PEGMATITE MINERALS OF ONTARIO AND QUEBEC (Concluded)

Hugh S. Spence, *Mines Branch, Ottawa, Canada.*

(*Continued from page 451*).

Quartz

Massive, white quartz occurs in abundance in the pegmatites, in ledges, stringers and often in large segregated bodies. Often, quartz constitutes the principal mineral of a dyke, and if transport conditions permit, the dyke can sometimes be worked for quartz, with feldspar as a by-product. In the Buckingham district, Que., large tonnages of pegmatitic quartz are mined, or saved at feldspar mines, and shipped to the works of the Electric Reduction Company, at Buckingham.

Most of the quartz is cloudy and non-transparent. Occasionally, it is smoky, and sometimes milky. Clear, glassy quartz is not common, but is found at some of the mines in small amount. Pale, rose quartz occurs at the Villeneuve mine, Que., and in a dyke in Lyndoch township, Ont.: the colour is not, however, good enough to be suitable for ornamental purposes.

Freely crystallized quartz is not common, owing to the comparative rarity of vugs or cavities in the dykes,and when found, is generally cloudy and of poor quality. Small, distorted crystals of smoky quartz occur scattered through calcite at the McDonald mine, near Hybla, Ont.

In many of the pegmatites, a large proportion of the quartz present occurs in graphic granite intergrowth with the feldspar, and some dykes consist almost wholly of graphic granite. Others contain irregular masses of graphic granite, distributed through or around zones of segregated feldspar and quartz.

Samarskite

The occurrence of small amounts of massive samarskite at the old Maisonneuve mica mine, in Berthier county, Que., is mentioned by Obalski (17), (26), (56), (57) who also records (56) it from the Pied des Monts mica mine, in Charlevoix county, Que. It is stated (53) to have been observed in the beryl pegmatite in Lyndoch township, Ont. (See also calciosamarskite).

Sphalerite

A single occurrence of sphalerite in noteworthy amount in a pegmatite has been observed by the writer in Dill township,

Sudbury district, Ont. Here, the sphalerite occurs in a small, vuggy, vertical shoot, or chimney-like vein, near one wall of the dyke. The mineral is black and massive, and is associated with muscovite, plates of which lie embedded in the sulphide. The occurrence is possibly related to the metalliferous veins of the Sudbury basin, the rim of which lies a short distance to the north.

Thucholite

Thucholite is a remarkable, rare carbon mineral containing rare elements, and has been recorded from a few Canadian pegmatites. It was first noted about 35 years ago by Obalski (14), (51) in the Pied des Monts mica mine, near Murray Bay, Que., where it occurs in small amount with uraninite. Ellsworth has since described (13) an interesting occurrence of the mineral in a red pegmatite in Conger township, Parry Sound district, Ont., where it occurs associated with uraninite, samarskite, allanite and cyrtolite, and also an occurrence in a white dyke in Derry township, Que., where it is associated with allanite, uraninite, and cyrtolite (13). From this last locality, Ellsworth illustrates an interesting pseudomorph of thucholite after tourmaline.

The writer has lately noted an even more remarkable occurrence of thucholite in the Parry Sound district, where it is found with uraninite, cyrtolite, titanite and allanite. This occurrence will be described in a paper shortly to appear in this Journal.[1] The chief points of interest in connection with the deposit are the comparative abundance of the thucholite, and the fact that it occurs in cubic crystals, often of large size, and apparently pseudomorphous after uraninite; also, that a thick oil, as well as a substance resembling elaterite, which hardens on exposure to a pitch-like consistency, also occurs in the dyke.

Obalski termed the Murray Bay mineral simply "coal." Similar carbonaceous material from the crystalline rocks of Canada later usually was designated anthraxolite, a name first given to such a substance from Lake Superior and later applied, more specifically, to the hard, vein-like carbon of the Sudbury district, Ont. The term thucholite has been proposed by Ellsworth for the true pegmatitic carbon, the name being formed from the chemical symbols of some of the main constituents—thorium, uranium, carbon and water.

[1] The article referred to will appear in the November issue of the Journal.

Titanite

Titanite is not a common mineral in the pegmatites, but is sometimes present in small amount in the wall zones.

At the McDonald mine, near Hybla, Ont., which has yielded so many interesting rare-element minerals, brown titanite in

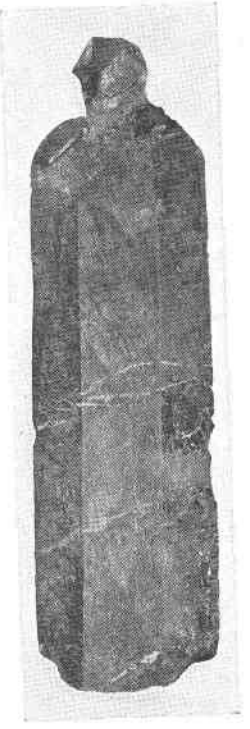

Fig. 2. Large, twinned crystal of titanite, with small, terminal individual in parallel growth, from lot 14, concession VII, township of Calvin, Nipissing district, Ontario. (½ Natural size).

crystals measuring sometimes several inches in length occurs associated with ellsworthite and cyrtolite in pink calcite, as well as in the feldspar of other parts of the dyke. Small masses, sometimes possessing obscure crystal outline, of a brown mineral that appears to be an intimate mixture of titanite and hatchettolite, also occur here. Titanite also occurs at the nearby Plunkett mine (23).

