

ON THE OCCURRENCE OF TIN IN NOVA SCOTIA.—BY HARRY
PIERS, Curator of the Provincial Museum, Halifax.

Read 18th May, 1908.

In the following notes I desire to place on record such particulars as are known regarding the recent interesting discovery of tin ore *in situ* in Nova Scotia.

Tin supply and demand.—New sources of tin ore are being eagerly looked for throughout the world, and every new find immediately attracts attention; for when we consider the large and yearly increasing consumption of tin, and the limited sources of supply, we readily see that the supply is now not equal to the demand, and new deposits must be looked for. During the year 1907 the average price of tin in New York was about 38 cents per pound. In 1903 the average price was 28 cents. With the exception of the Cornish mines, nearly all the world's production of tin is obtained from alluvial deposits and not from vein formations. Over half of the world's production comes from the alluvial deposits of the Malay States. Owing to the high price of the metal, it is possible to work very low-grade ores, if in quantity. If a vein contain but one per cent. of metallic tin, with the metal at 38 cents a pound, it would make an ore worth \$7.60 a ton, and should be a profitable proposition if the deposit was of sufficient size.

In North America tin has been found in Maine, New Hampshire, Massachusetts, North and South Carolina, Virginia, Alabama, South Dakota, Texas, California, Alaska, Mexico, and in the Yukon in Canada, and it has been detected by analysis in small quantities elsewhere. In the United States, with the exception perhaps of Alaska, the deposits found in North and South Carolina are the only ones lately discovered

that have offered any chance of becoming commercial producers of tin. In Carolina the ore mostly occurs in pegmatite dikes, etc., in a wide area of schist (probably of Cambrian age), bordered by granite on one side and gneiss (probably Archæan) on the other.*

Previous occurrences in Nova Scotia.—In tracing the reported finds of tin in Nova Scotia, we learn that some time previous to 1869, W. Barnes is said to have discovered tin in a granitic sand, composed of grains of quartz and feldspar, at Tangier, Halifax county; and John Campbell is said to have found it at Shelburne.† Dr. E. Gilpin also obtained it in panning gold at Tangier. It has likewise been reported from Country harbor, Guysborough county.‡ I have also been informed on good authority (Dr. E. Gilpin) that it was found in a granite boulder near Rawdon, Hants county. All of these finds were in connection with drift material derived from granite areas, none of which was traced to its original source.

I may say that since the discovery at Lake Ramsay, now to be described, tin has been reported to me as found in small quantity and determined by test at two other localities in Nova Scotia, but at present I am not at liberty to give further information thereof.

Tin at Lake Ramsay.—For some years past, two or three persons have been employed in prospecting for tin in Nova Scotia, and from time to time suspected samples have been brought to the Provincial Museum, which mostly proved to be sphalerite or zinc-blend, or tourmaline. One of these prospectors who has been longest in the field, is Charles Keddy, of Lake Ramsay, to whom further reference will soon be made.

During the summer of 1906, pieces of quartz crystal were discovered on the surface of John Reeves's land, in woodland a few hundred yards south-westward of his house, and about

* Pratt (J. H.) and Sterrett (D. B.). Tin deposits of the Carolinas. N. Carolina. Geol. Sur., Bul. 19 (1904).

† How (H.). Mineralogy of N. S., 1869, p. 78.

‡ Gilpin (E.). Minerals of N. S., 1901, p. 60.

$\frac{3}{4}$ th of a mile south of the Dalhousie road, and about $\frac{1}{4}$ th of a mile south-south-west of the southern extremity of Lake Ramsay, to the west of New Ross, 16 miles inland from Chester Basin, Lunenburg county, N. S. With the expectation of finding diamonds, Mr. Reeves and a neighbor, Benjamin Meister, dug a shallow pit where the crystals were observed, and soon were in a deposit of white kaolin in which occurred large crystals of quartz, mostly with a faint smoky tint, and also a little purplish-black fluorite. Specimens of these minerals were first brought to the Provincial Museum on 29th August, 1907, and other samples subsequently.

Charles Keddy, the prospector before-mentioned, examined the material thrown out by Reeves and Meister in the course of their operations, and found a few small pieces of a heavy, dark-colored mineral which he brought to the museum in the middle of October, 1906. This proved to be cassiterite (tin oxide), a mineral which, when pure, contains theoretically 78.6 per cent. of metallic tin. This was the first discovery of tin ore *in situ* in Canada in anything approaching economic quantity, and the first discovery of it *in situ* in Nova Scotia. Mr. A. L. McCallum, assayer of Halifax, produced a button of metallic tin from Keddy's samples. This interesting button is now in the museum. Upon discovering the character of his find, Keddy took up the property on 22nd October, under a license to search, in the names of John Reeves, Benjamin Meister and Charles Keddy of Lake Ramsay, and E. E. Bishop of Halifax. Since then I understand Reeves's and Meister's shares have been transferred. No work was done on the prospect for the rest of the year, owing to the lateness of the season and lack of harmony among those interested.

