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MANGANESE OCCURENCES IN CANADA

(Preliminary Report and Metallogenic Map 15-1964)

A. G. Johnston and W. D. McCartney

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ABSTRACT

Manganese occurrences in Canada are individually summarized with references, and their positions and simple geological classifications are shown on a metallogenic map with subdued geological base on a scale of 1:7,603,200. Localities that yielded some production, and some areas known to contain large deposits of low-grade material of possible future value, are distinguished from other occurrences. Canadian production has totalled about 50,000 short tons of ore. No manganese is currently being mined, and large deposits of present ore grade are not known.

Numerous occurrences in British Columbia are associated with pre-orogenic volcanic rocks of late Palaeozoic to early Mesozoic age, and manganiferous gangue minerals occur in some metalliferous deposits. Early Palaeozoic, pre-orogenic sediments in the Canadian Appalachians contain bedded manganese deposits, which for the most part show no relationship to volcanism. Mississippian limestone in post-orogenic clastic sediments contains numerous manganese occurrences in Nova Scotia and New Brunswick. Deposits in the Canadian Shield are less abundant but include manganiferous iron formation and manganiferous gangue minerals in metalliferous veins.

MANGANESE OCCURRENCES IN CANADA

INTRODUCTION

This preliminary report and accompanying metallogenic map record the known distribution of manganese in Canada as related to major geological features and provide, where possible, one or more selected references for each deposit. No field or laboratory studies were made, thus these references were freely drawn upon to prepare the brief property descriptions included in this report. Simple geological types of manganese mineralization are separated on the map by various symbols. One number on the map may represent more than one symbol, and one symbol may represent either a single deposit or a number of deposits in a compact group. Some minor occurrences of mineralogical or academic interest are tabulated. Locality numbers in the text correspond to those on the metallogenic map (in pocket).

A.G. Johnston compiled the map and data used, W.D. McCartney is responsible for geological interpretations, and both collaborated on problems of general and particular geological classification and property descriptions. Sources of information to the end of 1963 were checked.

PRODUCTION, USES, AND TECHNOLOGY

World production of manganese ore (30% or more Mn) in 1962 was an estimated 15,590,000 short tons[1] (in DeHuff and Fratta, 1963)[2]. The chief producers were Russia, Republic of South Africa, India, China, Brazil, Ghana, and Morocco.

The United States, as the largest consumer, imported 1,971,232 tons of manganese ore in 1962; her domestic production during the same year was 24,758 tons.

Canadian imports[3] of manganese ore have fluctuated in the 1950-1962 period from 222,082 tons in 1951 to 42,060 tons in

[1] Short tons are used in this report.
[2] Names and/or dates in parentheses refer to publications listed in the References.
[3] Dominion Bureau of Statistics.

1958. The 1962 imports totalled 90,725 tons of manganese ore; ferromanganese, 14,986 tons; and silicomanganese, 2,727 tons.

Canadian manganese deposits by present standards are, with few exceptions, either too small or too low-grade to be of commercial value. Small amounts of manganese ore, however, were recovered in the past from bogs (about 4,600 tons) and bedrock deposits (about 42,000 tons). Pleistocene glacial erosion has probably removed large deposits of enriched, oxidized material that might have existed in the past.

Beneficiation and/or electric smelting or electrolytic manganese production from large, low-grade manganese deposits appears to be the most likely future source of manganese in Canada. The two largest low-grade deposits are believed to be the manganiferous carbonate and shale beds in basal Middle Cambrian sediments in Conception Bay, southeast Newfoundland (locality 101) and the Silurian manganiferous hematite-slate beds near Woodstock, New Brunswick (locality 67). Beneficiation and electro-metallurgical tests on both deposits have been undertaken.

A simplified tabulation of some classes of manganese ore and their uses is given in Table 1. Further information on some of these factors is given by Johnstone and Johnstone (1961).

TABLE 1

Classification of Manganese Ores and Uses

Class of Ore		Per cent Mn in Ore	Metallurgical product	Per cent Mn in product	Use	Per cent of Mn production consumed by each industry
Manganiferous ore (5-35 per cent Mn)	Manganiferous iron ore (5-10 per cent Mn)	5 - 10	Manganiferous pig iron		Metallurgy of steel, alloy and foundry work	95
	Ferruginous manganese ore (10-35 per cent Mn)	20 - 35	Spiegeleisen	26 - 28		
Manganese ore (35 per cent or more Mn)	Metallurgical grade (usually greater than 48 per cent Mn)	Greater than 35	Silicospiegeleisen	25 - 30		
			Silicomanganese	50 - 75		
		Usually greater than 48	Ferromanganese	75 - 85 90 - 95		
		May be low grade	Manganese metal	95 - 99.9		
	Battery grade	Usually greater than 70 per cent MnO_2. Suitability depends upon the purity and form in which the manganese ore occurs			Dry batteries	5
	Chemical grade	Usually greater than 75 per cent MnO_2. Grade for fertilizer use can be much lower			Drier for paint and varnish, colouring agent in ceramics, decolourizer in glass making, manufacture of manganese chemicals including manganese sulphate fertilizer	

A list of the more common manganese minerals and their compositions follows:

TABLE 2

Common Manganese Minerals

Mineral	Ideal Composition	Manganese Oxide Content of Mineral Samples (per cent)
Oxides		
Pyrolusite	MnO_2	to 98.72 MnO_2
Manganite	MnO (OH)	79.55 to 80.66 MnO
Psilomelane	Ba Mn $Mn_8O_{16}(OH)_4$	66.35 to 80.19 Mn_2O_3
Wad	Chiefly hydrous manganese oxides	7.61 MnO to 68.36 Mn_2O_3
Hausmannite	Mn Mn_2O_4	83.40 to 93.01 MnO
Carbonates		
Rhodochrosite	$MnCO_3$	30.17 to 61.71 MnO
Manganiferous siderite	(Fe, Mn) CO_3	1.12 to 23.86 MnO
Silicates		
Rhodonite	$MnSiO_3$	29.20 to 50.54 MnO
Braunite	$3Mn_2O_3 . MnSiO_3$	80.23 to 81.42 MnO
Spessartite	$Mn_3Al_2(Si_3O_{12})$	25.96 to 39.83 MnO

(Data mainly from Dana's System of Mineralogy by C. Palache, H. Berman, and C. Frondel, Seventh Edition, volumes 1 and 2, John Wiley and Sons.)

GEOLOGICAL CLASSIFICATION

Manganese deposits of Canada in the present classification are grouped according to physical characteristics, stressing genetic aspects where possible. The classification is necessarily restricted by the lack of field and laboratory study and by the scale of the metallogenic map used.

Stratified deposits of sedimentary origin

1. Bedded sedimentary deposits
2. Sedimentary iron deposits containing minor manganese
3. Bog deposits

Unstratified deposits

1. Mainly epigenetic metallic deposits with manganiferous gangue
2. Veins, lenses, stringers, nodules, disseminations.

The unstratified deposits are of two types. The first comprises mainly metallic mineral deposits as veins or irregular replacement deposits with manganiferous gangue minerals. These were probably introduced into the enclosing rocks with no apparent relationship to sedimentary processes. The second type comprises lenses, veinlets, nodules and disseminations of manganese minerals which are commonly confined or most abundant in particular beds, but which have unproven relationships to sedimentation. The two principal groups of the latter deposits are those found in cherty sediments associated with eugeosynclinal mafic volcanic rocks of Late Carboniferous to Triassic age in southern British Columbia, and the quite different deposits in post-orogenic Mississippian (Windsor) limestone in Nova Scotia and New Brunswick.