In a dyke in Calvin township, near Mattawa, Ont., both fresh, brown and altered, greyish-green titanite occur adjacent to the wall. An interesting, twinned crystal from this dyke is illustrated in Fig. 2.

Enormous brown titanite crystals, associated with very large zircons, were formerly obtained (33) from the apatite-bearing, pyroxene-feldspar pegmatites of Sebastopol township, in Renfrew county, Ont., but these pegmatites do not come within the class of those dealt with in this paper. Similar large crystals, however, occur in a coarse granite in North Crosby township, near Westport, Ont.

Small titanite crystals occur in a white pegmatite cutting crystalline limestone in North Burgess township, Ont., associated with diopside, calcite, apatite and pyrite (35), and also in a similar dyke in Loughborough township, Ont. (4).

Toddite

(See columbite)

Tourmaline

The black schörl variety of tourmaline is one of the commonest accessory minerals in the pegmatites, and most dykes contain it in some amount. It occurs frequently in groups of radiating, acicular crystals penetrating feldspar or quartz, the groups often radiating outward from cracks or joints. It is sometimes found in large, well-formed prisms having the rounded triangular outline typical of the mineral, and then often exhibits rhombohedral terminations.

Good examples of large crystals, sometimes one inch or more across, are found at the Villeneuve mine, in Villeneuve township, Que., and at the Leduc mine, in Wakefield township, Que. At the former locality, tourmaline also often occurs embedded between the plates of muscovite crystals, and the mine has also yielded interesting pseudomorphs of muscovite, garnet and quartz after tourmaline. The Villeneuve tourmaline is often altered externally to muscovite, and in this mica there often occur small, nodular pellets of gummite. Very large tourmaline crystals are also associated with euxenite and monazite in a dyke in West Portland, Que.

The lepidolite-bearing dyke at the Leduc mine, in Wakefield township, Que., carries considerable green and lilac-red tourmaline,

in addition to the black, but the mineral is cloudy, flawed and of poor quality. An attempt was once made to mine this pegmatite for gem tourmaline, but with disappointing results.

Large tourmaline crystals also occur in the beryl pegmatite in Lyndoch township, Ont. Large masses of rather loosely-intergrown tourmaline crystals, in the cavities of which sit splendent pyrite individuals, are found at the O'Brien mine, in Derry township, Que.

Tremolite

Massive, fibrous tremolite is sometimes found as a contact mineral in the wall zones of pegmatites cutting crystalline limestone, as in a dyke on Rock lake, in Storrington township, Ont.

Uraninite

Uraninite occurs somewhat sparingly in certain of the pegmatites, but it is to be included among the rarer minerals.

It has been found probably in greatest amount at the old Villeneuve mica mine, in Villeneuve township, Que., where it occurred usually in small pellets, but sometimes also in larger masses up to one pound in weight (20), (48). It was often associated with gummite of a brilliant scarlet-orange colour. It has also been noted in small amount in a similar dyke in the adjoining township of West Portland, and also at the Leduc mine, in Wakefield township.

Uraninite occurs (51) at the Pied des Monts mine, near Murray Bay, Que., associated with thucholite. It is also found in small cubic crystals in certain of the dykes in Buckingham township, Que., and at the Wallingford mine, in the adjoining township of Derry, where it is also associated with thucholite. (13).

In Ontario, it has been described by Ellsworth (13) from the township of Conger, Parry Sound district, where it occurs in cubic crystals up to one inch in diameter, associated with thucholite, samarskite and cyrtolite. It also occurs in some quantity, both in crystals and massive, in the remarkable thucholite-bearing pegmatite in Henvey township. Small amounts have also been found in dykes in Butt Township, in Nipissing district (19), (27). In the western part of the Province, there is an early record (49) of uraninite (coracite) near Mamainse, on the east shore of Lake Superior, but the location has been lost and nothing accurate is known about the occurrence.

The most important uraninite discovery in Canada to date is that in Cardiff township, near Wilberforce, where the mineral has recently been found to occur in considerable amount (24). This occurrence is associated with syenite pegmatite and is described under that class of dykes.

Uranophane

Small groups of minute, yellow, waxy crystals, that are probably uranophane, accompany the uraninite and thucholite of a dyke in Henvey township, Parry Sound district, Ont. The mineral is also recorded (58) from the Villeneuve mine, in Villeneuve township, Que.

Uranothorite

Ellsworth has described (8) a thorite, rich in uranium and calcium, from the McDonald mine near Hybla, Ont. The mineral occurs in square prisms, up to one-half inch across, embedded in feldspar or quartz. This is the only recorded occurrence of thorite in Canada.

Xenotime

Stated (31), (59) to have been found years ago in small amount at a mica mine in Calvin township, near Mattawa, Ont.

