

*Canadiana - Mineralogy*

(206)

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NOTES

ON A FEW

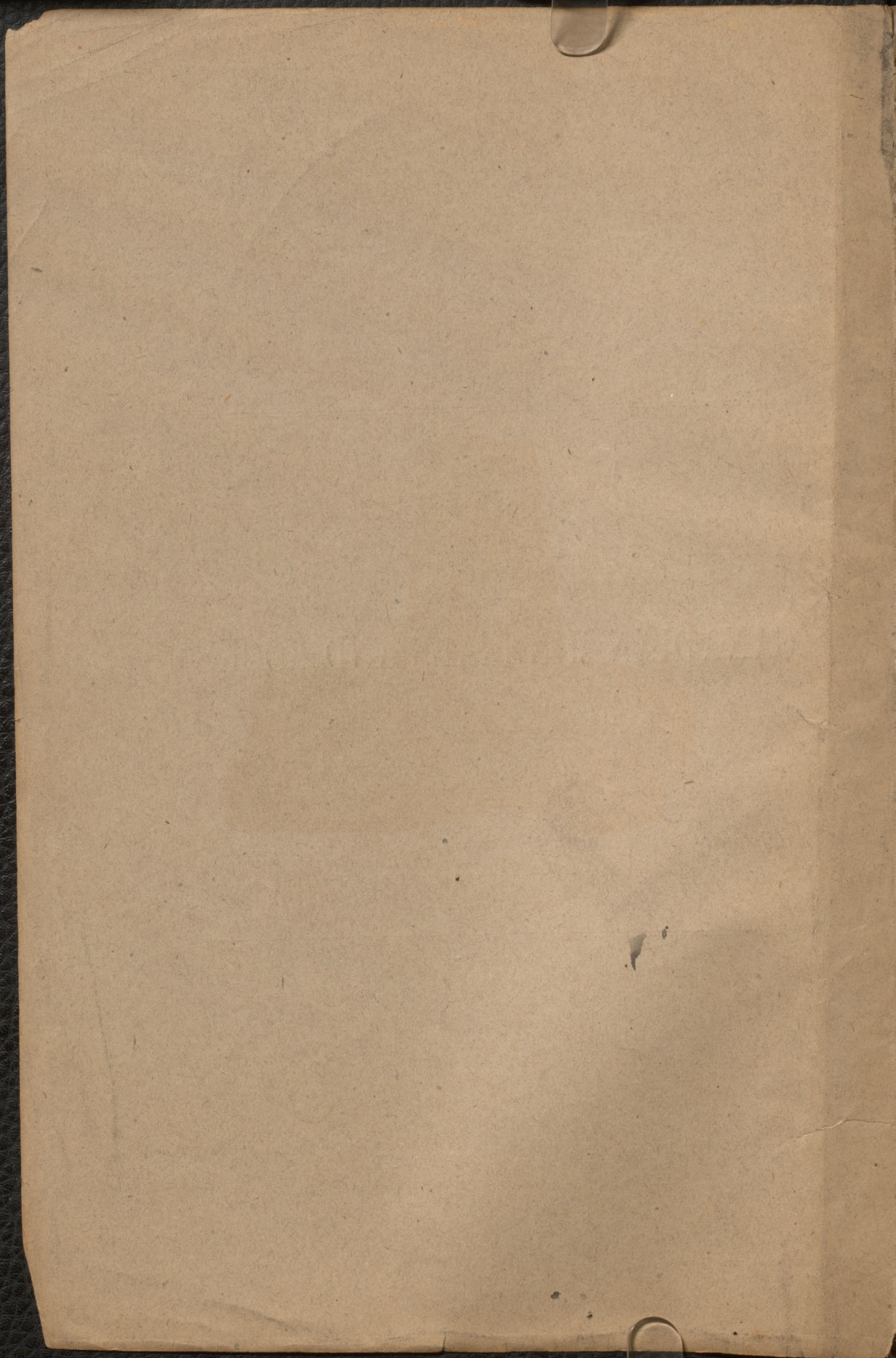
CANADIAN MINERALS AND ROCKS

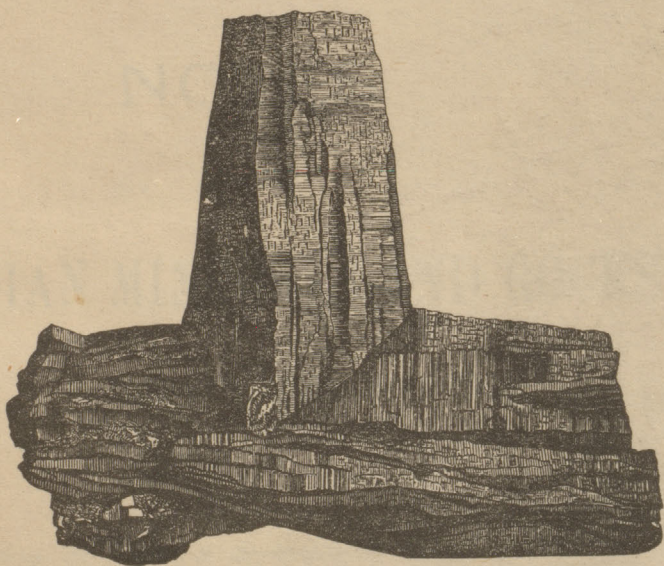
