompanying report No. 151.)

*119-137. Mica: Township maps, Ontario and Quebec—by Hugh S. de Schmid. (Accompanying report No. 118.)

†138. Mica: Showing Location of Principal Mines and Occurrences in the Quebec Mica Area—by Hugh S. de Schmid. Scale 3·95 miles=1 inch. (Accompanying report No. 118.)

†139. Mica: Showing Location of Principal Mines and Occurrences in the Ontario Mica Area—by Hugh S. de Schmid. Scale 3·95 miles=1 inch. (Accompanying report No. 118.)

†140. Mica: Showing Distribution of the Principal Mica Occurrences in the Dominion of Canada by Hugh S. de Schmid. Scale 3·95 miles=1 inch. (Accompanying report No. 118.)

†141. Torbrook Iron Bearing District, Annapolis county, N.S.—by Howells Fréchette. Scale 400 feet=1 inch. (Accompanying report No. 110.)

†146. Distribution of Iron Ore Sands of the Iron Ore Deposits on the North Shore of the River and Gulf of St. Lawrence, Canada—by Geo. C. Mackenzie. Scale 100 miles=1 inch. (Accompanying report No. 145.)

NOTE.—1. Maps marked thus * are to be found only in reports.
2. Maps marked thus † have been printed independently of reports, hence can be procured separately by applicants.

†147. Magnetic Iron Sand Deposits in Relation to Natashkwan harbour and Great Natashkwan river, Que. (Index Map)—by Geo. C. Mackenzie. Scale 40 chains=1 inch. (Accompanying report No. 145.)

†148. Natashkwan Magnetic Iron Sand Deposits, Saguenay county, Que.—by Geo. C. Mackenzie. Scale 1,000 feet=1 inch. (Accompanying report No. 145.)

†152. Map showing the Location of Peat Bogs investigated in Ontario—by A. v. Anrep.

†153. Map Showing the Location of Peat Bogs investigated in Manitoba—by A. v. Anrep.

†157. Lac du Bonnet Peat Bog, Manitoba—by A. v. Anrep.

†158. Transmission Peat Bog, Manitoba—by A. v. Anrep.

†159. Corduroy Peat Bog, Manitoba—by A. v. Anrep.

†160. Boggy Creek Peat Bog, Manitoba—by A. v. Anrep.

†161. Rice Lake Peat Bog, Manitoba—by A. v. Anrep.

†162. Mud Lake Peat Bog, Manitoba—by A. v. Anrep.

†163. Litter Peat Bog, Manitoba—by A. v. Anrep.

(Accompanying report No 151) [for †152–†163]

†164. Julius Peat Litter Bog, Manitoba—by A. v. Anrep.

†165. Fort Francis Peat Bog, Ontario—by A. v. Anrep.

(Accompanying report No. 151.) [for †164–†165]

*166. Magnetometric Map of No. 3 Mine, Lot 7, Concessions V and VI, McKim township, Sudbury district, Ont.—by E. Lindeman. (Accompanying Summary report, 1911.)

†168. Map showing Pyrites Mines and Prospects in Eastern Canada, and Their Relation to the United States Market—by A. W. G. Wilson. Scale 125 miles=1 inch. (Accompanying report No. 167.)

†171. Geological Map of Sudbury Nickel region, Ont.—by Prof. A. P. Coleman. Scale 1 mile=1 inch. (Accompanying report No. 170.)

†172. Geological Map of Victoria Mine—by Prof. A. P. Coleman.

†173. " " Crean Hill Mine—by Prof. A. P. Coleman.

†174. " " Creighton Mine—by Prof. A. P. Coleman.

(Accompanying report No. 170.) [for †172–†174]

†175. " " showing Contact of Norite and Laurentian in vicinity of Creighton mine by Prof. A. P. Coleman. (Accompanying report No. 170.)

†176. " " of Copper Cliff offset—by Prof. A. P. Coleman. (Accompanying report No. 170.)

†177. " " No. 3 Mine—by Prof. A. P. Coleman. (Accompanying report No. 170).

†178. " " showing vicinity of Stobie and No. 3 mines—by Prof. A. P. Coleman. (Accompanying report No. 170.)

†185. Magnetometric Survey, Vertical Intensity: Blairton iron mine, Belmont township, Peterborough county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†185a. Geological Map, Blairton iron mine, Belmont township, Peterborough county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†186. Magnetometric Survey, Belmont iron mine, Belmont township, Peterborough county, Ont. —by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†186a. Geological Map, Belmont iron mine, Belmont township, Peterborough county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

NOTE.—1. Maps marked thus * are to be found only in reports.
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†187. Magnetometric Survey, Vertical Intensity: St. Charles mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†187a. Geological Map, St. Charles mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†188. Magnetometric Survey, Vertical Intensity: Baker mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†188a. Geological Map, Baker Mine, Tudor township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†189. Magnetometric Survey, Vertical Intensity: Ridge iron ore deposits, Wollaston township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†190. Magnetometric Survey, Vertical Intensity: Coehill and Jenkins mines, Wollaston township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†190a. Geological Map, Coehill and Jenkins mines, Wollaston township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†191. Magnetometric Survey, Vertical Intensity: Bessemer iron ore deposits, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†191a. Geological Map, Bessemer iron ore deposits, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†192. Magnetometric Survey, Vertical Intensity: Rankin, Childs, and Stevens mines, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†192a. Geological Map, Rankin, Childs, and Stevens mines, Mayo township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No.184.)