The British Columbia occurrences have been described as both sedimentary and epigenetic by various authors. Fyles (1955, pp. 66, 67) considered that structural and textural features in the Cowichan Lake deposits indicated either epigenetic replacement origin or simply a redistribution of manganese of sedimentary origin. He concluded by stating: "General features of the deposit and their similarity to others known to be of sedimentary origin, however, has led the writer to believe that they are metamorphosed sedimentary deposits". This conclusion is probably applicable to many deposits in similar rocks in British Columbia.

The deposits in Windsor limestone in New Brunswick and Nova Scotia are markedly concentrated in this particular limestone, suggesting a sedimentary relationship. On the other hand, no well-bedded occurrences of manganese minerals in this limestone are known to the writers and structural control seems to have been equally important as stratigraphic control for the manganese concentration. As well as manganese, numerous barite, siderite, and galena-sphalerite deposits occur in the same limestone. This suite of minerals is believed by the writers to be interrelated and localized by east-trending major faults, local faults and folds, and the Windsor-Horton contact.

In the classification used here, the weathering products of manganese occurrences have been included with the geological type of the unweathered bedrock deposit. Such supergene products are normally thin in Canada, although surface enrichment of primary manganese silicate or carbonate yielded economic ore at Cowichan Lake, British Columbia (locality 24). Locally, residual clay with manganese oxide nodules is developed from the weathering of Windsor limestone in Nova Scotia, but these deposits are extremely thin compared to similar clays in the eastern United States.

GEOLOGY, DISTRIBUTION, AND METALLOGENY

The distribution of manganese occurrences is shown on the metallogenic map (in pocket); the concentration of known occurrences in the Appalachian and southern Cordilleran regions is readily apparent on this map. Further information is summarized in Table 3.

To compare the geological relations of possible or proven sedimentary deposits of manganese in Canada, one must consider the geologic age, lithology, and the tectonic setting of the enclosing rocks. In general terms, conditions favourable to the deposition of manganese seemed to prevail early in the history of a geosyncline when mafic volcanic rocks, greywackes, and cherts were being deposited. Cherts deposited in this tectonic setting are commonly ferruginous and/or manganiferous. This early tectonic stage occurred mainly in Ordovician-Silurian time in the Appalachians and in roughly Late Carboniferous to Triassic time in the Cordilleran

TABLE 3

Summary of the Geological Environment of Manganese in Canada

Tectonic Stage	Tectonic Events	Age in Appalachians	Appalachian Examples	Localities	Age in Cordillera	Cordilleran Examples	Localities
(Recent)	(Post-glacial development of bogs and springs)	Recent	Numerous bog deposits, which are commonly associated with springs	76, 83, 98, 104	Recent	Kaslo area bog deposit	32
Final	Plateau basalts and clastic terrestrial sediments	Triassic	Manganese oxide cement in conglomerate	85	Tertiary	Manganite in basalt breccia	7
Final	Various continental sediments, commonly coal-bearing	Pennsylvanian	Not known		Upper Cretaceous	Not known	
Late	Marine carbonate and evaporite beds in Appalachians (Windsor) underlain by sandstone and shale (Horton) Dominantly clastic beds in Cordillera	Mississippian	Numerous manganese oxide pods, nodules and disseminations in Windsor limestone	67, 80, 82, 83, 84, 86, 87, 94, 102	Middle Cretaceous	Not known	
Middle	Uplift and intense folding accompanied by batholithic intrusions	Middle Devonian and earlier	Fissure vein in Devonian granite. Age and origin uncertain	89	Lower Cretaceous and Jurassic	Manganiferous gangue minerals in quartz and/or carbonate veins, commonly with metallic minerals. Some may be post-Jurassic	6, 10, 11, 12, 26, 33, 35
Early	Less volcanism than in initial stage	Silurian	Manganiferous slate	71			
Initial a) Eugeosynclinal	Mafic submarine lava flows with siliceous shale, jasper, greywacke, tuffs. Minor carbonate	Ordovician	Ferruginous and manganiferous cherts and siliceous slate	71, 75, 109	Triassic to Mississippian	Manganese minerals in cherts and in volcanics	8, 9, 13, 15, 20, 23, 24, 25, 28, 32
			Veinlets in slate	69			
b) Miogeosynclinal	Sandstone and slate southeast of eugeosyncline in Appalachians.	Ordovician and Cambrian	Manganese carbonate in shale Spessartite and other manganese minerals in sandstone, quartzite, and schist	111, 112, 113, 115 88, 93, 96, 99, 101			

Deposits in early Palaeozoic rocks in the Cordillera include manganiferous carbonates in silver or gold deposits (localities 4, 17).

Deposits in the Canadian Shield occur for the most part in late Precambrian (Proterozoic) rocks (localities 2, 3, 46, 47, 48, 56, 58, 59, 60, 61, 63, 64).

area[1]. Canadian sedimentary or suspected sedimentary deposits in the Cordilleran and Appalachian areas roughly conform to this distribution in the early history of the geosynclines, but each show some peculiar features.

The Lower Palaeozoic manganiferous beds in the Canadian Appalachians are known in various parts of the early geosyncline and range in age from basal Middle Cambrian to Silurian. Many of these deposits lie east of the principal belt of early tectonic, mafic volcanism. Deposits typical of the volcanic association include Ordovician manganiferous and ferruginous cherts at Notre Dame Bay, Newfoundland (locality 109), siliceous slates containing manganese and iron near Woodstock, N.B. (locality 71), and with cherts at Birch Island, N.B. (locality 75). East of the volcanic (eugeosynclinal) belt, Middle Cambrian manganiferous carbonates in shale are widespread in southeast Newfoundland in a thick assemblage of shale, slate, and minor limestone (localities 112, 113). Local areas of slightly younger Middle Cambrian submarine volcanism are known in the same area, and Cambrian volcanic and clastic sediments occur in Cape Breton. Cambrian rocks are covered in the central belt of the Appalachians, thus Cambrian tectonic events in the geosyncline there are poorly understood.

Ordovician deposits about 200 miles east of the principal belt of contemporary volcanism include slightly manganiferous, oolitic iron ores at Wabana, southeast Newfoundland, and manganese deposits in Ordovician sediments at scattered localities in Nova Scotia southwest from the Canso area (localities 93, 99, 101). At present, not enough detailed stratigraphic or fossil evidence is available to define more clearly the age relations of these deposits. Because manganiferous shales are susceptible to conversion to spessartite-bearing slates at a fairly low grade of regional metamorphism (biotite zone), many of the manganiferous beds in eastern Nova Scotia now contain spessartite.

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[1] It is not considered relevant that Mississippian Windsor limestone, which contains numerous manganese deposits, was deposited in the Maritime Provinces at the same time as some of the manganiferous cherty rocks formed in British Columbia. The former rocks are post-orogenic and much younger in a tectonic sense than the early tectonic rocks of the same geological age in British Columbia. The tectonic equivalent of the Carboniferous sediments of the Appalachians would be roughly Late Cretaceous and younger beds in British Columbia.

