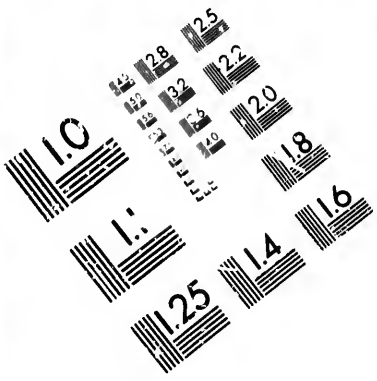


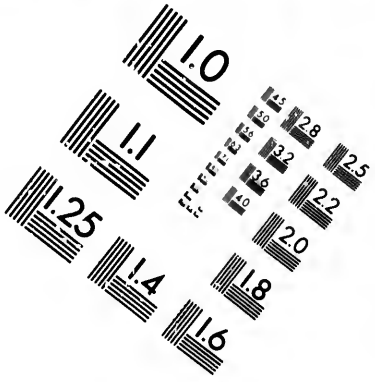
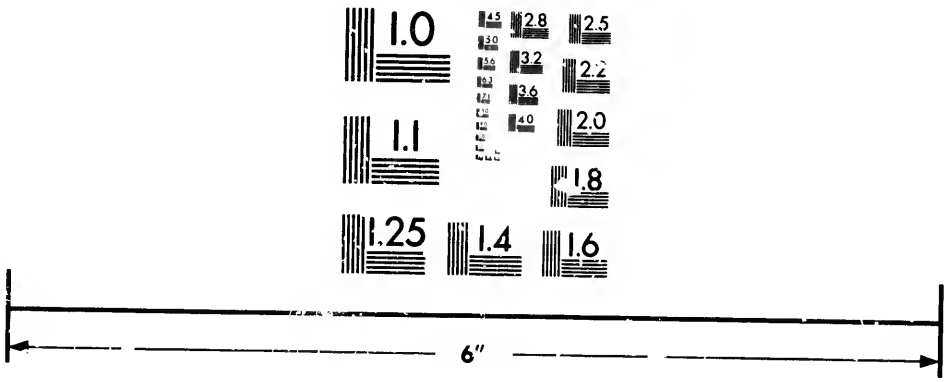
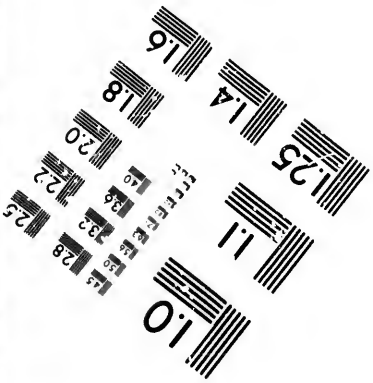
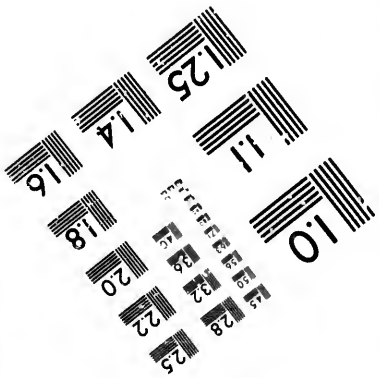


IMAGE EVALUATION TEST TARGET (MT-3)







Photographic Sciences Corporation

23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

Technical and Bibliographic Notes/Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- [x] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [ ] Bound with other material/ Relié avec d'autres documents
- [ ] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distortion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments:/ Commentaires supplémentaires:

- [ ] Coloured pages/ Pages de couleur
- [ ] Pages damaged/ Pages endommagées
- [ ] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] Showthrough/ Transparence
- [ ] Quality of print varies/ Qualité inégale de l'impression
- [ ] Includes supplementary material/ Comprend du matériel supplémentaire
- [ ] Only edition available/ Seule édition disponible
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image/ Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
					✓						

The copy filmed here has been reproduced thanks to the generosity of:

National Library of Canada

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Original copies in printed paper covers are filmed beginning with the front cover and ending on the last page with a printed or illustrated impression, or the back cover when appropriate. All other original copies are filmed beginning on the first page with a printed or illustrated impression, and ending on the last page with a printed or illustrated impression.

The last recorded frame on each microfiche shall contain the symbol → (meaning "CONTINUED"), or the symbol ▽ (meaning "END"), whichever applies.

Maps, plates, charts, etc., may be filmed at different reduction ratios. Those too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:

L'exemplaire filmé fut reproduit grâce à la générosité de:

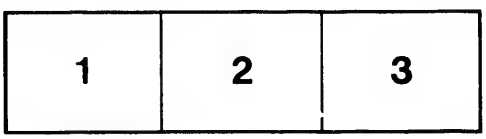
Bibliothèque nationale du Canada

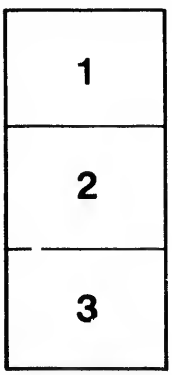
Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

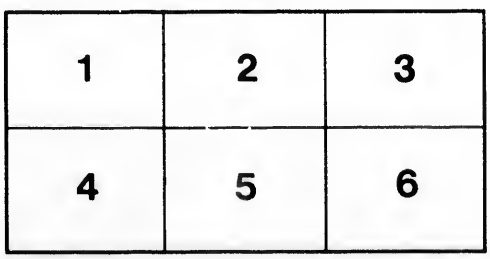
Les exemplaires originaux dont la couverture en papier est imprimée sont filmés en commençant par le premier plat et en terminant soit par la dernière page qui comporte une empreinte d'impression ou d'illustration, soit par le second plat, selon le cas. Tous les autres exemplaires originaux sont filmés en commençant par la première page qui comporte une empreinte d'impression ou d'illustration et en terminant par la dernière page qui comporte une telle empreinte.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole → signifie "A SUIVRE", le symbole ▽ signifie "FIN".