Zircon (variety, cyrtolite)

The cyrtolite variety of zircon is a fairly common mineral in the pegmatities, particularly in those of the Hybla area, Ont., and in the Parry Sound district, Ont.

At the McDonald mine, near Hybla, cyrtolite is quite abundant throughout the dyke. It occurs as small individual crystals, or groups of crystals, and also in masses up to several pounds in weight, embedded in feldspar or quartz. It also occurs at the nearby Woodcox mine. (5).

In the Parry Sound district, cyrtolite is found in Conger (13), Henvey and other townships, where it is usually associated with rare-element minerals. Cyrtolite, indeed, seems to be a common associate of such minerals in the granite pegmatites of eastern Ontario.

Small amounts of cyrtolite accompany the euxenite in South Sherbrooke township, Ont., and it is also found in some quantity in the beryl pegmatite in Lyndoch (10).

In Quebec, no important occurrences are recorded. Small cyrtolite crystals, however, occur sparingly in the Villeneuve dyke, in Villeneuve township, and also in West Portland. Zircon is also recorded (53) from the Pied des Monts mica mine, near Murray Bay, Que.

Normal zircon does not occur, or at best, is extremely rare, in the granite pegmatites. Very fine zircons, however, were formerly found in the apatite-bearing, pyroxene-feldspar dykes of Sebastopol and Brudenell, in Renfrew county, Ont., where large crystals, measuring 12×4 inches, and weighing as much as 15 pounds, were obtained (33). Small crystals also occur in the syenite pegmatite of Cardiff township.

An interesting phenomenon in connection with the occurrence of cyrtolite in the dykes is the pronounced shattering effect that the mineral has exerted on the quartz and feldspar in which it is embedded. Quite small masses, and even single crystals, of cyrtolite often produce radial shattering to a remarkable degree, and the writer has observed an instance in the wall of the McDonald mine, near Hybla, Ont., where a small mass of cyrtolite, less than one inch across, had caused radial cracks over four feet long in the surrounding quartz. This phenomenon is not confined to cyrtolite alone, but seems to be common to a number of the rare-element minerals. It has been remarked by Ellsworth (19), and has been studied by Walker and Parsons in a special paper (5).

Cyrtolite is an interesting mineral on account of it having yielded the recently-discovered element hafnium. The Canadian cyrtolites seem generally lower in hafnium than those from Bedford, N.Y. (5.5 per cent HfO_2), and Rockport, Mass. (9.0 per cent HfO_2). Professor von Hevesy, who has kindly determined the hafnium content of the Henvey and Hybla cyrtolites, reports (private communication to the author) that the former yielded 2.14 per cent HfO_2, and the latter, 2.36 per cent.

B. SYENITE PEGMATITES

Description

The pegmatites included here comprise a class of dykes apparently having a restricted, regional distribution in the Bancroft-Wilberforce district, counties of Hastings and Haliburton, Ont. They are related either to the nepheline syenites of the region or to the marginal syenitic facies of large granite batholiths, several

of which occur in the area. The geology of the district was studied and described by Adams and Barlow about 25 years ago (36), since when there has been little further published.

Mining operations upon these pegmatites have been confined to a few shallow openings made for mica, in Faraday township, and for fluorite and radioactive minerals, in Cardiff township; hence, little opportunity has been afforded to study the dykes. The minerals here described were found at some pits made for dark mica on lot 32 in the fifteenth concession of Faraday township; at fluorite workings on lots 8 and 9 in concession 21 of the township of Cardiff; at openings made in 1929 for uraninite on lots 4 and 5 in concession 21 of the same township; and on lot 10 in concession 12 of Cardiff.

The dykes, as far as observed, consist of very irregular bodies of medium-grained syenite, made up principally of reddish-buff plagioclase and pyroxene, with accessory fluorite, zircon and garnet; nephelite is present locally. In these dykes occur miarolitic cavities, sometimes of large size, the walls of which are lined with large and well-formed feldspar crystals. It is the coarse crystallization of the marginal feldspar of such cavities, as well as of the associated minerals, that imparts pegmatitic character to the dykes, the main portions of which are often little coarser-grained than ordinary syenite. It is from the cavities that most of the minerals here described have been obtained.

Characteristic of the dykes is the mineral filling of their cavities, this consisting principally of (a) calcite (Faraday and concession 10 of Cardiff), and (b) fluorite and calcite (concession 21 of Cardiff).

In Faraday, groups of lepidomelane crystals, some of them of enormous size, occur upon the feldspar of the walls, sometimes associated with tourmaline and fluorite, while apatite and smaller lepidomelane crystals occur embedded in the calcite.

On concession 21 of Cardiff, fluorite is by far the most abundant miarolitic mineral, with calcite in lesser amount scattered through it. On lot 5, large apatite and hornblende crystals lie embedded in the fluorite, in which also occur magnetite and uraninite crystals of considerable size. The cavity here is of exceptional extent, being at least 150 feet long by 5 to 10 feet wide and partaking of the nature of a vein. This vein is being developed at the present

time for uraninite, which occurs in considerable amount. The occurrence has lately been described by the writer (24). In some of its main features, it seems to resemble the uraninite-bearing deposit at Wölsendorf, in Bavaria (39).