As the find was one of unusual interest, I was directed by the inspector of mines to make an examination of it, and proceeded to the locality accompanied by M. H. McLeod of the Geological Survey, who wished to obtain samples for that

department. On the way there a snowfall unfortunately occurred which covered all exposures. I visited the deposit on 29th November, and found a small pit, about 12 feet long by 5 feet wide and 10 feet deep. The hole was nearly three-quarters full of water, and this with the mantling of snow, made it impossible to make a satisfactory examination. From what could be seen under these unfavorable conditions, the country-rock was apparently an ordinary grey granite, consisting of quartz, white feldspar and mica. I noted masses of reddish granitic rock, perhaps a half-mile eastward on the Dalhousie road, and it was also reported at Lake Ramsay, but it seemed to have no connection with the deposit at Reeves's. I could not hear of any sedimentary rocks in the neighborhood, the nearest rocks of this kind being about two miles to the north-west towards Wallabach lake. None were associated with the tin deposit.

It was found that the cassiterite occurred in small quantities in either a dike or a schlieren of coarse pegmatite, becoming aplitic in parts, cutting or segregated from the ordinary granite. The pegmatite mass apparently had a nearly vertical attitude, and if the length of the hole indicated the strike of the deposit, as it undoubtedly did, it lay in a north-east and south-westerly direction. How far the pegmatite extended in either direction horizontally, or how it changed in character in those directions could not be ascertained, and I recommended that the surface be stripped at intervals on the strike that this might be ascertained if possible, in preference to continuing to sink for the present in the pit.

The feldspar in the upper parts of the deposit had decomposed to kaolinite, some portions of which were of fair quality and colour. In the deeper part of the pit the rock was becoming less altered. In the kaolin and unaltered feldspar were numerous immense crystals of quartz, of a slightly smoky tint, unfortunately not sufficiently transparent to make them of com-

mercial value. The largest of these crystals, which is now in the museum, with two others nearly as large, measures 27 inches in length by 10 inches in thickness. These are by far the largest quartz crystals ever found in Nova Scotia, and they bear favorable comparison with large crystals found elsewhere in America.

Mica was not as abundant as I had expected, as I supposed it might have been segregated into large masses commensurate with the size of the quartz and feldspar crystals. Such possibly may yet be found to be the case in another part of the deposit. Most of the mica, especially in the more aplitic parts, is a lithia mica, probably lepidolite, sometimes with a delicate lilac-pink tint.

The cassiterite occurred in small quantities in the kaolinite, as far as shown by the material then taken out, although it was hoped that elsewhere in the deposit it might be found more largely segregated. It could not be ascertained if the ore occurred specially in any particular part of the deposit or in a pay-shoot.

Associated with the pegmatite and kaolinite were also purplish-black fluorite, amblygonite of a beautiful light blue color (the first time this mineral has been discovered in Canada), black tourmaline, wolfram, tungstite, scheelite, molybdenite, etc.

Subsequent to my visit another dike or vein carrying tin was reported to have been found near the main road, not far from the first locality.

From samples brought to the museum, I find that some of the grey and reddish granites near Lake Ramsay carry small amounts of chalcopyrite or pyrite; and small vugs in some of the reddish granitic rocks contain deposits of purple fluorite as well as the sulphides. Slender crystals of transparent tourmaline with a dark outer shell occur in a hematite-coated quartz boulder from the shore of Lake Ramsay. Ordinary

black tourmaline occurs in the granite of the district. Sphaerite has also been brought to me from the district, as well as a small gold specimen in quartz said to occur in the granite of Lake Ramsay. About one and a half miles eastward of the tin deposit, is an interesting occurrence of molybdenite in a dike or vein in granite on Larder river. At Wallabach lake, to the north-west, is a well-known deposit of manganese ore in a fissure in granite, which has been rather extensively mined in the past.

A report on the discovery of tin at Lake Ramsay was made in the Museum Report for 1906, and the find immediately attracted attention, and enquiries regarding the deposit were received from the United States and elsewhere.

In May, 1907, Mr. W. F. Ferrier, formerly a member of the staff of the Geological Survey of Canada, visited the locality in company with Mr. A. A. Hayward, president of the Mining Society of Nova Scotia, and brought away samples which are now at the museum. Work at sinking was then in progress under charge of Neil A. King, who had acquired an interest therein. In June, July and September, Mr. McIntosh of the Geological Survey visited the deposit to watch developments, and in August Mr. E. R. Faribault examined it, the hole then being 18 feet deep, 12 feet long and 10 feet wide; and in October and November Mr. R. A. Johnston of the survey was there, on the last occasion accompanied by Dr. G. A. Young of the department, who has special knowledge of igneous rocks. The pit was then about 20 feet deep.