BY B. J. HARRINGTON, B.A., PH.D.

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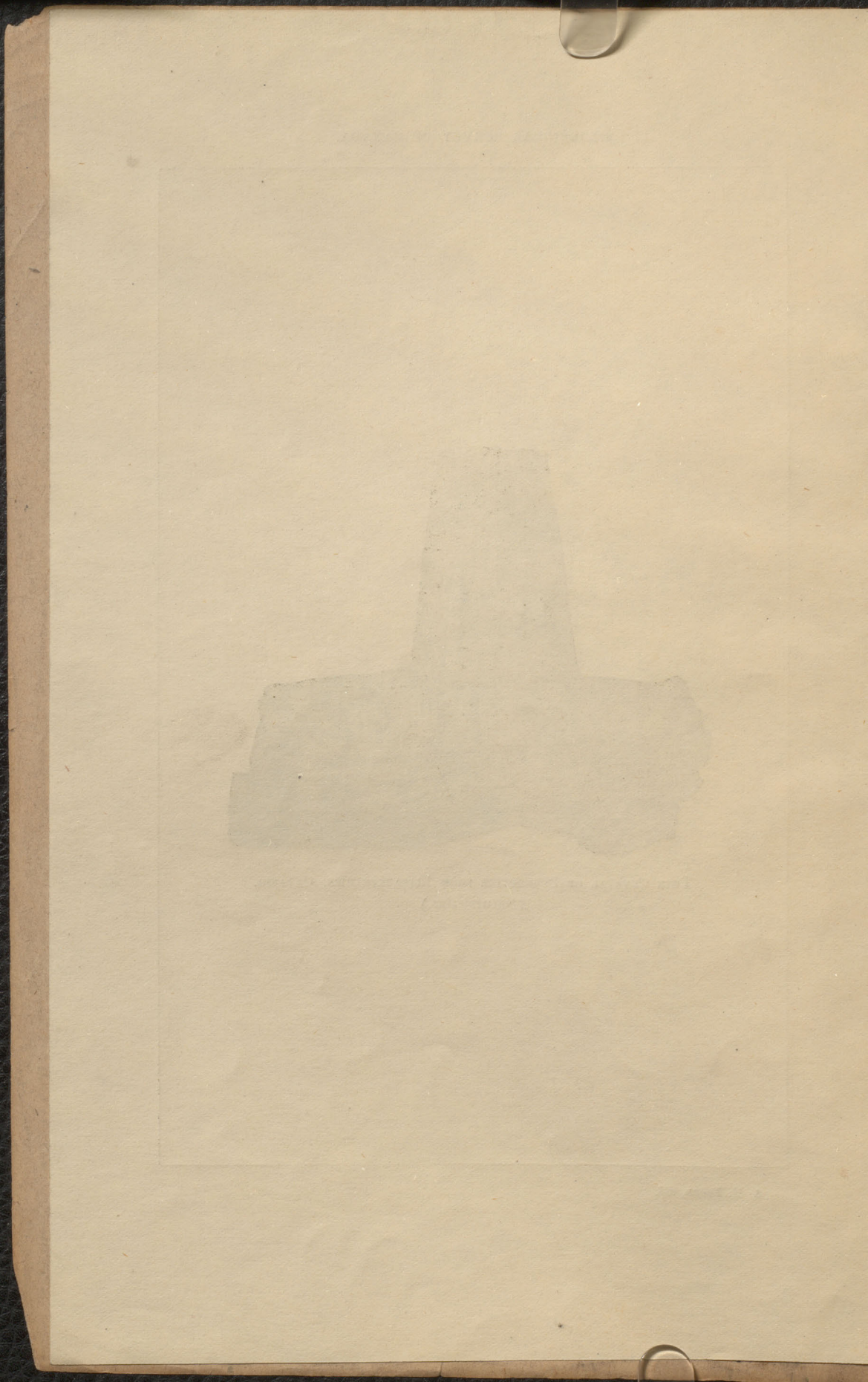
*(Extracted from the Report of the Geological Survey for 1874-75.)*