Albite

The predominating feldspar of the pegmatites, according to Adams and Barlow (36, pp. 229–240), is plagioclase, ranging from albite to andesine. The only feldspar considered in this paper is that which occurs in well-formed crystals lining the walls of miarolitic cavities. In Faraday, this is flesh-coloured, exhibits the twinning striations characteristic of plagioclase, and on the basis of a microscopic examination by Walker and Parsons (38), albite. In Cardiff, the feldspar is predominantly orthoclase.

The very perfect feldspar crystals lining the walls of cavities in these dykes are one of the interesting features of the pegmatites, since feldspar crystals are rare in the granite pegmatites. The Faraday crystals attain a length of about 4 inches, while those from Cardiff are sometimes as much as 6 inches long. The Faraday crystals exhibit interesting corrosion pitting, possibly by the agency of fluorine vapours, since fluorite occurs filling in the spaces between crystals. The corrosion seems to have proceeded along cleavage planes, and the resulting regular pitting figures resemble in form the quartz pattern in graphic granite. Corrosion has been selective, certain faces being more deeply pitted than others.

Allanite

Miller mentions (40) the occurrence of allanite in the massive pegmatite of the Richardson mine, in Cardiff, as does also Ellsworth (23). The mineral has not been observed by the writer.

Apatite

Apatite is an important constituent of the dykes, and occurs as well-formed crystals, ranging up to 30 pounds in weight, embedded in calcite (Faraday) or fluorite-calcite (Cardiff). The colour varies from yellow to green or red. The mineral is clear and glassy and very brittle. Clear fragments of considerable size and without visible flaws can often be picked from broken crystals. On crystals exhibiting terminal faces, there is often a conspicuous develop-

ment of the basal plane. This is sometimes so pronounced that the crystals appear to have almost square ends. In this respect, the apatite of these dykes differs from that of the basic (pyroxenite) pegmatites, the crystals of which seldom, if ever, exhibit the basal plane. The apatite occurs always in free crystals, no massive, compact material being observed. Small, nodular masses of fluorite are often enclosed within the Cardiff apatite. The Faraday apatite has been described by Walker and Parsons (38).

Ellsworth has detected (23) small amounts of cerium and other rare earths in the brown apatite from the Richardson mine, in Cardiff.

Autunite

Occurs sparingly as minute plates, associated with torbernite upon apatite, at the Richardson mine, in Cardiff township.

Calcite

Calcite seems to be almost universally present in the dykes, usually as one of the principal cavity-filling minerals. In Faraday, a large mass of rather coarsely-crystalline, cream-coloured calcite constitutes the filling of a large cavity, and carries scattered through it well-formed apatite and lepidomelane crystals. On concession 21 of Cardiff, calcite is subordinate to fluorite, and occurs in small grains scattered throughout fluorite: the two minerals sometimes exhibit a banded arrangement. At the surface, the calcite has often been leached out, resulting in open pockets in which lie free crystals of apatite, tourmaline, uraninite, etc.

On concession 10 of Cardiff, where a number of small openings have been made, the calcite ranges in colour from light, creamy-pink to dark, reddish-brown: it is predominantly fine-grained. Small apatite and lepidomelane crystals, as well as crystallized ellsworthite, occur scattered through it. In the vicinity of the last-named, the calcite always is of a characteristic, purplish shade.

Ellsworth has discussed (23) the occurrence of calcite in the syenite and granite pegmatites.

Chalcopyrite

Occurs in small amount in the massive pegmatite of the Richardson mine, in Cardiff (23).

Diopside

Rarer than hornblende, but present in medium-sized, free crystals in the fluorite workings on lots 8 and 9 in concession 21 of Cardiff township.

Ellsworthite

Ellsworth has described (37) crystallized ellsworthite from lot 10 in the 12th concession of Cardiff township. The crystals are of rounded octahedral habit and range from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. They occur embedded in calcite, associated with small apatite crystals. The original ellsworthite from Hybla, Ont., has not been found there in crystal form.

Euxenite

Small pellets and veinlets of euxenite occur associated with lepidomelane in Faraday.

Fluorite

Fluorite, of a deep purple colour, is extremely abundant in the pegmatite in the 21st concession of Cardiff township, where it forms the principal mineral filling of miarolitic cavities. Attempts to mine the Cardiff fluorite have been made, but it proved to contain too much calcite, apatite and other accessory minerals to be of commercial grade without concentrating. Finely disseminated fluorite occurs also as an accessory mineral in the massive pegmatite bordering the fluorite workings on lots 8 and 9 in this concession. In Faraday, it is much less common, occurring only in small amount as granular material between feldspar and lepidomelane crystals lining the walls of cavities. Interesting, small masses of finely-granular, colourless fluorite were observed here, which exhibit on their surfaces spherulitic patches of a purple shade. These patches are sometimes as much as $\frac{3}{4}$ inch in diameter. The material had been exposed to weathering, which usually exercises a rather rapid bleaching effect on the fresh fluorite of the dykes. It would appear that the purple patches of the material in question owe the retention of their colour to a central nucleus of a radium-bearing mineral, the emanations of which have proved sufficient to negative, or at least to materially slow down, the bleaching effect of sunlight.