Les cartes, planches, tableaux, etc., peuvent être filmés à des taux de réduction différents. Lorsque le document est trop grand pour être reproduit en un seul cliché, il est filmé à partir de l'angle supérieur gauche, de gauche à droite, et de haut en bas, en prenant le nombre d'images nécessaire. Les diagrammes suivants illustrent la méthode.







MINERALS

OF THE

OTTAWA DISTRICT.

BY CHAS. W. WILLIMOTT.

Extracted by permission from Transactions No. 6 (Vol. II, No. 2), Ottawa Field-Naturalists' Club.

OTTAWA:
Printed by the Citizen Printing and Publishing Co., 31 Metcalfe Street.
1886.

MINERALS OF THE OTTAWA DISTRICT.

CHAS. W. WILLIMOTT.

Read 15th January, 1885.

It will be unnecessary to enter into any introduction, more than to define the limits expressed in the title as the Ottawa district. As my own observations have extended only over portions of the three neighboring townships, Templeton, Hull and Wakefield, and having a strong aversion to indirect information, I think perhaps it might be best to concentrate our views to this area, and even to do justice to these three townships would require a far more voluminous treatise than our available space will permit.

About sixty minerals are found in these three townships, many of which are not rivalled in the Dominion. It is doubtful whether the same extent of country elsewhere in Canada can claim one half that number.

In bringing together such a large variety of minerals in such a limited space I must necessarily curtail many of their features, and, indeed, little more than giving a general outline, touching on their more important characters, is all I can expect to accomplish.

Each mineral will be treated separately, giving at the same time the lot and range, or the name of the mine at which it occurs, so that those interested in this science may have an opportunity of testing the merits of this paper, as well as forming an introduction to the minerals of our neighborhood.

We shall first consider the metallic minerals, foremost of which is native gold.

Native Gold.—The only instance of the occurrence of this metal is based on the authority of the late Mr. H. G. Vennor, who obtained a specimen from Capt. Cates of the Péche village. It was said by the latter gentleman to have been picked up during a journey through the woods on the east side of the Gatineau river, in the township of Wakefield. The mineral, which I had the pleasure of seeing, consisted of fine visible native gold in a ferruginous quartz, associated with green apatite. This specimen assayed, gold, 11.725 ozs. to ton, silver, 52.323 ozs. to ton.

Lead and Zinc.—The only representatives of these metals observed in our district are the two sulphides, galena and blende. These minerals are found associated in a greyish-white crystalline garnet that occurs in lenticular masses in a crystalline limestone on lot 6 of the 1st range of Wakefield. The blende, which is in black, shining cleavable masses, is often so intermingled with the galena as to give, apparently, more prominence to the latter mineral, a feature that must ever be guarded against by intending speculators.

Copper.—The only mineral representing this metal is the yellow sulphide (chalcopyrite) found in specks and small imperfect crystals in some of the veins of the apatite mines.

Iron.—Under this heading we shall, for the sake of convenience, include both the oxides and sulphides of this metal, viz, magnetite, hematite and varieties, limonite, pyrite and pyrrhotite. The magnetic oxide, or magnetite, is found in more or less quantity in the above townships. The more workable deposits, however, so far as our present knowledge goes, lie in the township of Hull, where mining operations have been carried on at intervals for the last thirty years.

The ore coming from these mines is coarse in texture and is often traversed by veins of red hematite, besides occasionally enclosing scales of graphite and mica. Lenticular patches of this ore occur in a dark green pyroxenite on the south half of lot 7, in the 1st range of Wakefield, and also on the north half of the same lot it fills a vein in limestone. The outcropping portion is highly crystalline, and owing to the crumbling nature of the walls good crystals often variously modified may be obtained.

The variety known as specular iron ore occurs at the Haycock location in Templeton and Hull. According to Dr. Harrington it is in parallel beds in a highly feldspathic gneiss. This ore is often mixed with the magnetic oxide, and often to such an extent as to almost wholly replace the former. A white granular apatite, and a translucent variety of greenish fluor are often associated. The finest crystal of specular iron found in Canada came from these mines.

The next iron ore noticed (although probably not in sufficient quantity to be available for practical purposes) is a vein of limonite of about 1 foot wide, resulting from the alteration of iron pyrites

Flanking this vein is a less altered pyritous substance enclosing black shining crystals of tourmaline.

The variety bog iron ore is found in several places in Templeton and Hull. But the area covered by this mineral has yet to be ascertained.

We now come to the two sulphides of iron, pyrrhotite and pyrite. The former, by far the more uncommon, occurs in small veins and masses in some of the apatite mines. The latter is much more abundant, and is rather an objectionable than a desirable substance.

It frequently permeates apatite deposits, often to such extent, as to detract greatly from the commercial value of the latter. In some of the apatite mines, large bedded masses of this mineral occur, enclosing various minerals, the most noticeable of which are crystals of apatite and scapolite with their angles more or less rounded. At other times it is evenly distributed through large deposits of apatite. To enumerate all the physical characters exhibited by this mineral would be both endless and useless. I shall therefore select from a few places, this mineral that offers various physical characters. At Haldane's mine in Wakefield, large bedded masses of pyrites were penetrated in sinking their deep pit, often enclosing rounded green crystals of apatite, and a rusty brown scapolite. During the progress of oxidation of the pyrites, the latter mineral (scapolite) only, is affected, the apatite in all cases retaining its original color, even when partly liberated by the disintegration of the pyrites. This locality has afforded from time to time, fine brass yellow crystals of this mineral, exhibiting such faces as the cube, octahedron, dodecahedron and other modified forms.

At McBryde's Mine, in the same township, this mineral is found associated with blende, galena, garnet, &c., in bronze-brown masses, which might, at first glance, be taken for pyrrhotite, but which, however, is not magnetic.

At the Jackson Rae Mine in Templeton, large quantities of this mineral have been extracted, graduating in color from a brass-yellow to almost grey. Sometimes thin coatings entirely envelope apatite crystals.