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TWIN CRYSTAL OF PYRRHOTITE FROM ELIZABETHTOWN, ONTARIO.  
(Natural size.)



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NOTES

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CANADIAN MINERALS AND ROCKS

BY B. J. HARRINGTON, B.A., PH.D.

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*(Extracted from the Report of the Geological Survey for 1874-75.)*

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NOTES

GENERAL HISTORY OF THE

S. R. J. HARRINGTON

THE HISTORY OF THE

# NOTES

ON

## A FEW CANADIAN MINERALS AND ROCKS.

BY

B. J. HARRINGTON, B.A., PH.D.,

ADDRESSED TO

ALFRED R. C. SELWYN, Esq., F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.



Sir,—I have the honor to submit to you a small contribution towards our knowledge of Canadian minerals and rocks. The majority of the facts given can scarcely be said to be of general interest; but it must be borne in mind that a great deal of light is often thrown upon economic mineralogy by the study of minerals possessing no intrinsic value whatever. This, indeed, must be my excuse, if an excuse be necessary, for presenting the following notes.

Introductory  
note.

### *Aluminous Pyroxene.*

Associated with mica (phlogopite) and calcite, at the Grenville mica mines, and forming the largest proportion of the deposits from which the mica is derived, is an interesting variety of pyroxene. Its predominant colour is pale greenish-grey; but this passes on the one hand into greyish-white, and on the other into dark greenish-grey. It is massive crystalline, and often affords cleavage planes several inches in length and breadth. Crystals are also common, and are occasionally five or six inches in length, and from one to two inches in thickness. The planes of the rhombic prism are sometimes almost wanting, but are more frequently well developed, producing eight-sided prisms, which are often tapering, and which were formerly known to the miners as "teats." They frequently penetrate the plates

Characters of  
pyroxene from  
Grenville.

of mica, rendering them useless. The pyroxene is opaque to translucent, and has an uneven fracture; the lustre is vitreous, or frequently resinous. An analysis of a specimen, of a pale greenish-grey colour, with a hardness of 5, and specific gravity of 3.35, gave the following results:—

Silica .....	51.27
Alumina .....	4.00
Ferric oxide .....	0.10
Lime.....	25.27
Magnesia.....	17.46
Potash .....	0.14
Soda.....	0.62
Lithia .....	traces.
Water (ign.).....	1.63

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100.49

Pyroxene as a  
constituent of  
Laurentian  
rocks,

Regarding the alumina as replacing silica, we find that the ratio of the oxygen in the silica and alumina to that in the protoxide bases, is nearly 2: 1. The mineral may then be correctly termed an aluminous diopside. The occurrence of pyroxene as a constituent of Laurentian rocks has been repeatedly noticed in the reports of the Survey, and Dr. Hunt has shown (*Geol. of Can.*, 1866, p. 207) that one or other of the varieties diopside, sahlite, or coccolite, often forms the predominant mineral of Laurentian veinstones. An aluminous pyroxene from Burgess, which he examined many years ago, does not differ essentially in composition from the one just described; and this is but one of the many points of resemblance between the minerals of the Burgess and Grenville regions.