Manganese occurrences associated with rocks formed early in the last tectonic cycle in British Columbia are confined to the Cache Creek and Sicker Groups and to similar rocks, which comprise cherts, cherty quartzites, limestones, and mafic volcanic rocks of Late Palaeozoic and Triassic age. An unusual feature of these rocks in both southern and northern British Columbia is the lack of reported ferruginous cherts and the apparent restriction of manganese occurrences to the southern part of British Columbia. These manganese silicates and/or oxides commonly fill small fissures and fractures in the cherty beds or occur as lenses or irregular masses in cherty tuff. Although opinions differ, the writers believe that the manganese was originally deposited with the enclosing rocks.

Post-orogenic sediments that contain numerous manganese occurrences are not known in British Columbia, but are well represented in Mississippian beds in Nova Scotia and New Brunswick. These beds and associated occurrences lie north of Sussex, New Brunswick (locality 83), in the Minas Basin, Nova Scotia (localities 85 to 88), and in the lowland region of Cape Breton Island (locality 102). Similar deposits are found on the Magdalen Islands (locality 67). Although the contact of the Windsor limestone with Horton sandstone is a well-defined stratigraphic control for many of these occurrences, no descriptions of well-bedded manganese minerals have been found and the manganese oxides normally form irregular, lenticular bodies and fissure fillings. Manganese is markedly more common near east-trending faults and shows roughly the same distribution as numerous barite, siderite, and galena-sphalerite occurrences. Thus the writers are uncertain whether sedimentary or epigenetic-structural controls dominate this type of manganese deposition.

Vein deposits of manganese oxides can form under surface conditions by the oxidation of primary minerals in sediments, followed by the local migration of manganese to adjacent cracks and fissures, or by oxidation in place of epigenetic veins of manganese carbonate. The New Ross, Nova Scotia vein deposit in faulted Devonian granite may be an example of the latter type.

Epigenetic deposits of metallic elements in which manganese-bearing minerals form part of the gangue are most abundant in southern and central British Columbia. These are considered Jurassic or younger in age.

Bog manganese deposits, which normally include limonite admixed with peat and vegetation, are commonly found near the outlet of springs in the Appalachians. Bog deposits at Dawson Settlement, New Brunswick (locality 83), and Kaslo Creek, British Columbia (locality 32), were formerly exploited.

DESCRIPTION OF OCCURRENCES

NORTHWEST TERRITORIES

Locality 1. O'Connor Lake

Reference: Lord, C.S.; Manganese (No. 2) deposit, O'Connor Lake Mining Corporation Limited, N.W.T., unpublished report, 1942, on file, Geol. Surv., Canada.

Blue-black manganese oxide stains and crusts up to 1/2 inch thick occur on fractures within tabular bodies of amphibole-biotite gneiss containing quartz seams, pyrite, and pyrrhotite. The manganese content ranges from 0.94 per cent to 12.07 per cent.

Locality 2. Hornby Bay Reserve

References: Baragar, W.R.A.; The mineral industry of the District of Mackenzie, N.W.T., Geol. Surv., Canada, Paper 61-3, 1961, pp. 16, 17.

Blackadar, R.G. and Fraser, J.A.; Precambrian geology of Arctic Canada, a summary account, Geol. Surv., Canada, Paper 60-8, 1960, p. 23.

Fraser, J.A. (et al.); North-central District of Mackenzie, N.W.T., Geol. Surv., Canada, Map 18-1960, scale 1 inch to 8 miles, 1960.

Manganese occurs 12 1/2 and 19 miles northeast of the head of Hornby Bay. At the southern deposit a seam of manganese-bearing material from a few inches to more than 3 feet thick occurs in a silicified and brecciated zone lying along the unconformable contact between Hornby Bay sedimentary rocks and underlying Echo Bay volcanic rocks of Proterozoic age. This zone has a known length of about 500 feet and a maximum width of about 25 feet. It is associated with a quartz stockwork that intersects the Fault River fault.

A small specimen of massive material from the seam was identified as braunite, a manganese silicate. Manganese oxides have also been reported.

Locality 3. Port Radium - Camsell River Area

Reference: Lord, C.S.; Mineral industry of District of Mackenzie, Geol. Surv., Canada, Mem. 261, 1951, pp. 86, 87, 91-93, 140-146, 182.

At least five properties in the area, including the Eldorado uranium-silver mine, are known to contain manganese gangue minerals in veins. These occur in faulted, fractured, and sheared zones traversing tuff, stratified rocks, porphyry, diabase, and granodiorite of Proterozoic age.

The principal vein-forming minerals are quartz, carbonate, hematite, chalcopyrite, nickel-cobalt-minerals, pitchblende, bismuth, silver, argentite galena and pyrite. The manganese is found as pyrolusite, psilomelane, polianite(?), manganiferous carbonate, and manganiferous dolomite.

Locality 58. Nastapoka Islands

References: Hanson, 1932, p. 105.

McGerrigle, H.W. and Girard, H.; Special report on the iron deposits of the Province of Quebec, Que. Dept. Mines, P.R. 262, 1950, pp. 28, 29.

Geol. Surv., Canada, unpublished information.

Local enrichment of manganiferous iron carbonates occurs in siliceous iron formation forming the upper unmetamorphosed part of a late Precambrian sedimentary series with mafic flows and sills of diabase. Beds of carbonate-type rock contain up to 3.97 per cent manganese, 33.76 per cent iron, and 23.20 per cent silica. Higher than average manganese concentrations occur in a few lenses at the base of the iron formation. Pyrolusite has been identified.

YUKON TERRITORY

Locality 4. Keno Hill - Galena Hill Area

References: Bostock, H.S.; Mining industry of Yukon, Geol. Surv., Canada, Memoir 234, 1941, p. 39.

Boyle, R.W.; Geology and geochemistry of silver-lead-zinc deposits of Keno Hill and Sourdough Hill, Yukon Territory, Geol. Surv., Canada, Paper 55-30, 1956.

Boyle, R.W.; The geology and geochemistry of the silver-lead-zinc deposits of Galena Hill, Geol. Surv., Canada, Paper 57-1, 1957.

Kindle, E.D.; Keno Hill, Yukon Territory (map with marginal notes), Geol. Surv., Canada, Paper 55-12, 1955.

Silver-bearing galena, sphalerite, and freibergite occur in veins with a gangue of manganiferous siderite, quartz, minor calcite, and rare barite. Most of the ore deposits are found along fault fissures. Wall-rocks include quartzites of Precambrian or Palaeozoic age and schists interbedded with greenstone lenses. Bostock reported a manganese content of 12.65 per cent in siderite from near Keno City.

Locality 5. Mile 1212, Alaska Highway

Reference: Bostock, H.S.; Geology of Northwest Shakwak Valley, Yukon Territory, Geol. Surv., Canada, Mem. 267, 1952, p. 44.

A typical specimen from a vein, largely of psilomelane in rhyolitic tuff, contained 32.83 per cent manganese. The vein, which includes some partly replaced rhyolitic tuff, is 20 inches wide and had been exposed for 25 feet. It is found in an area mapped mainly as undifferentiated sedimentary and volcanic rocks of pre-Silurian to Cretaceous age, intruded by chiefly Cretaceous and Tertiary granitic rocks.

BRITISH COLUMBIA

Locality 6. Portland Canal Area (Silver Bell, Tiger, Last Chance, and Prosperity claims.)

References: Hanson, George; Portland Canal area, British Columbia, Geol. Surv., Canada, Mem. 175, 1935, pp. 57, 58, 77, 82, 138-140 (geological setting).

Ann. Rept., Minister of Mines, B.C., 1918, pp. 71, 72; 1930, p. 97; and 1951, pp. 101, 102.