Molybdenum.—The sulphide of this metal (molybdenite) has been ~~detached~~ found in small foliated masses at McBryde's Mine in Wake-

field. This mineral, until within the last few years, commanded a very high price; even as much as $4 per pound being paid for it. At present it is scarcely saleable at any price. It was formerly used in the production of a blue color for calico printing, which is now superseded by the bright and less expensive aniline colors.

Graphite or Plumbago.—This mineral bears a strong resemblance to the above mentioned molybdenite, physically, although to the accustomed eye it presents some points of difference; its lustre is scarcely ever as bright, and does not give the peculiar greenish streak on porcelain. But I doubt whether those characters would be conducive to its ultimate recognition. And I think, perhaps, in all cases it would be better, at least more reliable, to test it chemically. The disseminated foliæ of this mineral may almost be considered as a constant inclusion in the various bands of limestone and pegmatite that traverse these townships, in, however, as far as my observation goes, insufficient quantity to be available for practical purposes. On Lot 7, R. 1, of Wakefield, lenticular masses of serpentine enclose this mineral in foliated masses and disseminated foliæ. On the same property a fine granular variety, somewhat similar to the Cumberland plumbago, occurs in pockets of a crystalline limestone.

Apatite.—The elucidation of all the characters, physical as well as mechanical, that so conspicuously characterize this important mineral, must necessarily be attended with many theoretical ideas which will ever present themselves to the practical observer. It is a stupid idea, and yet rather a prevalent one, that the various products in nature must conform to the formulæ laid down by man. As practical observers can we reject such chains of evidence, linked as they may be by actual facts, because intricate nature will not divulge her secrets to an imaginative mind, I say no. If the existing laws that govern the chemical nature of minerals are not conformable with man's ideas, then all I can say is, so much worse for the man. For assuredly, the various gradations that mark the progress of alternation and dissemination of minerals will ere long (assisted by the all powerful microscope) crush out of existence many wild and exaggerated theories. So leaving the origin of this mineral (apatite) to the investigators of the near future, we will pass on to some of its physical characters. No mineral in the Ottawa dis-

trict is perhaps better known, especially the freshly fractured specimens. Out-cropping veins or beds are seldom so conspicuous, being generally made apparent by a whitish weathering, and might easily be passed over unnoticed. The similarity existing between pyroxene and apatite has often been the cause of much annoyance to the pseudo-miner. The mineral, locally known as phosphate, is found of almost all shades of color, from white to almost black, passing through various shades of green, red, yellow, and blue, the last color being by far the most uncommon. Small prisms of this color are sparingly dispersed through a disintegrating coarse crystalline limestone on the south half of lot 7, range 1, of Wakefield. The yellow variety occurs in crystals two inches in length, associated with oblique rhombic prisms of pyroxene, on lot 14, range 1, in the same township. The black, or dark-greenish variety is found in nuggets of a slaggy appearance, with pitted surfaces, at the Jackson Rae Mine in Templeton. The white is generally confined to the granular varieties, known as "sugar phosphate," but rarely occurs in a state of absolute purity, being more or less mixed with the coarse cleavable mineral. A dark-green granular variety, impregnated with iron pyrites, forms a large deposit on lot 12, range 1, Wakefield.

The green and red varieties may be regarded as the predominating mineral, and in many of the mines the two colors are interblended, which feature may continue through the entire mass. At the Jackson Rae Mine in Templeton, and at a pit known as the "Spring Mine," a quantity of a beautiful, translucent, sea-green apatite has been extracted comparatively free from foreign inclusions. A very pure reddish mineral, assaying as high as 86 per cent of tribasic phosphate of lime, occurs in bedded masses at Gemmill's Mine in Wakefield. A block, estimated at 4 tons, was blown out by a single blast from one of the masses. "Moore's Mine," in the same township, is remarkable for the abundance of crystals that have been extracted during the last four years. Huge crystals, hundreds of pounds in weight, have been met with imbedded in a pink cleavable calcite.

When visiting this mine two years ago, a beautiful vein of interlocking crystals of a translucent sea-green color, had been developed. The gangue formerly surrounding these crystals had been dissolved to

the depth of one foot, giving great prominence to these forms. But owing to their frangibility and easy cleavage, they could rarely be removed intact.

We may certainly infer from this that the phosphate mineral is less acted upon than the surrounding limestone, and yet, if these crystals are entirely liberated and exposed to a moist atmosphere they soon undergo disintegration.

The rounding of the angles of these crystals has drawn forth many theories respecting their disfigurement, fusion being offered as an explanation by some mineralogists, whilst others attribute it to a solvent action. Now, whether we adopt the igneous theory, or that of partial solution, serious objections may arise to refute either. In the first instance, minerals easily fusible and yet preserving their sharpness of outline, are found associated with rounded crystals of a less fusible apatite. Then again, we meet with rounded crystals of pyroxene (although much more rare) imbedded in limestone, also enclosing rounded crystals of apatite. Now, it is hard to understand how the apatite and pyroxene alike should be attacked by the action of a solvent, when the latter mineral is almost insoluble. Some aluminous varieties are, however, decomposed with great difficulty by sulphuric acid at the temperature of 250° c. It frequently happens that crystals of apatite assuming sharp angles are indiscriminately mixed with others that have been rounded, imbedded in the same limestone. On the other hand it rarely happens that crystals lining the walls of fissures have their angles rounded, although frequently one or more of their faces are obliterated or otherwise contorted, probably due to an interrupted crystalization. Bent or broken crystals that have been recemented are of common occurrence. The same crystals often enclose calcite, and others again have cavaties extending the whole length of the crystal, are entirely empty, or contain a rounded pebble of cleavable calcite.

I should like to engage your attention for a few moments on the occurrence of this mineral in Hull and Wakefield. At an opening known as the "Gow Mine," in Hull, a pit has been sunk 150 feet in limestone, parallel to the wall of a large fissure which may be said to characterize this band for several miles, it being made the more conspicuous by the abundance of crystals everywhere adorning its walls.

Several mines have been established on this band with gratifying results. The apatite, which is mostly of the greenish variety, runs in most cases conformably with the limestone, although some small veins were seen intersecting it. The aggregate yield of this band in the township of Hull may be roughly placed at 4,500 tons.