#### *Sodalite, Natrolite and Analcite.*

Dykes cutting  
the Trenton  
limestones.

At what is known as the Montreal reservoir extension, the Trenton limestones are cut by numerous dykes, the more recent of which consist of fine-grained dolerites, or anamesites, while the more ancient ones are apparently composed largely of feldspar, with, in some instances, more or less hornblende.\* One of the latter, varying in colour from fawn-colour to lavender-grey and greyish-brown, and containing a good deal of hornblende, and small quantities of iron pyrites, has afforded specimens of sodalite, natrolite and analcime. The

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\* These dykes require further study. Some of them were, many years ago, described by Hunt, under the name of trachytes; but they differ essentially from the rocks ordinarily called trachytes. The one containing the sodalite is often porphyritic, with crystals of feldspar.



sodalite is found in small, irregular, crystalline masses, scattered through portions of the dyke, and appears to have crystallized contemporaneously with the feldspar and hornblende, while the natrolite and analcime have evidently been deposited subsequently on the walls of cavities. Sodalite.

The sodalite varies in colour from white to azure blue; it is translucent to sub-transparent, and has a vitreous lustre; the cleavage is dodecahedral, and the fracture uneven, or sometimes conchoidal; the hardness is 5.5, and the specific gravity 2.22. The material for the following analysis was dried at 100° C:—

Silica .....	37.52
Alumina.....	31.38
Ferric oxide.....	trace.
Lime.....	0.35
Magnesia .....	trace.
Soda.....	19.12
Potash .....	0.78
Sodium .....	4.48
Chlorine.....	6.91

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100.54

A separate portion of the mineral lost on ignition one per cent. It is readily decomposed by hydrochloric or nitric acid, with separation of gelatinous silica. Before the blowpipe it fuses (fusibility almost 4) with slight intumescence to a colourless glass. In the closed tube the blue variety turns white.\*

The natrolite occurs in slender, almost acicular crystals, often inter-lacing, and in groups of less perfect radiating crystals. It is colourless to white, and has a vitreous lustre, inclining to pearly in the case of the radiating crystals. The hardness is 5, and specific gravity 2.22. An analysis gave the following results:— Natrolite.

Silica .....	47.40
Alumina.....	26.38
Lime.....	0.48
Soda.....	16.48
Potash .....	0.57
Water .....	9.75

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101.06

\* Since the above was written, sodalite in considerable quantity has been detected in a similar rock forming part of Belœil mountain. The occurrence of sodalite in the "granitoid trachyte" of Brome was observed by Hunt many years ago.

## Analcite.

Analcite is almost invariably associated with the natrolite in small white, translucent crystals, averaging about an eighth of an inch in diameter. It seems to be much more liable to decomposition than the natrolite, and is often altered to a dull white substance, which, in some cases, retains the form of the trapezohedron. When in this altered condition it forms a fine background for the glassy crystals of natrolite.

*Chromiferous Serpentine.*

Associated with chromic iron, in the townships of Bolton and Melbourne, there occurs a mineral which has long been supposed to be k mmererite—a mineral related in chemical and optical characters to penninite. A specimen recently examined, however, has rather the composition of an aluminous serpentine. It is massive, or slightly foliated; greasy to somewhat pearly in lustre, and translucent to sub-translucent; the colour is pale violet by reflected, and somewhat deeper violet by transmitted light; feel almost as greasy as that of talc; hardness only 2. The specimen analyzed was found to contain,

Analysis of  
serpentine.

Silica.....	43.94
Alumina and ferric oxide.....	5.69
Chromic oxide.....	0.67
Lime.....	1.22
Magnesia.....	34.80
Water.....	14.54
	<hr/>
	100.86

In appearance the mineral resembles some of the varieties of k mmererite from Texas, Pennsylvania. The latter mineral, however, contains much less silica, and a far larger proportion of alumina.