The country rock in this area belongs to the Hazelton Group of Mesozoic age. Quartz veins in agglomerate and tuff and brecciated volcanic rock, cemented and replaced by quartz, jasper, barite, and calcite contain lead, zinc, silver, and copper sulphides with values of 3.5 to 5.0 per cent manganese.

Locality 7. Klashwun Point, Queen Charlotte Islands

Reference: Ann. Rept., Minister of Mines, B.C., 1960, p. 11.

Basaltic lavas of the Masset Formation of Tertiary age are cut by a north-trending fault, on the east of which the lavas are underlain by shale and sandstone. The fault is filled with 5 to 15 feet of basalt breccia, which is cemented by variable amounts of manganite. Veinlets of manganite also extend into the volcanic rocks of the west wall of the fault. The mineralization is primary and is Tertiary in age.

Locality 8. Indata Lake

Reference: Armstrong, J.E.; Fort St. James map-area, Cassiar and Coast Districts, B.C., Geol. Surv., Canada, Mem. 252, 1949, p. 195.

A vein of braunite and psilomelane occurs in limestone of the Cache Creek Group, which is mapped as Permian and Pennsylvanian(?) age. The vein has been traced for 60 feet and ranges from a few inches to 2 feet in width.

Locality 9. Tsitsutl Mountain

Reference: Armstrong, J.E.; Fort St. James map-area, Cassiar and Coast Districts, B.C., Geol. Surv., Canada, Mem. 252, 1949, p. 194.

A vein consisting of about 70 per cent rhodonite with 2 or 3 per cent arsenopyrite and a variable amount of calcite, garnet (spessartite), and ilmenite is found in Cache Creek metamorphosed sedimentary rocks of Permian and Pennsylvanian(?) age, near the contact of a quartz porphyry stock of possible Tertiary age. The vein ranges from 18 to 24 inches in width and has been uncovered at two places 24 feet apart.

Localities 10 and 11. Rocher Déboulé (10) and Hudson Bay (11) Mountains

References: Armstrong, J.E.; Preliminary map, Smithers, B.C., Geol. Surv., Canada, Paper 44-23, 1944 (geological setting).

Armstrong, J.E.; Preliminary map, Hazelton, B.C., Geol. Surv., Canada, Paper 44-24, 1944 (geological setting).

Hanson, 1932, p. 119.

Kindle, E.D.; Mineral resources, Hazelton and Smithers areas, Cassiar and Coast Districts, B.C., Geol. Surv., Canada, Mem. 223, 1954, pp. 36, 37, 103-111.

Ann. Rept., Minister of Mines, B.C., 1908, p. 172 (Hummingbird claim).

Ann. Rept., Minister of Mines, B.C., 1926, p. 131 (Trixie claim).

Ann. Rept., Minister of Mines, B.C., 1929, p. 155 (Comeau group).

Manganese gangue minerals occur on the Hummingbird, Trixie, and Duthie properties, Hudson Bay Mountain, and on the Comeau group, Rocher Déboulé Mountain.

Copper and lead-zinc sulphide deposits with values in gold and silver occur in fault and shear zones. Wall-rocks are volcanic flow breccia and tuffs of the Hazelton Group of Jurassic and (?) Early Cretaceous age. Gangue minerals are quartz, carbonate, rhodochrosite, rhodonite, and manganiferous siderite. Pyrolusite is present on the Hummingbird claim.

Locality 12. Owen Lake and Buck Flats Areas

References: Lang, A.H.; Owen Lake mining camp, B.C., Geol. Surv., Canada, Sum. Rept., 1929, Part A, 1930, pp. 77-91.

Lang, A.H.; Mineral deposits at Buck Flats, B.C., Geol. Surv., Canada, Sum. Rept., 1929, Part A, 1930, pp. 92, 93.

Copper, lead, and zinc sulphides, gold and silver occur in shear zones and fissures in a post-Cretaceous microdiorite stock at Owen Lake, and in tuffs and breccias of the Hazelton Group of Jurassic and (?) Cretaceous age at Buck Flats. Gangue minerals are quartz, calcite, and rhodochrosite, chalcedony, barite, some limonite, and manganese oxides.

Locality 13. Nechako River (Tead and Godwin properties)

Reference: Armstrong, J.E.; Fort St. James map-area, Cassiar and Coast Districts, B.C., Geol. Surv., Canada, Mem. 252, 1949, p. 195.

Pyrolusite and psilomelane fill small fractures in cherty quartzites of the Cache Creek Group of Permian and Pennsylvanian(?) age. Manganese oxides with thin seams of sandy yellow clay form a small lense. At one exposure manganese oxides have completely replaced individual quartzite beds.

Locality 14. Nazko

Reference: Stevenson, J.S.; Nazko manganese, Ann. Rept., Minister of Mines, B.C., 1955, p. 30.

Black manganese oxide occurs below a few inches to 3 feet of soil and is underlain by soil, sand or gravel. Analyses of samples indicate 11.6 to 53.1 per cent manganese and 0.30 to 29.0 per cent iron.

Locality 15. Quesnel map-area

References: Tipper, H.W.; Geology, Quesnel, B.C., Geol. Surv., Canada, Map 12-1959.

Tipper, H.W.; Geology, Prince George, Cariboo District, B.C., Geol. Surv., Canada, Map 49-1960.

Western Miner, April 1963, p. 16.

On Baker Creek and the Lower West River, psilomelane fills fractures in chert of the Cache Creek Group mapped as Pennsylvanian(?) and Permian age.

An occurrence of bog manganese containing 27.93 per cent manganese in one assay was recently discovered 5 miles northwest of Quesnel.

Locality 16. Barkerville Area

Reference: Johnston, W.A. and Uglow, W.L.; Placer and vein gold deposits of Barkerville, Cariboo District, B.C., Sum. Rept., 1932, A1, 1933.

Manganiferous siderite occurs in gold-bearing quartz veins that carry a few sulphide minerals. The veins occupy fissures in quartzites, slate, schist, limestone, and volcanic breccia of the Cariboo Group of rocks.

On Burns Mountain, near Stanley, a random sample from a deposit of bog manganese gave an analysis 21.7 per cent manganese.

Locality 17. Yanks Peak

Reference: Holland, S.S.; Yanks Peak-Roundtop Mountain area, Cariboo District, B.C., Dept. Mines, Bull. No. 34, 1954, pp. 24, 92.

Pyroblasts, disseminated grains, streaks, and narrow veinlets of ankerite with varying manganese content are found in silty quartzites, and in schists and limestone of the Cariboo Group of Cambrian age. Manganese-bearing ankerite, gold, and some sulphides occur in the quartz veins of possible Post-Jurassic age that cut the Cariboo Group. It is considered that the quartz veins in part introduced ankerite into the sediments; however, a bed of ankeritic quartzite near the top of the Midas Formation of the Cariboo Group of rocks, occupying the same stratigraphic position over wide areas, suggests that some or all of the constituents of ankerite were contained in the original sediments.

Locality 18. Williams Lake Area

References: Ann. Rept., Minister of Mines, B.C., 1942, p. 75.

Sargent, 1956, p. 16.

Report of the ore dressing and metallurgical laboratories (Canada, Mines Branch) Investigation No. 1136; Gravity concentration of manganese ore from A.W. Haddock, Williams Lake, B.C., 1941.