We also find this mineral an ingredient of the orthoclase band running through this township, and like the latter, characterized in places by a contact wall covered with crystals of pyroxene, apatite, phlogopite, &c. I am not aware of any remunerative mines situated on this band. Many attempts have been made to work the small veins that occur at places, but have generally resulted in failure.

At Haldane's Mine, in Wakefield, a pit has been sunk 125 feet, on what appears to be a vein, cutting the stratification, of a dark-green granular apatite, impregnated with pyrites, also often enclosing epidote, scapolite, pyroxene, &c. The latter mineral is frequently of a cavernous nature, in which case the cavities are filled with chabazite and a silky fibrous mineral resembling natrolite.

At Wilson's mine in the same township a fine granular, strongly coherent, reddish apatite, mixed with a green, cleavable variety filled a vein 12 inches wide in gneiss, which, however, became "nipped" at no considerable depth.

In following some of the crystal beds at "Moore's Mines" large cavernous "lugs" were struck, walled with beautiful crystals of pyroxene, phlogopite and apatite. One of these caves was 30 feet long, 6 feet in width and 8 feet in height, roofed with a pink crystalline limestone, studded with green crystals of apatite standing out in relief on its partly dissolved surfaces.

The following statistics for the three townships may be summarized as follows:—For the township of Hull, up to the present time, between 5,000 and 6,000 tons have been extracted. Wakefield has probably afforded between 8,000 and 9,000 tons, and Templeton between 16,000 and 17,000 tons. The total output of all the mines in Canada for this year (1884) is 22,143 tons, extracting 1,790 tons supplied by the Perth and Kingston district, we have 20,353 tons, the product of the Ottawa county for one year.

We now come to the anhydrous and hydrated silicates, of which we have about 30 representative minerals.

The first of these we shall notice is the fibro-tabular Wollastonite occurring on lot 7, range 1 of Wakefield, in small delicate pink crystals, but which, however, soon fade on exposure. This mineral also occurs in large, fibrous masses in a dark sky-blue calcite at the same locality. A similar mineral occurs on lot 14 of the same range, enclosing an amber-colored garnet and prisms of a brown or greenish idocrase.

Pyroxene.—This mineral, either massive or crystallized, may be regarded as the most common associate of the apatite deposits. Now, under this heading, we have a number of varieties, but until more extended research shall have established their authenticity it will be better to retain the general name of pyroxene. The massive variety, which is mostly of some shade of green or grey, comprises large areas of rock masses, which may conform to the general deposition or cut it.

No attempt can or will be made, with our limited space, to enumerate every physical character offered by this mineral. But we will select such illustrations as ma ffer the widest points of difference.

On lot 9, range 13, of Hull, crystals of a grayish or grass green color, often doubly terminated, occur in a band of pink limestone, making up one-half its volume. They vary in size from 1 oz. to many pounds in weight. Good crystals are often found in the soil, that have been liberated by solution. The largest and finest crystals of this mineral are found at Moore's Mines, in Wakefield. Their planes, however, are rough and dulled by an incipient decomposition, a defect more than counterbalanced by their sharpness of angles. These crystals frequently attain an enormous size, often enclosing portions of calcite, phlogopite and apatite, and like the latter mineral are often found bent, and sometimes broken and recemented. On the 7th lot of the first range various modified forms of the four-sided prism occur in a crystalline limestone, and by extended replacements of their basal edges produce such forms as the octahedron with rhombic bases. Other complicati ons exist, such as the enlargement of one set of faces at the expense of others, giving rise to very unsymmetrical shapes. Their color is white and translucent, their opacity depending on the advancement of decomposition that so conspicuously in places mars their exterior lustre. On this same lot a mineral is found, having the crystalographic form of pyroxene, exhibiting every hardness between 6 and

2. In the vicinity of some lenticular patches of a serpentinous mineral fine inclined square prisms of pyroxene are associated with a scaly white garnet, and although their external planes are converted into an unctuous steatitic mineral their internal fracture are vitreous; generally semi-transparent to translucent, of a greenish white color. These crystals are built up of thin laminæ, parallel with their lateral planes, in the direction of which they cleave with great facility. The dark green lamellar variety occurs in patches in a massive scapolitic rock on lot 7, range 7, of Templeton, and at the same locality in calcite veins, crystals with rounded angles, often semi-translucent, are frequently met with. Fine crystals of a black color are said by Dr. Harrington to occur on lot 13, range 11 of Templeton.

The mineral uralite, also mentioned by the same gentleman, is found in many places in Templeton, where it apparently forms a transitory mineral between pyroxene and hornblende.

Hornblende, although a common associate of the apatite veins, is nevertheless never as constant as the latter mineral (pyroxene). Independent of the extensive rock masses wherein this mineral forms a variable ingredient, it may be said to be confined to mixed veins, commingling with such minerals as apatite, pyrite, pyroxene, epidote, scapolite, &c. The crystallised varieties are seldom observed in the apatite veins, although remarkably fine prisms often occur in close connection. On lot 12, range 16 of Hull, dark green translucent prisms nearly 4 inches in length are interspersed through a band of pink limestone. They are also met with in radiating groups in cavities in a pyroxene rock. A pale green translucent variety, occurs in modified rhombic prisms on lot 17, range 1 of Wakefield. A greenish gray fibro-bladed variety in reticulating masses occurs at one of the openings at Gemmill's mine in the same township, associated with apatite and occasionally enclosing ferruginous prisms of zircon. A broken section of the latter mineral measured half an inch by a quarter. The fibrous variety actinolite may be frequently met with. On the 12th lot in the 12th range of Templeton, a bluish, fibrous, partly altered hornblende occurs on the walls of an apatite vein.

A white fibrous tremolite is found in the neighborhood of Old Chelsea, in white crystalline dolomite.