*Pyrrhotite or Magnetic Pyrites, and the Minerals associated with it at  
Elizabethtown, Ontario.*

On the nineteenth lot of the second range of Elizabethtown, there occurs in rocks of Laurentian age an important deposit of pyrites (see Geol. of Can., 1863, p. 747), which has long been known, and has been mined for several years by the Brockville Chemical and Superphosphate Company. It is not only of economic importance, but also of scientific interest, on account of the association of minerals which it contains. The minerals number about a dozen species, being pyrite, pyrrhotite, magnetite, quartz, talc, labradorite (?) phlogopite (?) a black hydrated silicate of iron

List of minerals  
occurring at  
Elizabethtown.

alumina and magnesia, somewhat resembling hisingerite in appearance, calcite, siderite, apatite and cacoxenite. The variety in the composition of these minerals is worthy of note, there being sulphides, oxides, anhydrous and hydrous silicates, carbonates and phosphates (anhydrous and hydrous). Another curious aggregate, in some respects resembling the above, may be cited here. It was mentioned in the *Report of Progress* for 1873-'74, p. 194, and occurs on the sixth lot of the eighth range of Marmora. The minerals are pyrite, pyrrhotite, chalcopyrite, magnetite, fluorite, feldspar, hornblende, siderite and calcite. These deposits are possibly both veins, but differ in their constituents from any of those hitherto observed in the Laurentian of Canada.

Curious mineral  
aggregate  
in Marmora.

Of the minerals occurring at Elizabethtown, pyrite and calcite are the most abundant. The former is generally massive and amorphous, but is sometimes well crystallized, the most common form being a combination of the cube and octahedron. Perfect octahedra, with the axes more than two inches in length, have also been obtained, and mammillary groupings of cubical crystals with rounded faces occasionally occur. According to the determinations of Hunt and Macfarlane,\* the massive brilliant pyrites contains from 0.50 to 0.60 per cent. of oxide of cobalt.

Description  
of the  
Elizabethtown  
deposit.

Calcite forms the principal gangue in which the other minerals are embedded. It is mostly massive, but is also found on the walls of cavities in rhombohedral crystals, which are often highly modified. It ranges from opaque to transparent, and varies much in colour, being white, grey, pale fawn-colour, and sometimes red. The black hydrated silicate alluded to above has been examined by Mr. Hoffmann, and an analysis of it will be found in his report. It frequently forms the gangue of the pyrites, and with it is occasionally associated a triclinic feldspar, showing a beautiful play of colours. Magnetite is rather common, and sometimes occurs in the form of irregular grains scattered through the calcite. The rare mineral cacoxenite is a hydrous phosphate of iron—generally regarded as an iron-wavellite. At Elizabethtown it occurs in the form of beautiful little yellow tufts on the walls of cavities in the calcite, and is generally accompanied by pyrite. It has not been quantitatively analyzed, but was found to be soluble in hydrochloric and nitric acids, and to contain iron and phosphoric acid.

Cobalt.

Cacoxenite.

The quartz, mica, talc, siderite and apatite were only observed in small quantity. The talc is mainly in the form of steatite, some of which occurs in curious honey-combed masses. The cavities have

Steatite.

\* Geol. of Can., p. 506, and Can. Nat., 1st ser., vol. vii., p. 194.

Pyrrhotite.

probably been filled at one time with some mineral which has since been removed, and in a few instances loose pieces of quartz were found in them. The occurrence of steatite in the Laurentian series is, according to Hunt, uncommon, its place being generally taken by pyrralolite. Pyrrhotite was common in portions of the deposit worked several years ago, but seems to have become less so as the mining advanced. It is sometimes massive, but more frequently occurs in acute rhombohedral crystals, varying in length from a quarter of an inch or less, up to several inches, and generally embedded in calcite, though sometimes in steatite. The frontispiece is a drawing of a very interesting twin crystal, by Mr. Arthur H. Foord, Artist to the Survey. It was found several years ago, and has been examined by Mr. Edward Dana, of New Haven, who has kindly promised to describe it in the American Journal of Science. The following is an analysis of a portion of another crystal about an inch in diameter:—

Iron .....	60.560
Copper .....	0.145
Manganese.....	0.060
Nickel.....	0.112
Cobalt.....	0.11
Sulphur ..	39.020
Silica.....	0.036
	<hr/>
	100.044

The mineral is readily attracted by the magnet, and possesses polarity; the opposite poles being situated not at opposite ends of the crystals, but along the sides. The hardness is between  $3\frac{1}{2}$  and 4, and the specific gravity 4.622.