Manganese oxides in a quartz vein approximately 4 feet wide and 500 feet long, and surface outcroppings of manganese occur at the Newon deposit. Chemical analysis of a sample across the vein shows a total manganese content of 28.8 per cent.

Manganese oxides are also reported in a deposit about 18 miles south of Williams Lake.

Locality 19. Birch Island, Thompson River

Reference: Hanson, 1932, p. 114.

Manganese occurs as oxides mixed with soil and vegetation, probably deposited from springs. Altered rocks at the contact between sediments and granite contain some manganese-bearing minerals and may have been the source of manganese oxides.

Locality 20. Clinton Area (Marble Mountain and Clinton deposits)

References: Hanson, 1932, p. 114.

Ann. Rept., Minister of Mines, B.C., 1948, pp. 91, 92.

Psilomelane, manganite, and pyrolusite occur as nodules, narrow stringers, and irregular masses in quartzites cut by quartz stringers, and in chloritic schists of the Cache Creek Group of rocks of Pennsylvanian(?) and Permian age.

Locality 21. Rex Peak

Reference: Leech, G.B.; Geology and mineral deposits of the Shulaps Range, Southwestern B.C., B.C. Dept. Mines, Bull. No. 32, 1953, p. 51.

Black, cherty-looking, manganiferous rock appears in an area mapped as undifferentiated sedimentary and volcanic rocks of probable Mesozoic age. It consists of black opaque grains in a matrix of silicate minerals with magnetite as a major constituent. Selected samples assayed 6.27 per cent and 8.49 per cent manganese.

Locality 22. Crown Mountain, Tenquille Creek (Crown group)

Reference: Alcock, F.J.; Zinc and lead deposits of Canada, Geol. Surv., Canada, Econ. Geol. Ser. No. 8, 1930, pp. 305, 306.

Upper Triassic volcanic and sedimentary rocks are intruded by granodiorite, quartz diorite, and related rocks. Where intersected by a shear zone, original limestone bands have been altered to a magnetite-garnet rock containing minor sulphide minerals, limonite, and pyrolusite.

Locality 23. Vargas Island

References: Hanson, 1932, p. 119.

Sargent, 1956, p. 19.

Black manganese oxide, filming sheared ferruginous cherty tuffs, may be in rocks that belong to the Sicker Group of Permian or pre-Permian age.

Locality 24. Cowichan Lake Area

References: Fyles, T. James; Geology of the Cowichan Lake area, Vancouver Island, B.C. Dept. of Mines, Bull. No. 37, 1955, pp. 65-69.

Hanson, 1932, pp. 115-119.

Eight occurrences, including the Hill 60, Black Prince, and Cottonwood groups of claims are known in the area. Rhodonite, the chief primary manganese mineral, is found in lenses parallel to the bedding of the sediments and veinlets cutting across the bedding, and as irregular masses. The wall-rocks are cherty tuff, interbedded with cherty sediments and jasper beds belonging to the Sicker Group of Permian or pre-Permian age. Texturally, manganese appears to replace the cherty sediments but may represent manganese of original sedimentary origin. Rhodochrosite is present in small amounts in some of the deposits, especially at the Cottonwood group, and a yellow mineral in the chert at the Hill 60 deposit is considered to be a type of manganese garnet.

Manganese oxides coat the outcrops at all occurrences, and at several localities the silicates are oxidized to a depth of several feet. At the Hill 60 deposit the oxidized zone is reported to have extended to a depth of 15 feet. Most of the 1,117 tons of ore that were shipped during the most recent production in 1919 and 1920 came from this zone.

Locality 25. Saltspring Island

Reference: Sargent, 1956, p. 19.

A manganese deposit occurs in cherty tuffaceous sediments mapped as Sicker Group of Permian and pre-Permian age. It is thought to be similar to the Cowichan Lake deposits.

Locality 26. Summit Camp

References: Hanson, 1932, p. 119 (Cedar Creek).

Ann. Rept., Minister of Mines, B.C., 1952, pp. 124, 125.

A lead-zinc-silver ore with a small amount of associated quartz and carbonate gangue is found in veins or lodes. Mineralization was controlled by a fault zone that cuts volcanic and sedimentary rocks of the Dewdney Creek and Pasayten Formations of Early Cretaceous or possibly Late Jurassic age. Spectrochemical analysis of the ore indicated the presence of manganiferous siderite. Assays of sixteen samples yielded from 0.2 to 18.5 per cent acid soluble manganese. An occurrence of manganese was also reported in the vicinity of Cedar Creek.

Locality 27. Mammoth Group of claims, Sumallo River

References: Cairnes, C.E.; Coquihalla area, B.C., Geol. Surv., Canada, Sum. Rept., 1920, Part A, pp. 40, 41.

Cairnes, C.E.; Geological exploration in Yale and Similkameen mining divisions, Southwestern B.C., Geol. Surv., Canada, Sum. Rept., 1922, Part A, p. 121.

A lime silicate rock, possibly a metamorphic limestone, is part of a massive cherty member of the Hozameen series of Carboniferous age. Segregated in this rock are calcium tungstate of scheelite, nickeliferous pyrrhotite, ferruginous sphalerite, and less commonly pyrolusite and molybdenite. Manganiferous deposits were reported in the immediate area.

Locality 28. Bradshaw Mountain, Olalla Area, and Orofino Mountain

References: Ann. Rept., Minister of Mines, B.C., 1937, Part D, pp. 8-11.

Ann. Rept., Minister of Mines, B.C., 1955, p. 42.

Cairnes, C.E.; Mineral deposits of the west half of Kettle River area, B.C., Geol. Surv., Canada, Paper 37-21, 1937, p. 46.

Bostock, H.S.; Olalla, Similkameen, Osoyoos, and Kamloops Districts, B.C., Geol. Surv., Canada, Map 628A, 1941.

Rhodonite occurs in cherty sediments of Permian and Triassic age within these three areas. On the Olalla 1 - 8 claims on Olalla Creek, a zone of red chert is traversed by a network of minute veins of rhodonite that merge laterally into zones of hard black siliceous manganese containing small irregular masses of rhodonite and chert. Manganese minerals near the surface have been oxidized to black manganese oxides. Assays of channel samples show 7.1 per cent manganese over a width of 6'4" and 48.3 per cent manganese over a width of 1'11".

Locality 29. Fanny Joe Claim, Greenwood Area

Reference: Ann. Rept., Minister of Mines, B.C., 1933, p. 161.

A 4-inch quartz vein traceable for 300 feet contains pyrite and some galena. It is found in andesite close to a granodiorite contact. The following statement is quoted directly from the above reference, "work done since June 1933, according to the owner, included sinking the shaft another 10 feet to where a considerable amount of manganese occurred."

Locality 30. Sproat Mountain

Reference: Hanson, 1932, p. 107.

Carbonates that show on weathering a considerable content of manganese occur in grey quartzites bordering a body of serpentine rock. The serpentine carries a certain amount of carbonate, and manganese carbonates occur as local replacements or fissure fillings in the sedimentary formations that belong to the Lardeau Group of Early Palaeozoic age.

Locality 31. Lardeau Map-area (Ajax mine and Ophir Lode property)

Reference: Gunning, H.C.; Lardeau map-area, B.C., Geol. Surv., Canada, Mem. 161, 1930, pp. 49, 67-70.

Gold-bearing quartz carbonate veins, irregularly mineralized with sulphides, occur in fractures cutting schists, quartzites, and phyllites of the Lardeau Group of Early Palaeozoic age. At the Ajax mine wad occurs in the oxidized zone. One assay shows 9.36 per cent manganese. On the Ophir Lode property ferruginous carbonate carrying appreciable quantities of manganese occurs in gold-bearing quartz veins.