Garnet.—This mineral, until within the last two or three years, was regarded as a rare occurrence in this neighbourhood, being principally confined to small crystals, distributed through the laurentian gneisses. In the vicinity of the Baldwin Mines in Hull, the precious variety, probably almandine of a blood-red color, in lamellar masses, often an inch or more across, occurs in a schistose rock. A massive variety of a dingy reddish-brown color occurs on lot 18, range 2, of Wakefield, in a vein cutting the stratification. Crystals showing rhombic faces sometimes an inch or more across, are associated with crystals of epidote and stilbite in the more cavernous portions of the vein. The above garnet was mined to the extent of about two tons, in supposition that it was apatite. A red variety of this mineral occurs—according to Dr. Harrington—on lot 12, range 12, of Templeton. An amber-colored garnet, probably essonite, occurs on lot 14, range 1, of Wakefield. This locality a few years ago afforded some handsome crystals, having been extracted for apatite. A certain gentleman on hearing of the occurrence, with an eye to dollars and cents rather than national development, obtained, either by gift or purchase, nearly all the output. I am told some of these crystals measured three inches across, all of which were sold in the States. This locality has since been visited by dealers from Philadelphia and New York, who have now almost exhausted the mineral. These crystals occur in a bed of wollastonite, with brown prisms of idocrase; sometimes the latter mineral is imbedded in the former. Occasionally patches of a translucent scapolite are entirely enveloped in a coating of garnet. Notwithstanding its high lustre and bright color, it could not be applied to any ornamental ues, owing to the grains constituting the crystals, being so loosely coherent.

A few miles west of this locality, on lot 6, in the same range, handsome crystals of a lime garnet, occur in a band of crystalline limestone, associated with pyrite, galena, sphalerite, wollastonite and pyroxene, forms exhibiting the faces of the rhombic dodecahedron and trapezahedron being common. ~~Layers~~ Faces of the latter are often extended almost to the obliteration of the former. Their color varies from white, or almost colorless, to dark-green, passing through wine-yellow, sulphur-yellow, and purple. One perfect crystal from this locality would

weigh about one pound, being of a dark-green color, translucent only on the edges. One of its planes was penetrated by an octahedron of grey pyroxene. The white variety attains even a much larger size, and crystals as large as a cricket-ball may be frequently met with. On the next lot, 7, a garnet apparently containing much more iron, fusing to a black glass, occurs in a band of disintegrating limestone, and, like the latter rock, is rapidly losing its cohesive properties. A portion of a large crystal obtained near the surface could not have weighed less than five pounds originally. Its color is more of a brownish tinge, and it is seldom as bright in lustre. A peculiar white scaly variety in crystalline masses, more or less mixed with a serpentinous mineral (its line of contact being often difficult to discern) occurs in close connection with the above. It sometimes exhibits one or more rough faces, which are invariably altered to a steatitic mineral.

Chrome Garnet.—Beautiful little dodecahedrons of this mineral occur in small groups, or attached crystals, in a fine granular grey pyroxene, on lot 29, in the 4th range of the same township.

Zircon.—Fine specimens of this mineral have been found at various times during the development of the apatite deposits in the above townships. A crystal 15 inches in length is said to have been found by a miner on lot 23, range 13, of Templeton, who, being doubtful of its nature, broke it up to satisfy his inward curiosity. You may imagine the poor man's feelings when he was told that he had just let slip through his fingers $200. One crystal preserved from this locality, now in the possession of Mr. J. G. Miller, measures four and a half inches laterally and one inch across the faces. Another crystal from Gemmill's Mine in Wakefield is said to be six inches in length. Small crystals may frequently be found in calcareous portions of the pyroxene rocks. On lot 14, range 1, of Wakefield, crystals from a quarter to an inch in length occur in a thin layer of shaly limestone that is intercalated between beds of wollastonite. At Haldane's Mine, in the same township, minute pink semi-transparent prisms occur in pyroxene.

Idocrase.—Handsome crystals of this mineral are found in Templeton and wakefield. Brownish-red slightly modified prisms, an inch in diameter, occur on lot 7, range 12, of the former township, and on lot 14, range 1, of Wakefield, brownish and greenish prisms often over an inch in diameter, occur in a wollastonite rock.

Caxoclasite.—In this connection may be mentioned a mineral that has been described by Prof. Lewis, of the Academy of Natural Sciences, Philadelphia, as caxoclasite. This mineral occurs in blue calcite on lot 7, range 1, of Wakefield, in square prisms with their solid angles unsymetrically truncated. Its color is white, generally more or less stained with oxide of iron, lustre resinous, sometimes inclining to pearly, opaque.

The name chosen would imply that the mineral in question has a poor cleavage, whereas it has none. Then again, in the analysis given by the same gentleman, two or three per cent. of phosphoric acid was determined. Perhaps Mr. Lewis did not observe the minute prisms of green apatite that sometimes penetrate this mineral, and from which source, no doubt, his phosphoric acid was obtained.

Scapolite.—This mineral may be regarded as one of the most constant associates of the apatite deposits, generally occurring in bedded masses, sometimes alternating with hornblende, producing a banded structure of several feet in thickness.

At times masses of this mineral are made up of aggregations of huge but rough crystals of a grayish white color. However, some good examples of crystallized forms are met with in many places in Wakefield and Templeton. For localities in the latter township I would refer to Dr. Harrington's report, 1877-78. He says the finest crystals occur on lot 14, range 12, and on lot 23, range 13; crystals over one foot in length, although externally rough, are frequently met with. On lot 7, range 7, of the same township, a thick bed of grayish white scapolite was penetrated, enclosing patches of a lamellar dark green pyroxene and green apatite. On lot 10, range 10, a beautiful translucent variety occurs, and which assumes a pink color on exposure. In the township of Wakefield, on lot 17, range 1, fine square prisms, sometimes modified, of a grayish white color, occur, coating an outcrop of the massive variety. On the next lot, 18, range 2, a grayish translucent massive variety is interstratified with hornblende. On lot 7, range 1, doubly terminated prisms with rough exterior planes are liberated from a disintegrating limestone. On lot 6, range 2, a translucent canary yellow cleavable variety occurs, but how associated I did not ascertain.