†193. Magnetometric Survey, Vertical Intensity: Kennedy property, Carlow township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†193a. Geological Map, Kennedy property, Carlow township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†194. Magnetometric Survey, Vertical Intensity: Bow Lake iron ore occurrences, Faraday township, Hastings county, Ontario—by E. Lindeman, 1911. Scale 200 feet=1 inch. (Accompanying report No. 184.)

†204. Index Map, Magnetite occurrences along the Central Ontario Railway—by E. Lindeman, 1911. (Accompanying report No. 184.)

205. Magnetometric Map, Moose Mountain iron-bearing district, Sudbury district, Ontario: Deposits Nos. 1, 2, 3, 4, 5, 6, and 7—by E. Lindeman, 1912. (Accompanying report No. 266.)

†205a. Geological Map, Moose Mountain iron-bearing district, Sudbury district, Ontario. Deposits Nos. 1, 2, 3, 4, 5, 6, and 7—by E. Lindeman. (Accompanying report No. 266.)

†206. Magnetometric Survey of Moose Mountain iron-bearing district, Sudbury district, Ontario: Northern part of Deposit No. 2—by E. Lindeman, 1912. Scale, 200 feet=1 inch. (Accompanying report No. 266.)

†207. Magnetometric Survey of Moose Mountain iron-bearing district, Sudbury district, Ontario: Deposits Nos. 8, 9, and 9A—by E. Lindeman, 1912. Scale 200 feet=1 inch. (Accompanying report No. 266.)

†208. Magnetometric Survey of Moose Mountain iron-bearing district, Sudbury district, Ontario: Deposit No. 10—by E. Lindeman, 1912. Scale 200 feet=1 inch. (Accompanying report No. 266.)

NOTE.—1. Maps marked thus * are to be found only in reports.
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†208a. Magnetometric Survey, Moose Mountain iron-bearing district, Sudbury district, Ontario: Eastern portion of Deposit No. 11—by E. Lindeman, 1912. Scale, 200 feet=1 inch. (Accompanying report No. 266.)

†208b. Magnetometric Survey, Moose Mountain iron-bearing district, Sudbury district, Ontario: Western portion of Deposit No. 11—by E. Lindeman, 1912. Scale, 200 feet=1 inch. (Accompanying report No. 266.)

†208c. General Geological Map, Moose Mountain iron-bearing district, Sudbury district, Ontario—by E. Lindeman, 1912. Scale, 800 feet=1 inch. (Accompanying report No. 266.)

†210. Location of Copper Smelters in Canada—by A. W. G. Wilson, Ph.D. Scale, 197·3 miles=1 inch. (Accompanying report No. 209.)

*215. Province of Alberta: showing properties from which samples of coal were taken for gas producer tests, Fuel Testing Division, Ottawa. (Accompanying Summary Report, 1912.)

†220. Mining Districts, Yukon—by T. A. MacLean. Scale 35 miles=1 inch. (Accompanying report No. 222.)

†221. Dawson Mining District, Yukon—by T. A. MacLean. Scale 2 miles=1 inch. (Accompanying report No. 222.)

*228 Index Map of the Sydney coal fields, Cape Breton, N.S. (Accompanying report No. 227.)

†232. Mineral Map of Canada. Scale 100 miles=1 inch. (Accompanying report No. 230.)

†249. Magnetometric Survey, Caldwell and Campbell mines, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale, 200 feet=1 inch. (Accompanying report No. 254.)

†250. Magnetometric Survey, Black Bay or Williams Mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale, 200 feet=1 inch. (Accompanying report No. 254.)

†251. Magnetometric Survey, Bluff Point iron mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale, 200 feet=1 inch. (Accompanying report No. 254.)

†252. Magnetometric Survey, Culhane mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale, 200 feet=1 inch. (Accompanying report No. 254.)

†253. Magnetometric Survey, Martel or Wilson iron mine, Calabogie district, Renfrew county, Ontario—by E. Lindeman, 1911. Scale, 200 feet=1 inch. (Accompanying report No. 254.)

†261. Magnetometric Survey, Northeast Arm iron range, Lot 339 E.T.W. Lake Timagami, Nipissing district, Ontario—by E. Nystrom, 1903. Scale, 200 feet=1 inch.

IN THE PRESS.

268. Map of Peat Bogs Investigated in Quebec—by A. v. Anrep, 1912.

269. Large Tea Field Peat Bog, Quebec	"	"
270. Small Tea Field Peat Bog, Quebec	"	"
271. Lanori Peat Bog, Quebec	"	"
272. St. Hyacinthe Peat Bog, Quebec	"	"
273. Rivière du Loup Peat Bog	"	"
274. Cacouna Peat Bog	"	"
275. Le Parc Peat Bog, Quebec	"	"
276. St. Denis Peat Bog, Quebec	"	"
277. Rivière Ouelle Peat Bog, Quebec	"	"
278. Moose Mountain Peat Bog, Quebec	"	"

Address all communications to—

Director Mines Branch,
Department of Mines,
Sussex Street, Ottawa.

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