Mr. Faribault reported on the deposit in the *Summary Report of the Geological Survey* for 1907, pp. 80-83,* and Dr. Young in the same report, p. 77.† The former states that there is no well-defined foot- or hanging-wall. The strike, he says, is N. 65° E. and the dip is to the north-west at an angle vary-

* Faribault (E. R.). New Ross tin deposits. Sum. Rept. Geol. Surv. Canada, 1907, pp. 80-83.

† Young (G. A.). The tin-bearing locality at New Ross, N. S. Sum. Rept. Geol. Surv. Canada, 1907 p. 77.

ing from 75° at the surface to 60° at the bottom of the pit. The outcrop is about 8 feet wide and 12 feet long, but at one end at least it extends farther to the north-east under a cap of granite. The deposit, he continues, appears to be what is often called by miners a 'blow-out,' and is probably the result of deep solfataric action, and it should extend to a great depth. He considered that the results so far should be considered very satisfactory and warrant much greater development.

I had hoped that additional surface work might prove that the pegmatitic cassiterite-bearing rock extended to some distance, as is the case in most dikes, but Dr. Young reports that at the time of his visit a certain amount of stripping in the immediate neighborhood had failed to disclose further outcrops of the tin-bearing body, which seems to be of the nature of an irregular, acid schlieren, closely connected in origin with the containing muscovite granite. He says the light-colored muscovite granite with which the cassiterite-bearing pegmatite is associated, was seen at a number of points in the neighborhood and appears to be cutting a coarser-grained biotite granite.*

Much activity followed the discovery of tin-ore at this place, and several pegmatite dikes, etc., near New Ross were located and prospected. The Geological Survey found traces of tin in small specimens from a pegmatite dike, 24 feet wide, a mile north of Nevertell lake, six miles south of Reeves's place. Bismuthinite and molybdenite were discovered in a silicious and aplitic dike or vein, one mile south of New Ross corner; and tungston ores and rare earths were found in a dike of pegmatite, 20 feet wide, one mile east of New Ross Corner, on land taken up, on a license to prospect, by Dr. Lavers and Frank Boylen of New Ross.

Associated minerals.—As a result of the examination made at the survey's laboratory, by Mr. R. A. A. Johnston, of material from all the deposits in the granites of the vicinity of

* Young (G. A.). *Loc. cit.*

Lake Ramsay and New Ross, the following unusually long list of minerals have been detected in varying quantities:—Cassiterite, monazite, one of the columbite minerals, durangite, amblygonite, a lithium mica (probably lepidolite), wolframite, scheelite, hübnerite, molybdenite, sphalerite, beryl, apatite, tourmaline, fluorite, pyrolusite, manganite, limonite, hematite, magnetite, siderite, bismuthinite, argentiferous galenite, chalcopyrite, pyrite, arsenopyrite, kaolin, and crystals of light and dark smoky quartz.* Some of these are rare minerals which have a use in the arts and command a large price. Amblygonite and durangite are new to Canada.

Concentration test.—On 6th August, 1907, a sample of the material from the deposit at Reeves's pit at Lake Ramsay, consisting of 14 bags, each weighing about 300 lbs., was received by Professor Frederic H. Sexton, director of technical education, Halifax, from Neil A. King, in order that a test thereof might be made. This lot of ore was stated to have been taken directly across the deposit (about 12 feet wide), from wall to wall, at a depth of 18 feet, and represented the average ore that could be extracted from the pit at that depth. The lot was just as it had been taken from the pit, except that the large crystals of quartz had been picked out, and it was said that about one-fifth to one-sixth of the bulk of the ore in quartz crystals had thus been removed by hand-picking. Professor Sexton reports that the ore consisted for the greater part of transparent vitreous quartz, quartz crystals, a soft friable lustrous greenish feldspar, and soft kaolin from the decomposition of the feldspar by weathering agencies. Some lumps were stained a dark red, indicating the weathering of pyrites, and Mr. King said that such material contained the most tin. Muscovite in small crystals was sparsely distributed throughout the ore. Sprinkled through the ore were small dark crystals of tourmaline and almost black fluorite. Cassiterite was not identified in any of

* Faribault (E. R.). *Loc. cit.*

the lumps inspected. Some of the fluorite occurred in dendritic form.

A sample of five bags was selected for treatment, whose combined net weight was 1403.94 pounds (637 kilos). The results of the concentration and assays are thus summarized by Professor Sexton, in his report dated 4th September, 1907:

(a) The original ore as sampled and assayed contained only a trace of tin.

(b) 543.2 pounds of product through 4 on 8 mesh were treated on a Collom jig with no resulting concentration whatever. An assay of the material fed showed a trace of tin.