Wilsonite.—This mineral is now generally believed to be an altered scapolite, and may often be observed forming a nucleus in masses of the latter mineral. Good illustrations occur at many of the scapolite localities.

Epidote.—Independent of the occurrence of this mineral in the stratified rocks of the neighborhood, we meet with it in crystals lining cavities, besides forming an ingredient in many mixed veins. On lot 18, range 2, of Wakefield, dark yellowish green crystals, from a sixteenth to an inch in length, line cavities in massive garnet. At Haldane's mine in Wakefield large quantities of a greenish crystalline epidote were extracted, associated with pyrite, &c. Occasionally terminated square prisms of a light yellowish green color, enclosing disseminated pyrites, are embedded in a grayish green granular apatite, and are apparently pseudomorphs after scapolite. In the township of Templeton this mineral occurs on lot 9, range 10 and lot 23, range 13.

Mica.—This name will be retained to include a number of doubtful minerals, all of which have one perfect basal cleavage. Besides being disseminated through the schistose and gneissic rocks it often constitutes large volumes in some of the phosphate veins, either distributed in small scales through extensive masses of apatite and pyroxene, or forming large aggregations, sometimes affording plates two feet square in a calcareous gangue.

The mica fever, so prevalent in all parts of the Dominion, does not seem any milder in this neighborhood. The unwavering enthusiasm after marketable mica, encouraged by flattering reports, of irresponsible persons, will always remain a source of dubious speculation with the far-seeing capitalists. We shall not attempt to deny that unlimited quantities of this mineral are found in the above townships, but with one or two exceptions I have rarely met with plates sufficiently transparent, or free from included minerals, or from contortion, as to be available for commercial purposes. On the south half of lot 10, range 10, of Templeton, plates two feet square were taken out during the development of an apatite deposit. These plates were perfectly free from folds or inclusions, transparent enough in thin laminæ, but yet unsaleable because they would not stand the so-called New York fire test. Yet this same mica has been exposed to the heat of an ordinary

stove for the last two years, and although it became slightly discolored it nevertheless compares favorably with some grades of the commercial article. At Chitty's mine in Wakefield, great quantities of this mineral were met with, capable of supplying very large plates, although occasionally marred by lateral joints.

What this mineral lacks in a commercial point of view is more than counterbalanced by the magnificent prisms available to the scientific world. For symmetry of form the crystals lining the walls of fissures, or enclosed in limestone, are not rivalled in the Dominion.

At Moore's mine, in Wakefield, prisms over a foot in diameter with lateral planes varying from an inch to a foot or more, stand out in relief on the dissolved surfaces of the limestone. Thin plates of this mineral are remarkable for showing in a strong degree the asterism or radiating star when viewed through a transparent plate of it. This is due, according to G. Rose, to intersecting minute crystals of biotite, but considered by Tschermak to be some undetermined substance. More recent investigations have put forth rutile as the inclusion. This peculiarity does not extend to all our micas alike, as non-asteriated varieties are frequently associated with the asteriated. Neither is it confined to any particular color, as the pearly white and the black both exhibit these optical characters. Prisms of the black variety often exhibit lateral cleavages, which are easily obtained, breaking up into rhombic forms. On lot 7, range 1, in the same township, a pearly white sometimes tinged with a copper red color occurs in a bed of limestone often holding concretionary inclusions of calcite. These crystals, which are sometimes twinned, are peculiarly characterized by a phosphorescent light that glows momentarily when the plates are suddenly parted. Large aggregates of these crystals are sometimes met with, where one-half the prisms, laterally, are transformed in a slightly micaceous steatitic rock, the unaltered portion having thin films of carbonate of lime interpolated between the laminæ.

Oligoclase.—A mineral occuring in veins in a gray pyroxene rock on lot 16, range 12, of Hull, has been referred by Mr. Hoffmann to oligoclase. It is often beautifully crystallized, of a slightly translucent white color, weathering to an opaque milky white.

Albite.—This mineral is mentioned by Dr. Harrington as occurring at several places in Templeton. No locality being cited, it is

possible this name may be applied to many of our local feldspars, but until analysis shall have established their properties it will be better to refer to them under the general heading of feldspar.

Orthoclase.—The gneissic and granitic rocks, so extensively developed in these townships, consist for the most part of various colored feldspars, associated with quartz, mica, hornblende, &c. The strong structural resemblance of the various members of the feldspar family makes it difficult to discriminate between the several allied minerals. Neither do I think it possible (except in well crystallized specimens) to establish any member of this family without the assistance of the chemist or the microscope. I have no doubt that much of our feldspar belongs to the triclinic group, yet there is every reason to suppose the greatest bulk of the above bands is largely composed of the oblique potash variety (orthoclase). In the township of Hull large cleavable masses of a white, vitreous feldspar, enclosing a nucleus of a grey material, make up considerable proportions of one of the above bands, sometimes to the exclusions of the quartz altogether. Feldspar, in some form, is almost invariably present, in more or less quantity, in all the apatite veins, sometimes associated with hornblende, pyroxene, quartz, sphene, &c.

Fine crystals of orthoclase are said to occur in Wakefield. In the township of Hull on lot 7, range 12, beautiful flesh-red crystals occur in cavities in a massive variety, and on the south half of lot 6, in the same range, large cleavable masses of a green feldspar, associated with a yellowish banded variety and a white translucent quartz, make up large proportions of a band traversing this lot. Sometimes large, brittle, black crystals of tourmaline are interspersed through this pegmatite rock.

Titanite or Sphene.—This mineral may also be regarded as a common associate of the apatite veins. Sometimes occurring massive in lenticular patches in pyroxene rocks, at other times distributed in crystals through various vein-stones.