The Cardiff fluorite varies from coarsely-to finely-granular. It has not been observed in free crystals. The coarser material usually contains considerable pale, pinkish-buff, coarsely-granular calcite mixed through it, or in banded arrangement with it. The finer-grained, on the other hand, contains comparatively little visible calcite. The fluorite is deep purple-violet, almost black, in colour when fresh, but fades to a pale violet shade on exposure to sunlight; the finer-grained material fading much more rapidly than the coarse. The former also weathers readily to a loosely-coherent, powdery material, whereas the coarser remains unaffected.

The other miarolitic minerals appear to occur, for the most part, distributed in irregular fashion through the cavity-filling material. In Faraday, however, the bulk of the lepidomelane is found along the cavity walls, with a subordinate amount in the form of large crystals disseminated through the calcite.

The deep purple colour of the fluorite, which at the Richardson mine, in Cardiff, is noticeably darkest around the crystals and masses of uraninite, is evidently due to the effect of radioactive emanations from radium-bearing solutions and from the uraninite. Such dark purple fluorite is a common associate of uraninite in other parts of the world, *e.g.* Jachymov, Freiberg, etc.

In Cardiff, the fluorite surrounding uraninite is usually fine-grained. A noteworthy feature of such fine-grained, almost black, fluorite is that when freshly-broken or struck with the hammer, it liberates a strong odour resembling that of ozone (24). This odour is of practical service in the mining of the uraninite, since it indicates to the workmen that they are breaking into a pocket of uraninite. Sine has investigated (4) the gas liberated by a similar fluorite from the granite pegmatite at the McDonald mine, near Hybla, some 25 miles distant, and has determined it as free fluorine. He found that 10 volumes of the Hybla fluorite contained about 8 volumes of fluorine. Similar strongly-foetid, purple fluorite was described (*Dana, 6th Ed.*, p. 163) many years ago from Wölsendorf, in Bavaria, under the name antozonite.

Gummite

Thin crusts of lemon-yellow to vivid orange-scarlet uranium salts often coat or penetrate massive uraninite at the Richardson

mine, in Cardiff township. Under the microscope, most of such material exhibits a waxy, amorphous structure and is probably gummite. Occasionally, there is an approach to obscure crystal structure.

Hornblende

Large, stout crystals of black hornblende are common as scattered individuals embedded in the calcite, or calcite-fluorite, filling of cavities. In Faraday, the crystals attain a length of 2 feet, and in Cardiff, individuals almost as large occur.

Lepidomelane

The lepidomelane variety of biotite occurs in Faraday in large amount and often in crystals of enormous size (18, No. 701). Plates have been secured measuring over 4 feet in diameter. The mineral is less common in the Cardiff dykes, but occurs in some amount in the massive pegmatite at the Richardson mine.

The Faraday lepidomelane has been described by Walker and Parsons (38). It is deep black in colour, and greenish-brown in thin films by transmitted light. The crystals possess good crystal form, but are frequently considerably pitted and corroded, possibly by fluorine vapours. The mineral contains over 2 per cent of fluorine, and fluorite is often present in the interstices between the crystals. Apatite crystals and small nodular masses of calcite are often enclosed within the crystals. The lepidomelane individuals from this occurrence are probably the largest on record.

Interesting specimens were obtained by the writer at this locality, showing feldspar undergoing alteration to mica. Incipient development of mica plates within the feldspar, and extending from a partly-formed mica crystal, is plainly shown. Similar examples of muscovite replacing feldspar have also been observed in a granite pegmatite in East Portland township, Que., where what appeared at first sight to be well-formed muscovite crystals, 2 to 3 inches in diameter, were found to be composed of a dull, "stony" material, possessing only traces of mica cleavage.

Magnetite

Magnetite is abundant at the Richardson mine, in Cardiff, where it occurs in large crystals, sometimes several inches in diam-

eter and exhibiting very perfect octahedral cleavage, and also in irregular masses, embedded in miarolitic calcite-fluorite. The massive material is frequently intergrown with uraninite, apatite or hornblende. Masses up to 200 pounds in weight are stated to have been found (23).

In Faraday, magnetite occurs more sparingly, as small isolated masses. Some of it has been altered to martite.

The Cardiff magnetite is stated by Ellsworth (23) to be titaniferous.

Molybdenite

Small amounts of flake molybdenite are stated to have been found in massive pegmatite at the Richardson mine, in Cardiff. As in the normal granite pegmatites, the mineral is rare.

Muscovite

Muscovite mica is comparatively rare in the pegmatites and was not observed in Faraday or Cardiff. Adams and Barlow mention (36) the occurrence of large crystals in a dyke on the first concession of Monteagle township, near Bancroft.

Nephelite

Nephelite occurs in small grains as a minor, rock-forming constituent of the massive pegmatite in Cardiff, and probably elsewhere in the district.