Since the above analysis was made, a small crystal of the pyrrhotite was sent to Professor J. Lawrence Smith, of Louisville, Kentucky, who was anxious to compare its composition with that of troilite, the sulphide of iron occurring in meteorites. The results of Professor Smith's analysis are as follows:—

Analysis by  
Professor Smith.

Iron.....	59.88
Sulphur .....	39.24
Silica (gangue-rock).....	1.01
	<hr/>
	100.13
Specific gravity.....	4.642

Troilite.

Both the analyses agree far more closely with the formula  $Fe_7 S_8$ , than with that of troilite,  $Fe S$ , which gives iron 63.64, sulphur 36.36.

*Manufacture of Acids at Elizabethtown, and of Superphosphate of Lime at Brockville, Ontario.*

The deposit just described has, as stated above, been mined for several years, and is of importance as being the source from which considerable quantities of pyrites have been derived for the manufacture of sulphuric acid. The present acid works of the "Brockville Chemical and Superphosphate Company" are situated close to the pyrites mine, and were completed in 1874. Acid works had previously been built by the same company at Brockville in 1869, but were destroyed by fire in 1871. The capacity of the works at Elizabethtown is about six thousand pounds of sulphuric acid (66° Beaumé) daily. The final concentration is carried on in glass retorts, of which there are thirty-two, arranged in two rows and heated with anthracite. According to the manufacturers, the acid as it comes from the chambers, varies in strength from 45° to 48° Beaumé (= Sp. gr. 1.45 to 1.49); by evaporation in leaden pans it is raised to from 60° to 62° B. (Sp. gr. 1.71 to 1.75), and the strength of the retort acid is about 66° B. (Sp. gr. 1.84).\* The nitrate of soda employed is obtained from Boston, and costs, laid down at the works, about 4½ cents per pound. Formerly nitre was imported from England, but was much more expensive. The pyrites yields, on an average, about forty per cent. of sulphur, and a ton of pyrites makes nearly a ton of acid. The acid sells for about 2½ cents per pound; some of it is employed in the manufacture of superphosphate of lime at Brockville, while the remainder is shipped to different parts of Canada and the United States. In addition to sulphuric acid, both hydrochloric and nitric acids are being made, and the establishment of other manufactures depending directly or indirectly upon sulphuric acid—such, for example, as that of soda—is probably not far distant. †

Site of acid works.

Hydrochloric and nitric acids.

The superphosphate works at Brockville were started in 1869, but since then many additions have been made to them. The apatite employed is from the township of North Burgess, and is stated to contain an average of about eighty per cent. of phosphate of lime. It is first broken up by a small Blake's rock-breaker, then crushed between iron rollers, and, after passing through a series of sieves, to free it from mica, ground between ordinary millstones. The ground mineral is then mixed

Manufacture of superphosphate.

\* The specific gravities here given as corresponding to degrees of Beaume's hydrometer are according to Poggiale.

† The growing importance of pyrites in the manufacture of sulphuric acid may be judged of from the quantities consumed in England and France. In England, according to the *Comptes Rendus*, the consumption has increased in the last ten years from 180,000 to 520,000 tons annually; while, in France, during the same period, it has increased from 90,000 to 180,000 tons.

in an *agitator* with an equal weight of sulphuric acid (50° B.), and the mixture afterwards emptied into a car, from which it is dumped into a series of boxes or bins, where it soon solidifies into white honey-combed masses of superphosphate, containing, according to the manufacturers, as high as twenty per cent of soluble phosphoric acid. The superphosphate is then broken or ground up in a *Carr's disintegrator*, and put into barrels for shipment. The price at Brockville is \$30.00 per ton of 2,000 lbs.

Both the acid and superphosphate works are under the management of Alexander Cowan, Esq., of Brockville, who has shown much skill and perseverance in their establishment.

Use of artificial manures.

The use of artificial manures is something to which the majority of our farmers are wholly unaccustomed, and it will, no doubt, be long before their application will become general; but considering the exhausted condition of the soil in many parts of the country, the subject is one demanding most careful attention. It must, however, be kept in mind that the indiscriminate use of such manures is not to be recommended. They should be used intelligently; for the wants of a soil in one region may be entirely different from those of another, and the food which nourishes one plant may not be required by another.