Locality 32. Kaslo Area

References: Hanson, 1932, pp. 107-111.

Cairnes, C.E.; Slocan mining camp, B.C., Geol. Surv., Canada, Mem. 173, 1934 (geological setting).

Cairnes, C.E.; Descriptions of properties, Slocan mining camp, B.C., Geol. Surv., Canada, Mem. 184, 1935, pp. 221, 222, 231-234.

Manganese Group of Claims - Bog manganese is interstratified with, and generally fairly sharply separated from hydrous iron oxides, calcareous tufa or sinter, and layers of clayey subsoil within terraces of glacial and post-glacial drift. The deposits have formed in swampy ground fed by mineral springs. By the end of 1918 more than 1,000 tons of ore were mined.

Manganese #4 Claim - Near the contact of sediments of the Milford Group of Carboniferous to (?) Middle Triassic age with greenstones of the Kaslo Group of Triassic age, altered quartzitic and argillaceous sediments are weathered brown and black as the result of the decomposition of contained iron and manganese minerals. Manganiferous garnet with rims of black manganese oxide and tiny crystals of braunite or hausmannite occur in the quartzitic sediments. A general sample of the deposit assayed 14.08 per cent manganese, 15.30 per cent iron, and 38.68 per cent silica.

Harp Group - Quartz veins impregnated with sulphides occur in sediments or along the contact of the Milford sediments of Carboniferous to (?) Middle Triassic age with greenstone schists of the Kaslo Group of Triassic age. The footwall rock of one vein is greenish schist composed of quartz, calcite, a little garnet, considerable graphite (or pyrolusite) and abundant rhodonite, the latter occurring in masses, streaks and disseminations. The hanging-wall is a banded quartzitic argillite composed chiefly of quartz and a manganiferous garnet partly altered to oxide of manganese.

Locality 33. Slocan Area

References: Hanson, 1932, pp. 112-114 (Contact (Black Prince) claim).

Cairnes, C.E.; Slocan mining camp, B.C., Geol. Surv., Canada, Mem. 173, 1934, pp. 131, 132.

Cairnes, C.E.; Descriptions of properties, Slocan mining camp, B.C., Geol. Surv., Canada, Mem. 184, 1935.

Siderite, the most common of the gangue minerals in the larger silver-lead-zinc deposits occurs with quartz in veins, lodes, and replacement deposits in sediments of the Slocan Group of Triassic age, and in the Nelson granite batholith of post-Triassic age. A sample of the less altered siderite from the Contact (Black Prince) claim contains: iron carbonate 63.20 per cent, manganese carbonate 20.98 per cent, and lime and magnesium carbonates 12.96 per cent.

Locality 34. Bearpaw Occurrence

Reference: Ann. Rept., Minister of Mines, B.C., 1938, Part E, p. 10.

A vein of pyrolusite occurs in decomposed granitic rock. A sample over the central part of the vein assayed 7.3 per cent manganese.

Locality 35. Nelson Area (Silver King, Centre (Wesko) mines and Free Silver group of claims)

References: Hanson, 1932, p. 119.

Little, H.W.; Nelson map-area, west half, B.C., Geol. Surv., Canada, Mem. 308, 1960, pp. 169, 177, 178 (Silver King and Centre (Wesko) mines).

Ann. Rept., Minister of Mines, B.C., 1915, p. 155 (Free Silver group).

Copper, lead, and zinc sulphides, gold and silver occur in quartz veins and quartz-carbonate gangue within sedimentary and volcanic rocks of Jurassic or older age at, or near the contact of the Nelson granite batholith of Early Cretaceous (?) age. A very small amount of manganese is found in the gangue of these deposits. Manganite has been identified.

Locality 36. Riondel, Kootenay Lake (Shepherd Mining Company)

References: Carnochan, R.K.; Investigations in ore dressing and metallurgy, Report 206, Dept. of Mines, Tech. Surv., Mines Branch, Pub. No.643, 1926, pp. 22-24.

A lead-zinc-silver ore with a gangue of rhodochrosite and quartz contains from 3.57 to 13.70 per cent manganese.

Locality 37. Moyie Lake (Finley - Leask group)

Reference: Ann. Rept., Minister of Mines, B.C., 1931, p. 140.

The country rock in the vicinity of the property is quartzite of the Proterozoic Aldridge Formation. A zone of decomposed gossan contains low values of silver and lead with appreciable percentages of zinc and manganese. A grab sample assayed 0.10 oz gold, 1.30 oz silver, 0.25 per cent lead, 8.30 per cent zinc, and 9.94 per cent manganese oxide.

Locality 38. Sand Creek, Galloway Area (Empire and Strathcona group of claims)

Reference: Ann. Rept., Minister of Mines, B.C., 1930, p. 243.

Chalcopyrite, pyrrhotite, and arsenopyrite occur in scattered stringers and disseminations in a gangue largely composed of siderite and some quartz with an indicated manganese content of 1.57 per cent.

ALBERTA AND SASKATCHEWAN

Locality 39. Cypress Hills

References: Hanson, 1932, p. 105.

Slipper, S.E.; Cypress Hills manganese; unpublished report, 1917, on file Mineral Resources Division, Dept. Mines and Tech. Surveys.

The natural resources of Saskatchewan 1947, Sask. Dept. Nat. Res. and Ind. Development, pp. 39, 40.

On the north fork of Willow Creek, Alberta, manganese is said to occur in pockets in a honeycombed formation of clay and sand 4 or 5 feet thick. The deposit is estimated to contain 5 per cent manganese. What appear to be similar deposits contain wad under clay and drift northwest of Govenlock in Saskatchewan.

SASKATCHEWAN

Locality 40. Goldfields, Lake Athabasca

References: Robinson, S.C.; Mineralogy of uranium deposits, Goldfields, Saskatchewan, Geol. Surv., Canada, Bull. 31, 1955, pp. 76, 77.

Lang, A.H. et al.; Canadian deposits of uranium and thorium, Geol. Surv., Canada, Econ. Geol. Ser. No. 16 (second edition) 1962, pp. 148-153 (geological setting).

Epigenetic uranium deposits occur as disseminations, pods, irregular masses, stringers, lenses, and true veins usually related to zones of fracturing, mylonitization, and brecciation in secondary structures close to major faults that intersect metamorphosed Tazin and relatively unmetamorphosed Athabasca sedimentary and volcanic strata and granitic rocks of Archaean(?) and Proterozoic age. The principal minerals associated with pitchblende are calcite, chlorite, hematite, and a little sulphide. Comparative spectrographic analysis indicates a small amount of mangane e present in the carbonates.

MANITOBA

Locality 41. Porcupine Mountain Area

Reference: Manganese occurrences in Manitoba, Man. Dept. Mines Nat. Res., Mines Branch, Pub. 42-1, 1942.

Iron-manganese concretions occur along bedding planes in Riding Mountain shale of Cretaceous age. The nodules make up more than 10 per cent of the material within the beds, and the nodules contain from 12 to 18 per cent manganese and from 9 to 10 per cent iron.

Locality 42. Riding Mountain Area

References: Manganese occurrences in Manitoba, Man. Dept. Mines Nat. Res., Mines Branch Pub. 42-1, 1942.