Pyrite

Pyrite occurs in small amount scattered through the miarolitic calcite and fluorite of Faraday and Cardiff. Crystals have not been observed, the material being in the form of small grains or shapeless masses. The concentrates made in the Mines Branch laboratories from a shipment of uraninite ore from the Richardson mine, in Cardiff township, proved to contain an appreciable amount of fine pyrite, although the ore itself showed but little macroscopic sulphide.

Pyrrhotite

Occurs in very small amount in the Faraday dyke, and also in Cardiff (23).

Titanite

Mentioned by Miller (40) and Ellsworth (23) as occurring in the massive pegmatite at the Richardson mine, in Cardiff. Microscopic titanite has been noted by the writer as an accessory constituent of the massive pegmatite bordering the fluorite workings on lots 8 and 9 in the same concession of Cardiff. The mineral also occurs in minor amount in the Faraday dyke.

Torbernite

Small plates of torbernite, seldom over 1 mm. in diameter, have been observed coating apatite in the main pit of the Richardson uraninite mine, in Cardiff township. In view of the large amount of apatite that accompanies the uraninite, and of the considerable degree of surface leaching that has taken place, secondary uranium phosphates are surprisingly scarce here.

Tourmaline

Ellsworth mentions (23) the occurrence of tourmaline in the massive pegmatite at the Richardson mine, in Cardiff township. It occurs in some quantity in the Faraday dyke, where stout, short, mis-shapen crystals, up to 2 inches in diameter, were found loose in a leached fissure-vug between the calcite-filling and wall of a miarolitic cavity. The tourmaline lay among the lepidomelane and feldspar crystals lining the wall of the cavity, and had evidently been deposited with these minerals. Like the mica and feldspar, it is severely corroded, and has apparently been attacked by fluorine vapours.

Uraninite

The pegmatite dyke at the Richardson mine, in Cardiff township, is remarkable for the amount of uraninite that it carries. Small occurrences of uraninite had been found at scattered outcrops on the property previous to 1929, and were described by Miller (40). These discoveries seem to have been made mostly in massive pegmatite, in which the uraninite is stated to have occurred associated with black mica, and often enclosed in mica "books." In 1929, however, a miarolitic cavity of unusual size was uncovered, which has proved to contain a considerable amount of uraninite in scattered crystals and irregular masses, embedded in a fluorite-calcite matrix.

The cavity in question possesses a proved length of 150 feet and is probably much longer, since outcrops occur for a fur her 350 feet along the strike; these, however, may be isolated, separate cavities and not part of the main pocket. The width of the main cavity ranges from 5 to 8 feet, while at one of the outcrops, the width between walls is 12 feet. The deposit thus approximates in character to a vein. It has a dip of about 45°. The occurrence has already been described by the writer, and its economic possi bilities described, in a recent paper (24).

The uraninite, which, as far as yet known, is the only radio-active mineral (outside of its minor alteration products) present in the deposit, occurs as well-formed crystals, or groups of crystals,

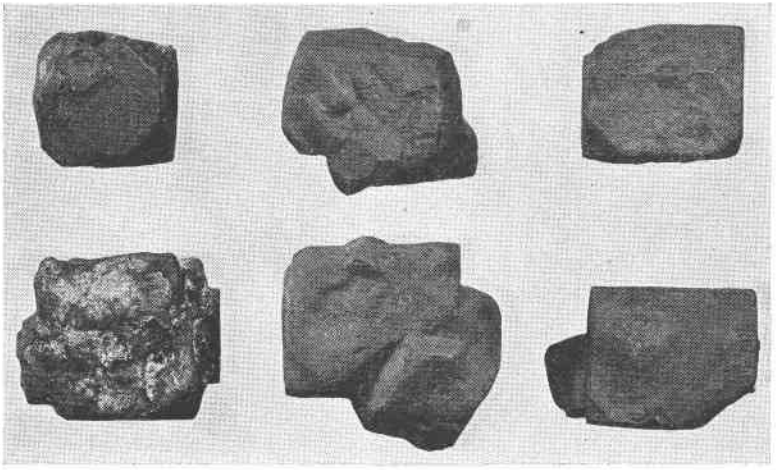

FIG. 3. Uraninite crystals from lot 5, concession 21, township of Cardiff, Ont. ($\frac{1}{2}$ Natural size).

and nodular lumps, embedded in the fluorite-calcite filling of the cavity. The crystals range from small forms $\frac{3}{8}$ inch in diameter to individuals measuring nearly 2 inches across (Fig. 3). They are of predominantly cubic habit, usually more or less modified by the octahedron. The faces are often somewhat pitted and indented, and perfect crystals are rare. The lumps range from small pea-like bodies to masses weighing several pounds.

Externally, the uraninite is usually rather severely altered to a soft, greenish-black substance (U_3O_8?). This alteration often penetrates to a considerable depth, and in some cases, the entire lump or crystal has suffered change. Nodules embedded in matrix are frequently seen to be surrounded by a thin film of red hematite. It should be noted that these observations on alteration have all been made on uraninite taken from within a short distance (20 feet) of the surface, no other material being yet available.

Under the microscope, the uraninite is frequently seen to enclose small grains, and sometimes also veinlets, of calcite, fluorite and pyrite.