#### *Magnesitic Ophiolite.*

It is well known that among the metamorphic rocks of the Eastern Townships serpentines or ophiolites are of common occurrence, and it was many years ago shown by Hunt that while some of them are nearly pure, massive serpentines, others are mixtures of this mineral with carbonate of lime and dolomite. For these mixtures Hunt suggested the names *calcitic ophiolite* and *dolomitic ophiolite*, while the corresponding rock, consisting of serpentine and magnesite, he styled *magnesitic ophiolite*. The last-named variety was not then known to occur in the Eastern Townships, although it had been detected by Drs. Jackson and Hayes among the rocks of Vermont. Recently, however, an ophiolite from the fifteenth lot of the first range of Melbourne has been analyzed and found to be magnesitic—the magnesite being the ferriferous variety known as breunnerite. This mineral is scattered through the serpentine in small irregular crystalline masses of a pale brown colour, constituting 15.50 per cent. of the specimen examined. It was separated from the serpentine by means of dilute nitric acid, and gave on analysis:—

Magnesitic ophiolite from Melbourne.

Carbonate of magnesia .....	83.23
Carbonate of lime .....	1.93
Ferrous carbonate .....	14.84
	-----
	100.00

The residue, constituting 84.5 per cent of the rock, consisted of serpentine containing chromium, manganese, nickel, and cobalt. Its quantitative analysis gave the following results:—

Silica .....	42.79
Chromic oxide .....	0.29
Oxides of nickel and cobalt .....	0.37
Manganous oxide .....	0.12
Ferrous oxide .....	6.05
Magnesia .....	36.54
Water (ign) .....	13.37
	-----
	99.53

In the mass the serpentine is of an olive-green colour, and has a splintery fracture. Its hardness is about 4.\*

*The Feldspars of some of the Diorites of Ontario.*

In my last report (Report of Progress, 1873-74, p. 198), reference was made to the diorites which are of frequent occurrence among the metamorphic rocks of Ontario, and are often accompanied by magnetic iron ore. It was also shown that the feldspar in a coarsely crystalline variety at the Fournier iron mine, in South Sherbrooke, was closely related in composition to oligoclase. Since then analyses have been made of the feldspars in diorites from two other localities, and not only were they found to differ from one another in composition, but neither of them could be referred to oligoclase. One of them is from "Hole in the Wall,"† in Tudor, and was collected by Mr. H. G. Vennor, in 1866. It is of a pale greenish-grey colour, mostly dull, though here and there exhibiting crystalline faces which have a vitreous lustre, and are occasionally

Oligoclase.

\* It may be stated here that specimens of the so-called serpentines from Cape Breton mentioned on page 9 of your Summary Report, were given me by Mr. Robb for examination, but proved not to be serpentines at all. They contain small quantities of a soft steatitic mineral in the joints which, no doubt, caused them to be mistaken for serpentines.

A supposed serpentine from the shore about two miles from Malignant Cove (near Arisaig, N.S.), was found to be simply a diorite with serpentine filling its joints. Another rock, which it was thought might be serpentine, was given me by Professor Bell for examination. It came from Dog Island, Lake Nipigon, and its mode of occurrence has already been described (Rept. for 1871-72, p. 104). It was found to contain nearly thirty per cent. of carbonates of lime and magnesia. The residue, insoluble in dilute nitric acid, after being dried at 100° C., contained 70.84 per cent. of silica and only 2.5 per cent. of water, and is therefore evidently not serpentine.

† A sort of defile passing through a great wall or cliff of rock

striated. Weathered surfaces are of a pale rust-colour, but this may be due to the oxidation of pyrites, small grains of which are scattered through the rock. The hardness is a little above 6, and the specific gravity, 3.02. Before the blowpipe it fuses (fus. above 4) on the edges to a greenish glass. The composition was found to be as follows:—

Analysis of  
feldspar related  
to anorthite.