Rude crystals of a brownish color occur in many places in the township of Templeton. In Hull, lot 12, range 13, imperfect crystals of this mineral are so abundantly distributed through a pyroxene rock as to make up one-half its bulk. The finest crystals I have observed

in these townships, occur on lot 7, range 1, of Wakefield, in a band of limestone. They are clove brown in color, sometimes measuring two inches across. A little south of this locality, on the same lot, crystals of a light cinnamon brown color are profusely disseminated through a dark cleavable pyroxene. The latter rock is cut by quartz also thickly studded with these crystals. A few hundred yards northeast from the latter place lenticular patches of a crystalline titanite of a dark brownish black color are enclosed in pyroxene.

This mineral is also said, by Mr. Frank Adams, to occur in crystals in a disintegrating dyke in Hull.

Tourmaline.—This mineral, of a black color, may frequently be met with, either enclosed by or investing the rocks of the neighborhood. Black, lustrous crystals, variously modified, occur in a pinkish calcite at Wilson's mine, in Wakefield, and in apatite on the next lot 17, range 1. Large radiating and reticulating masses invest the surfaces of a syenite, on lot 18, range 2. The interstices formed by the crossing of the prisms are occasionally filled with crystals of white scapolite.

The finest crystals of this mineral observed in this neighborhood occur sparingly on lot 15, range 12, of Hull, investing a hard grey pyroxenite. They are generally less than an inch in length, exceedingly bright in lustre. Their form is hexagonal, capped with planes of the rhombohedron. This mineral has been observed at several places in Templeton.

Having now reached the end of the anhydrous silicates, I will briefly allude to hydrous compounds.

Talc.—A mineral having the aspect of talc, occurs in small foliated masses of a silky lustre, enclosing a nucleus of calcite at McLaurin's mine in Templeton.

Steatite.—A mineral of the nature of steatite has been observed in several places in the above townships, forming small bedded masses. One of these is on lot 7, range 12, of Hull. On lot 7, range 1, of Wakefield, crystals of a yellowish steatite (pseudomorphs after pyroxene) occur in a coarse disintegrating crystalline limestone.

Serpentine.—This mineral is more confined to the limestone bands, through which it is distributed in grains, bands and lenticular masses.

Its color varies from a light yellow to a dark green, often revealing a sharp conchoidal fracture. In the neighborhood of Chelsea, serpentine limestone is interstratified with other bands enclosing apatite crystals. In the same limestone bands of a semi-fibrous yellow variety occur, resembling the structure of hornblende, and possibly pseudomorph after that mineral. On lot 7, range 1, of Wakefield, large lenticular masses of a translucent green serpentine occur in limestone. It breaks with a sharp conchoidal fracture, and is occasionally marred as an ornamental stone by inclusions of a foliated graphite and large masses of a white micaceous-looking garnet.

Chrysotile, or Serpentine Asbestos.—This mineral occurs in the neighborhood of Chelsea, forming concentric veins in a serpentinous limestone. The fibres are sometimes an inch and a half in length, and rather too strongly coherent, I think, to be of any immediate commercial value. Other localities in the neighborhood of Templeton have afforded a similar mineral, the fibres, however, in this instance being more separable. A quantity was mined some years ago from one of the latter localities, but with what success I am unaware.

Ripidolite.—A greenish foliated mineral occurring on the west half of lot 18, range 9, of Templeton, is referred by Dr. Harrington to this variety.

Prehnite.—This mineral was noticed at Post's mine in Templeton, in greyish white, strongly coherent, mammillated groups; in cavities in pyroxene. It has also been noticed elsewhere in the same township.

Zeolite group.—Four representatives of this family have been noticed in the above townships, viz., stilbite, chabazite, natrolite and heulandite. The first mineral, stilbite, occurs in small, sheaf like aggregations of a yellowish or white color, associated with epidote, lining cavities in a massive garnet rock on lot 18, range 2, of Wakefield. A mineral in acicular tufts resembling natrolite is also often associated.

The mineral chabazite occurs at Haldane's Mine, in the same township, in transparent to translucent rhombohedral crystals, often a quarter of an inch across. Their color varies from colorless to wine-yellow, and frequently fine illustrations of penetration twins may be observed. I also noticed a similar mineral at Post's Mine, in Templeton.

Heulandite.—This mineral, in small, opaque, white, oblique rhombic prisms, invests the surfaces of a paroxenic rock on lot 7, range 1, of Wakefield.

We now come to the sulphates, of which we have but one representative, in the form of Barite, or sulphate of barytes. This mineral is used extensively for the adulteration of white-lead, which, by affording a white powder when ground, together with its high specific gravity and cheapness, is often made to replace 75 per cent. of the lead, and although the bulk may be increased, the body of the paint is impaired.

A vein of this mineral, often veined with green fluor, was worked some years ago in the township of Hull. Another deposit of this mineral is on lot 12, range 12, of Templeton. It occurs in white lamellar bedded masses in gneiss. The appearance or overlying portion is more or less colored by the oxidation of some furruginous mineral, and is greatly mixed with calcite.

Carbonates.—Of this group, like the sulphates, we have but one member in the form of limestone, or calcite, Independent of the extensive beds of amorphous and crystalline limestone that so characterize this neighborhood, more especially the western portion, we find bands of a more cleavable nature cutting through the pyroxenic strata, forming the gangue of apatite and other minerals.

On lot 7, range 1, of Wakefield, a beautiful dark-blue cleavable variety is associated with wollastonite, and on the same property a translucent, green, cleavable variety, often exhibiting large cleavage planes, enclose garnet and pyroxene. Numerous other localities in these townships have afforded forms of the dog-tooth spar and other combinations.

Flourids.—Fluorite, or fluor-spar, may frequently be noticed amongst the associated minerals of the apatite veins. On lot 13, range 13, of Hull, small semi-transparent greenish cubes occur in a limestone, and on lot 10, range 14, octahedrons of the same color have been found. It is also frequently met with in small quantities of a blue, violet or purple color.