Ellsworth has analyzed and described (23) this Cardiff uraninite, and it has also been described by Walker (22). The analyses show 61.64 and 69.71 per cent U_3O_8, respectively. The age of the pegmatite on the basis of Ellsworth's analysis, is 1,299 millions of years, while Walker has calculated it as 1,239 millions.

Uraninite has not been observed by the writer in any of the other dykes of the district, but Miller mentions (40) the occurrence of uranium minerals in a dyke in Monmouth township, about 9 miles southwest of the Richardson mine.

Uranothallite (?)

Thin incrustations of a yellowish-green mineral that has not yet been identified, but which may be uranothallite (hydrous uranium-calcium carbonate), occur coating uraninite crystals at the Richardson mine, in Cardiff.

Zircon

In contrast to the granite pegmatites, which often carry considerable amounts of the cyrtolite variety of zircon, the syenite pegmatites appear to contain only the fresh, unaltered form.

Zircon appears to be a common accessory constituent of the nepheline syenites of the region, as observed by Adams and Barlow (36, p. 252). It occurs in some quantity in the medium-grained pegmatite dyke-mass at the Richardson mine, in Cardiff township, in scattered, small, brown, prismatic crystals seldom measuring over $\frac{3}{8}$ by $\frac{1}{8}$ inches. It appears to possess a rather zonal distribution in the dyke, being abundant in some parts of it while not visibly present in others. It has not been observed as a cavity mineral.

APPENDIX

Comparatively little in the way of detailed mineralogic studies on the minerals that occur in other types of Canadian pegmatites has yet appeared in the literature. However, it may be of interest to enumerate briefly here, incomplete as the lists may be in some cases, the minerals that have been observed in certain types of pegmatites having a restricted regional development in various parts of Canada. The pegmatites here considered are:

(1) Tin-bearing pegmatites of New Ross, Nova Scotia.
(2) Mica-apatite pyroxenite pegmatites of Ontario and Quebec.
(3) Lithium pegmatites of southeastern Manitoba.
(4) Granite pegmatites of British Columbia.

(1) The Tin-Bearing Pegmatites of New Ross, Nova Scotia

The occurrences and the minerals of these dykes have been described by Faribault (41), and, more recently, by Walker and Parsons (22). The minerals are described as occurring in pegmatitic segregations in grey granite, the association resembling that at Branchville, Connecticut. The species identified comprise the following:

Albite	Galena	Pyrite
Amblygonite	Haematite	Pyrolusite
Apatite	Hübnerite	Quartz
Arsenopyrite	Kaolin	Scheelite
Beryl	Lepidolite	Siderite
Bismuthinite	Limonite	Sphalerite
Cassiterite	Magnetite	Topaz
Chalcopyrite	Manganapatite	Tourmaline
Columbite	Manganite	Wolframite
Durangite	Monazite	Zinnwaldite
Fluorite	Molybdenite	

(2) The Pyroxenite Pegmatites of Ontario and Quebec

These pegmatites, which have been extensively mined for the amber mica and phosphate that they carry, have a considerable development in the Ottawa region. They have been fully described in two reports of the Mines Branch (18), the earlier of which (No. 118) describes their minerals in some detail and contains a bibliography. Comparatively few of these associated minerals,

however, have been the subject of mineralogic study. Large diopside crystals from Hull township, Que., have been described by Walker and Parsons (21), and zircon from North Burgess township, Ont., by Palache and Ellsworth (42).

Probably the most noteworthy minerals yielded by dykes of this type are the enormous crystals of zircon and titanite that were found many years ago in the townships of Sebastopol and Brudenell, Ont. (23).

The list of recorded species from the dykes comprises the following:

Actinolite	Galena	Quartz
Albite	Garnet	Rennselaerite
Allanite	Goethite	Rutile
Anhydrite	Graphite	Scapolite
Anthraxolite	Hematite	Serpentine
Barite	Hornblende	Specularite
Celestite	Magnetite	Sphalerite
Cenosite (62)	Microcline	Spinel
Chabazite	Molybdenite	Steatite
Chalcopyrite	Natrolite	Titanite
Chlorite	Olivine	Tourmaline
Datolite	Orthoclase	Tremolite
Epidote	Prehnite	Vesuvianite
Faujasite	Pyrite	Wilsonite
Fluorite	Pyrrhotite	Zircon

(3) The Tin and Lithium Pegmatites of Southeastern Manitoba

The discovery of these pegmatites was made in 1924, and there has since been a small amount of mining development done upon them, chiefly for lithium minerals (18, No. 701) (43), and also for tin and beryl (61).

The occurrences resemble somewhat the lithium pegmatites of the Black Hills, in South Dakota. The following partial list of recorded minerals is a short one, but doubtless it will be considerably extended as further development of the deposits proceeds. It may be noted that the presence of germanium has been detected by Papish (44) in the topaz from the Silver Leaf mine (Fig. 4), and of rubidium and gallium in the deep purple lepidolite and brown zinnwaldite (?) from the same property.