(c) 310.8 pounds of product through 8 on 16 mesh were treated on a Collom jig and only a very thin layer of about $\frac{3}{8}$ th inch on the first sieve showed signs of being concentrated material. This layer when separated by skimming was found to consist mostly of included grains of quartz and feldspar, with fluorite and tourmaline, and when this product was assayed it was found to contain tin, but in such small quantity that it could not be weighed.

(d) 257.3 pounds of product through 16 mesh sieve was treated on a half-size Wilfley table, making a small amount of impure heads containing 0.583 per cent. of tin, a very small amount of very impure tailings containing 0.08 per cent. of tin, and about 237.81 pounds (107.9 kilos) of clean tailings containing no tin at all. A calculation of the tin in the whole product fed to the Wilfley table showed it to contain 0.0192 per cent., a very small amount indeed.

Professor Sexton concludes that the percentage of tin present in the ore supplied to him is so small as to make the working of such ore as a whole unprofitable; and he thinks that the cassiterite must exist in the form of minute flakes and crystals in the ore, and in small quantity. He recommends the locating, by careful inspection and assays, of some ore-shoot which contains enough tin to make practical mining profitable, for it will

evidently not pay to mine the whole width of the pegmatite material (12 feet) because of its paucity of tin.

This proper method of concentration of this tin ore is direct graded crushing and concentration on a fine sand concentrator such as a jerking table like the Wilfley pattern.*

Conclusions.—Professor Sexton's test indicates that the whole width of the dike, at that depth, is low in tin contents, and an effort should be made to discover if the cassiterite is segregated in any one part of the dike, as is quite likely, in which case the percentage would be increased in the portion of the dike that might be mined. Numerous pieces of ore, about the size of a hazel-nut, have been obtained and are in the Provincial Museum, but it is not known from what part of the deposit they were taken. The presence of an ore-shoot should be ascertained if possible. It must be remembered that some of the associated minerals are valuable for various purposes, and bring excellent prices in the market, and if some of them are proved to be in sufficient quantity might be even more profitable than the tin, or at any rate might be worked conjointly with that ore, and so make a profitable proposition. So far these associated minerals do not seem to have attracted the attention of the owners, although they much merit consideration.

I would suggest that the gravels and sands of the low-lying districts about New Ross and other favorable localities on or adjoining the granitic areas of Nova Scotia be carefully examined for the occurrence of stream tin, as such alluvial deposits might be found to be more valuable than those *in situ*. Pegmatite dikes in granite and in the adjacent sedimentary metamorphic rocks of the gold-measures, particularly such dikes as contain boron and fluorine minerals, such as tourmaline, fluorite, etc., and also lithium-bearing minerals, should be

* Sexton (F. H.) Report on concentration test on tin ore from New Ross. 4th Sept., 1907. Manuscript.

closely examined.* In the neighborhood of New Ross, the vicinity of the sedimentary rocks, adjoining the granite, towards Wallabach lake, might well be prospected.†

It may be noted that sphalerite and tourmaline are sometimes mistaken for cassiterite, as I have found the case in Nova Scotia, but the unusual weight and hardness of the latter will probably be the readiest way for the prospector to roughly distinguish the mineral in the field. At Lake Ramsay the prospectors have often mistaken wolframite for tin ore. Cassiterite may be determined by the blow-pipe, by taking a small quantity of the mineral, very finely powdered, thoroughly mixing it with six or eight times its volume of sodium carbonate (baking soda) and a little powdered charcoal, and fusing this mixture on charcoal before the blow-pipe with the reducing flame, when a button of metallic tin will result.

* Prospectors might well examine, for traces of tin, the reported chalcopyrite-bearing granite of the Alton road which leads north from the Dalhousie road.

†On 24th June, 1908, there was received at the Provincial Museum from Dr. Henry W. Cain, a specimen of cassiterite with chalcopyrite, pyrite and sphalerite from a vein-like deposit in granite on the north-west side of Wallabach stream, (a branch of Gold river,) about half way between Camp and Harris Lakes, and nearly 1 mile south-west of south end of Wallabach Lake, on farm of Henry Meister, 3½ miles north of New Ross, Lunenburg Co. It was reported that the deposit had been found late in the summer of 1907, by Ernest Turner of Mill Road, New Ross, and the rights are now held by Mr. Turner, Mr. Meister, and Dr. Cain. Other specimens brought in later contained a little epidote and talc. Ore from this deposit assayed by A. L. McCallum of Halifax, gave the following result: silica (Si O₂), 2.50%; cassiterite (Sn O₂), 47.00%; chalcopyrite (Cu Fe S₂), 38.00%; Zinc (Zn), 12.25%. This ore differs in character from that at Reeves's.