Spector, I.H.; Manganese deposits in the Riding Mountain area, Manitoba, The Precambrian, July, 1941.

Most of the manganese in the seven known bogs in the area is pyrolusite. The largest bog deposit contains approximately 100 tons of manganese of possible chemical grade. The manganese was probably deposited from spring waters and may have been derived from the manganiferous iron-rich nodules in Cretaceous shale.

Locality 43. Roseisle Deposit

Reference: Manganese occurrences in Manitoba, Man. Dept. Mines Nat. Res., Mines Branch Pub. 42-1, 1942.

Hydrous oxides, probably manganite and psilomelane or wad accompanied by limonite, occur in swampy land at the base of an escarpment. They are either covered by 1 foot or 2 feet of soil or lie on the surface. The deposit has apparently been formed by springs issuing from the Pembina Hills. The best material contains 26.96 per cent manganese and 13.11 per cent iron.

ONTARIO

Locality 44. Bigstone Bay, Lake of the Woods (Golden Gate Mine)

References: Coleman, A.P.; Fourth report on the West Ontario gold region, Ont. Dept. Mines, Ann. Rept., vol. 7, pt. 2, 1898, p. 112.

Suffel, G.G.; Geology of the Bigstone Bay area, Lake of the Woods, District of Kenora, Ont. Dept. Mines, Ann. Rept. 1930, vol. 39, pt. 3, 1931, pp. 57-71 (geological setting).

Native silver, gold, galena, blende, pyrolusite, and several copper sulphides were reported in one of several veins within hornblende schist of Precambrian age.

Locality 45. Steep Rock Lake

Reference: Jolliffe, A.W.; Geology and iron ores of Steep Rock Lake; Econ. Geol., vol. 50, No. 4, 1955, pp. 373-398.

The Precambrian Steeprock Group of volcanic and sedimentary rocks in this area lies unconformably upon a granitic complex ("Laurentian"). The iron orebodies occur in a formation called the "orezone", which is apparently a stratigraphic member of the Steeprock Group. The stratigraphically lower part of the "orezone" is chiefly manganiferous waste (averaging more than 2% Mn) with minor iron ore, resting residually in erosional disconformity on the underlying leanly manganiferous and ferruginous limestone and dolomite. The upper part of the "orezone" carries negligible manganese and is composed chiefly of goethite with a few relatively narrow bands of cherty, sandy, and aluminous sediments.

Localities 46, 47, 48. Thunder Bay Area

References: Tanton, T.L.; Fort William and Port Arthur, and Thunder Cape map-area, Thunder Bay District, Ontario, Geol. Surv., Canada, Mem. 167, 1931, pp. 97, 100, 188.

Hanson, 1932, pp. 102-104.

McKeller Island (46) and Silver Islet Mine (47) - At both localities silver, lead, zinc, copper, nickel, cobalt, and a few other sulphide minerals occur in vein deposits. Gangue minerals are carbonate, barite, quartz, and rhodochrosite. At the Silver Islet mine, vein-forming cement fissures in a fault zone cutting diabase dykes within shaly sediments of the Animikie Series of Proterozoic age. Seamlets of pyrolusite occur in an accessory rhodochrosite gangue in the upper levels of the mine.

Pearl Area, McTavish Township (48) - Sediments of the Sibley Series of late Precambrian age are intruded by diabase dykes. One occurrence is in a shatter zone in chert rock. Some of the fissures are cemented with quartz, and one is occupied by a vein 6 inches in average width, which consists of an intimate association of braunite and psilomelane and local aggregates of barite and quartz. A sample across the width of the vein analyzed 85.87 per cent manganese.

At another location a manganese-bearing layer in conglomerate consists of pebbles and sand grains cemented by an intimate association of braunite, other manganese minerals, and barite.

Locality 49. Michipicoten Area

References: Moore, E.S. and Armstrong, H.S.; Iron deposits of the District of Algoma, Ont. Dept. Mines, Ann. Rept. 1946, vol. 55, pt. 4, 1948, pp. 53, 58, 59, 118.

Goodwin, A.M.; Genetic aspects of Michipicoten iron formations, Bull. Can. Inst. Mining Met., vol. 54, No. 585, 1961, pp. 38-42.

The iron mines in the area occur in a carbonate-sulphide type of iron formation of early Precambrian age. The manganese content of the siderite ore ranges from 0.55 to 2.4 per cent. Manganite and a little rhodochrosite are found at the east end of the Josephine hematite orebody. Analyses of a number of specimens yielded from 1.5 to 25.5 per cent manganese. The quantity found was not of commercial importance.

Locality 50. Devil's Warehouse Island, Gargantua Harbour

Reference: Hutchison, R.H.; Summary report on the Sibley - Marvin manganese location, Devil's Warehouse Island (island D), Gargantua, Ontario; unpublished report, 1942, on file Geol. Surv., Canada.

Disseminations and veins of manganese minerals associated with calcite occur in fine breccia containing numerous fragments of iron formation. The breccia occupies a fault zone in sandstone. A high-grade manganese sample contained 36.3 per cent manganese and 7.21 per cent iron. A sample of the breccia contained 4.26 per cent manganese.

Locality 51. Batchawana Bay, Lake Superior

References: Hanson, 1932, p. 104.

Weldon, F.E.; Summary report on Batchawana manganese property, Ley township, Algoma district, Ontario; unpublished report, 1942, on file Geol. Surv., Canada.

Manganite, psilomelane, and manganese carbonates, along with quartz, calcite, and fluorspar occur in closely spaced stringers in a reddish lava flow. No assay taken over a mining width contained more than 3.7 per cent manganese.

Locality 52. Mattagami River

Reference: Lindeman and Bolton, 1917, vol. II, p. 102.

Limonite deposits, believed to be an oxidation product of siderite, are associated with Devonian limestone. The manganese oxide content of the siderite is 1.74 per cent.

Locality 53. Leonard Township

Reference: Lindeman and Bolton, 1917, vol. II, p. 105.

Associated with fine-grained magnetite deposits are banded silica rocks, jasper, and siderite. Sampling of the principal iron outcrops indicated a large tonnage containing an average of 2.25 per cent manganese and 40.63 per cent iron.

Locality 54. Madoc Township

Reference: Hanson, 1932, p. 104.

Wad was reported to occur in a ploughed field.

QUEBEC

Locality 55. Chibougamau Lake (Copper Cliff Consolidated Mining Corp., Siderite Hill Zone)

Reference: Allard, G.; South half of McKenzie township, Abitibi East Electoral district, Que. Dept. Mines, Geol. Rept. 95, 1960, pp. 63, 64.

A zone of massive siderite containing disseminated blebs and small veinlets of chalcopyrite and minor pyrite ranges between 10 and 125 feet in width, and occurs in a sericite-carbonate schist, originally gabbro and anorthosite of early Precambrian age. Company officials report reserves of 2,000,000 tons carrying 31.1 per cent iron and manganese and approximately 1 per cent copper.

Locality 56. Albanel Lake

References: Neilson, James M.; Albanel Lake, Mistassini Territory, Que. Dept. Mines, Geol. Rept. 53, 1953, pp. 16, 30.

Wahl, William G.; Temiscamie River area, Mistassini Territory, Que. Dept. Mines, Geol. Rept. 54, 1953, p. 18.

Sater, G.S. (compiler); Preliminary report on the lead and zinc deposits of the Province of Quebec, Que. Dept. Mines, P.R. 371, 1958, p. 31.