Albite (cleavelandite)
Arsenopyrite
Beryl
Cassiterite
Columbite
Cookeite
Epidote
Fluorite
Ilmenite
Lepidolite
Lithiophilite
Magnetite
Montebrasite
Muscovite
Pollucite (trace)
Quartz
Sphalerite
Spodumene
Tantalite
Topaz
Tourmaline
Zinnwaldite (?)

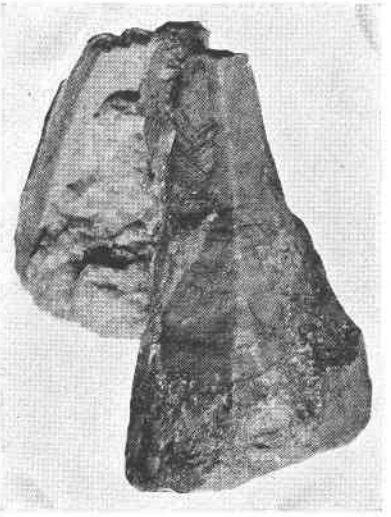

FIG. 4. Large, tapering crystal of topaz, with adhering massive topaz, from Silver Leaf mine, Winnipeg river, Manitoba. ($\frac{1}{2}$ Natural size).

(4) GRANITE PEGMATITES OF BRITISH COLUMBIA

The granite pegmatites here considered comprise a series of dykes that occur throughout a narrow belt extending from the Big Bend of the Columbia river to Fort Grahame, on the Finlay river, a distance of 400 miles. These dykes carry muscovite mica, for which a small amount of desultory mining has been conducted during the past 30 years. Their mineral association has not been studied in any detail, but the following species have been reported (18, No 701) (45), (46), (47):

Albite	Hornblende
Apatite	Microcline
Beryl	Muscovite
Biotite	Pyrite
Cyanite	Quartz
Garnet	Tourmaline

Of these minerals, possibly the most interesting is cyanite, a mineral that is not usually found in pegmatites. It occurs in some quantity in large, bladed crystals of typical cyanite form, and of a fine blue shade, in the pegmatites of the Tête Jaune district.

AUTHOR'S NOTE

The list of minerals recorded from pegmatites in various parts of the world is so large, and comprises so many interesting species—many of them known to occur, in mineralogically interesting form, at least, only in such rocks—that it is a matter of some surprise that no comprehensive work devoted solely to the pegmatites and their minerals has yet appeared. Many interesting papers dealing either systematically or individually with the pegmatite minerals of certain regions have been written, but these are so scattered through the literature as to be difficult of access. The compilation of a "Mineralogy of the Pegmatites," which would constitute a digest of such scattered information, should result in a volume that would fill a pronounced gap in our mineralogical literature. To the preparation of such a work, authorities in many countries would almost certainly be willing to contribute, by furnishing additional data, reference synopses, etc. It is, perhaps, not too much to hope that we shall, in the near future, see a treatise such as indicated, and that this will include a critical examination, in the light of world evidence, of the interesting replacement theory put forward for the pegmatites (of the United States) by Schaller (1b), and discussed by Hess (1a) and Landes (50).

In as far as the writer's own observations on the granite pegmatites of eastern Canada are concerned, soda-rich feldspar usually, though perhaps not invariably, surrounds such minerals as biotite, muscovite, tourmaline and beryl, and is particularly in evidence around the rare element minerals, allanite, cyrtolite, titanite, monazite, etc. Albitization of original microcline in such situation may, therefore, be presumed to have taken place.

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NOTES AND NEWS

MINERALS AT MANTON, RHODE ISLAND*

DUNCAN STEWART, JR., *Detroit, Michigan.*

INTRODUCTION. There is a small glaciated area in the vicinity of the town of Manton, Rhode Island, three miles to the west of the City of Providence, that is, geologically speaking, of a very complex nature. At Manton a quarry is located the rock of which is used for road material. Inasmuch as quarrying operations have produced a pit the geological and mineralogical problems can therefore be studied in considerable detail.

The general area is one of greatly metamorphosed igneous and sedimentary rocks. A pre-Cambrian quartzite is intruded by fine-textured greenstones, also of pre-Cambrian age. The greenstones are considered to be metamorphosed dikes and sills of either basalt or some other basic rock of similar nature. Intruded into the quartzite and the greenstones are dikes and stocks of granite of probably Devonian age. There are lenticular masses of marble and steatite in the greenstones. In the vicinity are also to be noted veins of quartz, quartz-tourmaline, quartz-epidote, calcite-epidote, talc-calcite, chlorite-calcite, and chlorite.

MINERALS RECORDED PREVIOUSLY IN THE AREA. In 1926 Messrs. L. W. Fisher and E. K. Gedney[1] listed the following twenty-eight minerals from Manton: actinolite, ankerite, apatite, asbestos, boltonite, calcite, chalcopyrite, chlorite, clinochlore, dolomite, enstatite, epidote, hematite, hornblende, limonite, magnetite, malachite, orthoclase, pyrite, pyroxene, pyrrhotite, quartz, rhodochrosite, rhodonite, serpentine, steatite, talc, and tremolite.

* A part of the thesis submitted in partial fulfillment for the degree of Master of Science in Brown University, June 1930.

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