Anhydrous Oxides.—Independent of those members of this group already mentioned under iron ores, we have spinel and rutile to notice. The former occurs in cubes, sometimes more than an inch

across, in a band of limestone, on lot 7, range 1, of Wakefield. These crystals vary from a dark-green to a light lavender blue, and may be more rarely observed in semi-transparent crystals of a pink color, constituting the spinel ruby. These crystals are built up of granular conchoidal fragments, which are often transparent. Some of these cubes when broken are found to contain a nucleus of a black, vitreous color, having the hardness of about four, and easily fusible before the blow-pipe. Another instance of the alteration of this mineral was observed in the same region where a group of these crystals were partly converted into a steatitic mineral. Crystals of spinel from the size of a pea to that of a bean are distributed through a grey pyroxene rock that extends over many acres.

Rutile.—Is found in small red geniculated crystals in barite on lot 12, range 12, of Templeton.

Silicon Group—Quartz.—This mineral, not only forms one of the commonest constituents of our rock masses, but fills many of the veins that traverse them. It sometimes encloses such minerals as apatite, pyroxene, titanite, &c. A vein of this nature occurs on lot 18, range 2, of Wakefield. Crystals of this mineral are by no means common; however, a few good forms have been met with in Templeton and Hull, of such shades of color as smoky-brown or amethystine, and colorless.

Jasper.—This mineral occurs in a bed 2 feet in thickness, overlain by gneiss, on lot 15, range 10, of Hull. It varies in color from a dark-red to a chocolate-brown, sometimes mottled with yellow, and is susceptible of receiving a high polish, comparing favourably with similar specimens from Lake Superior and Nova Scotia.

It is occasionally marred by inclusions of hard foliated masses of mica and crystalline specular iron.

Agate.—A yellowish-brown chalcedony alternating with bands of quartz may be referred to this mineral, occurring on lot 17, range 9, of Templeton.

Mr. W. L. Scott asked what Mr. Willimott's opinion was respecting the nature of caxoclasite, whether he agreed with Mr. Lewis as to its composition; also why the barite shaft on the road to King's mountain, which had been visited *en passant* on one of the club excursions had been abandoned?

The lecturer had never visited the locality of the barite shaft, and could not say why it had been abandoned. He did not agree with Prof. Lewis in thinking that caxoclasite contained phosphoric acid.

Mr. LAWSON had not caught the lecturer's idea respecting the rounding of the angles of pyroxene and apatite crystals. He combatted the theory of igneous action and favored that of solution, Mr. Lawson considered the objections to the igneous theory satifactory, and did not think the lecturer had made out his case against the theory of solution, which appeared to be, that, as rounded crystals of pyroxene were found with similarly rounded crystals of apatite, the modification in each being evidently due to the same cause, and as pyroxene was totally insoluble, the rounding could not have been effected by a solvent. Mr. Lawson thought that water at very high temperatures could dissolve almost anything.

Mr. W. P. ANDERSON understood that the mica of this locality was phlogopite, which contained a small quantity of water, and was in consequence less refractory than muscovite, the chief commercial variety. He had been informed that muscovite was found in the Mattawa district, and wished to know if such were the case. The lecturer had no doubt of it, as he had specimens probably referable to that variety.

In reply to Mr. Small, the lecturer stated that his apatite statistics were derived from the export returns, and consequently were exclusive of the quantity mined and awaiting shipment, as well as of the 800 tons used in the Brockville Chemical Works.

Mr. LAWSON asked what the New York fire test for mica was? Mr. Willimott was not certain, but thought it was merely resistance to a blow-pipe flame. It was recognized as the standard of value in Canada. Muscovite was untouched by the blow-pipe flame.

In a discussion on apatite it was elicited that nothing less than 70% material paid, although arrangements were reported as being in progress for shipping 65% stuff to England for treatment by a new process. Members of the British Association had informed Prof. Macoun that the refuse of the Templeton mines was superior to anything worked in England, and that in the future middlings would be of great value.

Mr. LAWSON stated that untreated apatite was proving in the long run superior to superphosphate.

Mr. WILLIMOTT thought this probable because in its action it would resemble the valuable fertilizer ground bones.

In reply to Mr. Fletcher, who asked if there was any official statement on the point, Mr. Small cited the report of the Department of Agriculture on tests made at the Agricultural College, Guelph, showing that good effects followed its use in the third year after application when applied to root crops, but not to cereals. He found this opinion endorsed in leading Scotch agricultural papers, and stated there was a large demand for the ground, untreated apatite in Belgium to fertilize the sugar beet farms.

Mr. FLETCHER thought if this were true the farms in the apatite district should be particularly fertile, which, from what he had seen in this district, did not appear to be the case.

Rev. Mr. MARSAN instanced some particularly fertile patches on the upper Gatineau, which had been worked for thirty years without manuring and still remained fertile. This success he attributed to the vicinity of phosphate deposits. He thought the two theories as to the best means of using the phosphate reconcilable. Roots require little phosphate, while fruits must have it. In spring it is found that all the phosphorus in a plant is contained in the root, in July it is in the straw, while at harvest time it has found its way into the fruit; consequently cereals would require it in such a form as would favor rapid assimilation, while root crops could get it from the more slowly disintegrating ground apatite. In the reports of the French agricultural schools preference was given to the raw material, and the French newspapers were advising the same treatment.

The lecturer's remarks on all points he considered most exact. He (Father Marsan) had studied the neighborhood of the Desert, which was very similar to the formation at Chelsea. No tract is so uniform as the crystalline limestone band. The observations of the survey had extended 60 miles up the Gatineau; 90 miles farther up the river the same formation was found.

He had found gold on Trout Creek, which empties into Eagle River. Although the geological formation would lead one to expect its existence he had paid little attention to the first reports of its presence, because farmers often confused mica and pyrites with the precious

metal, and would show him finds of these glittering deceivers, but when he had an opportunity he brought a sample of sand to the College laboratory and found traces of gold in it; he had, however, been unable to obtain any sand since in consequence of the water being too high whenever he passed.

Respecting the apatite deposits he had reached the conclusion that they diminished in number and quantity as the Ottawa basin was left behind.

Prof. MACOUN said that from a botanical point of view there were advantages peculiar to each method of applying apatite, as annuals required phosphorous supplied rapidly and would benefit from superphosphate, while biennials would require it principally the second year as a constituent of their large crops of fruit.