Silica .....	47.29
Alumina.....	26.98
Ferric oxide .....	3.11
Ferrous oxide.....	0.91
Lime .....	14.20
Magnesia.....	0.66
Soda .....	4.64
Potash .....	0.06
Water (ign).....	1.90
	99.75

The finely powdered mineral was found to be attacked by hydrochloric acid, which in one experiment dissolved 14.64 per cent. The high specific gravity and the composition appear to indicate that the feldspar is impure; but it may, perhaps, be referred to anorthite, and classed with the variety known as Bytownite. The oxygen ratio for the protoxide bases, sesquioxide bases, and silica, is 1:2.36:4.40; while that of the Bytownite from Ottawa, analyzed by Hunt, is 1:2.63:4.69.

Tudor diorite.

The hornblende of the Tudor diorite is of a dark olive-green colour, and much more highly crystalline than the feldspar. The texture of the rock moreover, is very coarse; far coarser, indeed, than is usual with the diorites of the region in question. The specimens examined bear no marks of stratification, but Mr. Vennor has shown me others from the same cliff in which the lines of bedding are distinctly visible.

Labradorite  
described by  
Mr. Hoffmann.

Orthoclase.

The other specimen referred to is from a coarsely crystalline diorite (one of Mr. Vennor's so-called "blotched diorites") which occurs on the sixteenth lot of the third concession of North Sherbrooke. It is a genuine labradorite, and will be described by Mr. Hoffmann in his report. Mr. Vennor has also described, in his report, rocks which he regards as forming a transition from diorite to syenite, and which he has called syenitic diorites; but no analyses of the supposed orthoclase in these rocks have been made, so that the matter cannot be regarded as certain.



*Limestone, Dolomite, and Marl.*

Some time since a specimen of limestone from the twenty-second lot of the third range of Wickham (E. T.), was left at the Geological Survey Office for examination, its owner, Mr. Touseant Garriepie, of Drummondville, being anxious to ascertain whether it might be expected to yield a hydraulic lime on burning. The limestone is blackish-grey in colour, and has a somewhat conchoidal fracture. An analysis showed it to contain,

Carbonate of lime.....	70.53	Analysis of hydraulic limestone.
Carbonate of magnesia.....	6.77	
Carbonate of iron.....	3.02	
Alumina.....	3.85	
Silica.....	15.95	
	100.12	

The dark colour is due to the presence of carbonaceous matter. This, however, burns away during calcination, leaving a buff-coloured lime from which gelatinous silica separates on treatment with hydrochloric acid. It will be seen that the limestone does not differ essentially from many which are elsewhere employed for the manufacture of hydraulic lime. Mr. Garriepie, however, states that he has erected a kiln and burned some of the stone, and that it exhibits no hydraulic properties whatever. But specimens sent to Montreal show that several kinds of limestone have been burned together, and it is more than likely that those in charge of the burning have been persons without any experience whatever in the manufacture of hydraulic lime.

A specimen of a hard rusty-weathering dolomite was also brought to the museum by Andrew Bell, Esq., C. E. It came from the township of Rigaud, near to the Rivière a la Graisse, and also to the boundary line between Quebec and Ontario, and is probably from the Calciferous formation. Its analysis gave,

Carbonate of lime.....	39.91
Carbonate of magnesia.....	32.85
Soluble alumina and ferric oxide.....	3.56
Insoluble matter.....	23.54
	99.86

The insoluble portion contained,

Silica.....	76.34
Alumina and ferric oxide.....	14.74
Lime.....	1.02
Magnesia.....	7.99
	100.09

There can be little doubt that this rock would yield hydraulic lime, the quality of which could, however, only be determined by experiment.

Marl:

In the Report of the Survey for 1871-72, Professor Bell mentions (p. 106) an "indurated, pink-colored calcareous marl," which occurs in horizontal beds on the Pikitigouching River. A specimen which he requested me to analyze was collected by his assistant, Mr. Lount. It contained,

Silica.....	39.87
Alumina and ferric oxide.....	9.34
Lime.....	22.40
Magnesia.....	6.24
Carbonic acid.....	23.40
	-----
	101.25

The residue left after treatment with hydrochloric acid amounted to 42.84 per cent. of the rock.

I have the honour to be

Sir,

Your most obedient servant,

B. J. HARRINGTON.

GEOLOGICAL SURVEY OFFICE,  
MONTREAL, 1875.