Small quantities of galena, sphalerite, and psilomelane are found in the dolomitic rocks of the Mistassini Series of late Precambrian age as well as in the Lower Albanel Formation in Township 1428.

Northeast of Kallio Lake, a weathered iron formation in the same series of rocks contains 55.45 per cent iron and 1.50 per cent manganese.

Locality 57. Richmond Gulf, Hudson Bay

Reference: Gilbert, J.E.; Northern Quebec. A new mining area. A study of the territory between Eastmain River and Ungava Bay, Que. Dept. Mines, Geol. Rept. 56, 1953, p. 19.

Rhodochrosite is one of the constituents in a rock containing lead and zinc sulphides.

Locality 58. See Northwest Territories, Nastapoka Islands, p. 11.

Locality 59. Roberts Lake

Reference: Waddington, 1960, pp. 88, 89.

Thin beds of almost massive magnetite or hematite interlayered with cherty beds containing disseminated iron oxides occur in the Sokoman Iron Formation of Proterozoic age and average 36.0 per cent iron and 1.0 per cent manganese.

Locality 60. Leaf Lake

References: Gross, G.A.; Iron deposits near Ungava Bay, Quebec; Geol. Surv., Canada, Bull. 82, 1962, pp. 16, 17.

Waddington, 1960, pp. 85-87.

Interbedded carbonate, chert, and jasper iron formation unusually rich in magnetite contains 20.90 per cent iron and 2.06 per cent manganese. Magnetite - hematite iron formation contains 31.12 per cent iron and 1.62 per cent manganese.

Locality 61. Forbes Lake and Larch River

Reference: Waddington, 1960, pp. 82, 85.

Zones of enriched iron formation occur in the Forbes Lake area. One bulk sample assayed 43.76 per cent iron and 5.60 per cent manganese.

South of Larch River interbedded iron carbonate and chert overlies a series of jasper metallic iron formation interlayered with carbonate and chert. The interbedded iron carbonate and chert average 24.0 per cent iron and 1.50 per cent manganese. The magnetite-hematite iron formation averages 33.0 per cent iron and 2.6 per cent manganese.

Locality 62. Wilson Lake

Reference: Gilbert, J.E.; Northern Quebec, A new mining area. A study of the territory between Eastmain River and Ungava Bay, Que. Dept. Mines, Geol. Rept. 56, 1953, p. 19.

Wad, containing between 10 and 35 per cent manganese overlies bog iron formation of goethite and limonite in a zone about a mile and a quarter long by three quarters of a mile wide.

Locality 63. Otelnuk Lake

Reference: Waddington, 1960, pp. 87, 88.

Carbonates in iron formation and banded jaspilite iron formation assayed 32.60 to 54.56 per cent iron and 0.51 to 2.79 per cent manganese.

Locality 64. Knob Lake - Schefferville area, Quebec - Labrador

References: Gross, G.A.; Mineralogy and beneficiation of Quebec iron ores; Bull. Can. Inst. Mining Met., vol. 57, No. 623, 1964, pp. 245-252.

Gross, G.A.; The iron ranges and current developments in New Quebec and Labrador, Canada; 21st Ann. Mining Symposium, Univ. Minnesota, 1960; Reprint-10, Geol. Surv., Canada.

Stubbins, John B., Blais, Roger A., and Zajac, Stephen I.; Origin of the soft iron ores of the Knob Lake range; Bull. Can. Inst. Mining Met., vol. 54, No. 585, 1961, pp. 43-58.

The direct-shipping earthy hematite-goethite ore of this region, derived mainly from the Proterozoic Sokoman iron formation, contains a variable manganese content due to the presence of pyrolusite, manganite, hollandite and other manganese oxides. Manganese was deposited in permeable zones, crevices and vugs in the ore deposits after the deposition of the iron minerals had taken place. Manganese oxides and hydroxides form up to 30 per cent of some ores.

Forty-three hematite-goethite iron deposits containing 418 million tons of ore have been discovered in the Knob Lake - Schefferville area and 53,366,000 tons are classified as manganiferous ore grading 50.17 per cent iron and 7.64 per cent manganese. Average grade of ore shipped prior to 1959 was 52.306 per cent iron and 1.591 per cent manganese.

A small amount of manganese occurs in carbonate within the oxide facies of taconite in the Knob Lake area and other iron ranges of the Labrador geosyncline.

Where the grade of regional metamorphism is greater, such as in the southwest end of the geosyncline in the Mount Reed - Wabush Lake region*, coarser grained iron deposits known as metataconite occur. A small amount of manganese occurs in carbonate and silicate minerals in these deposits. Siderite, which may contain 3 per cent manganese rhodonite, and other manganiferous silicates occur in some of these metataconite deposits. Secondary manganese oxide minerals are erratically distributed through some metataconite deposits in joints and vugs, or as grain coatings.

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*No symbol for this region appears on the accompanying map 15-1964. The information came to the attention of the authors after the map was printed. The Mount Reed - Wabush Lake region comprises a large area extending from 120 miles south to 220 miles south-southwest of Schefferville.

Locality 65. Eastern Townships and Surrounding District

References: Hanson, 1932, pp. 99, 100.

St.-Julien, P.; Saint Elie-D'Orford area, Sherbrooke and Richmond counties, Que. Dept. Natural Res., P.R. No. 492, 1963, p. 14.

Woddington, 1960, p. 60.

Bog manganese, earthy nodular masses, nodules in sand and clay, earthy oxides in small fissures, manganese in chert beds, and other minor manganese occurrences appear throughout the area.

A magnetite-hematite-bearing quartzite assayed, 5.13 per cent manganese in Spalding township, near Megantic.

Locality 66. Tessier, St. Denis, and Chasbourg Townships, Matane District

Reference: Béland, Jacques; Ste-Félicité - Grosses Roches area, Que. Dept. Mines, P.R. 339, 1957, pp. 7, 8.

Bog manganese occurrences are found at several localities in a belt 2 to 5 miles wide. Manganese occurs mostly as nodules in soil but wad appears along fractures in slates of Ordovician age. Assays indicate the nodules contain 20 to 50 per cent manganese and 8 to 10 per cent iron.

Because the stained slates contain 7 to 8 per cent manganese and 4.99 per cent iron, and the non-stained slates contain 0.16 per cent manganese and 4.99 per cent iron it is assumed that the slates are the source of the manganese.

Locality 67. Magdalen Islands

Reference: Alcock, F.J.; The Magdalen Islands, their geology and mineral deposits, Trans. Can. Inst. Mining Met., vol. XLIV, pp. 623-649, 1941.

Residual masses, mostly pyrolusite in clay, are found at various localities on the islands. On the Storer claims, on Grindstone Island, the superficial deposits are underlain by bedrock deposits that occur along the unconformity between the base of the red sandstone (Pennsylvanian age?) and an older complex of folded rocks (Windsor limestone, gypsum, and associated volcanic rocks of Mississippian age). Manganese oxides occur as veins and replacement masses in altered rock of high carbonate content. Mr. Storer reported in the Northern Miner of November 13, 1947 that in the bedrock deposit an estimated 40,000 tons of ore were available with an additional 140,000 tons of indicated ore. Assays of six samples show a manganese content of 37.0 to 53.3 per cent.

Locality 68. Port Daniel Township, Gaspé Peninsula

Reference: Ayrton, W.G.; Preliminary report on Chandler-Port Daniel area, Bonaventure and Gaspé - South counties, Que. Dept. Mines, P.R. 447, 1961, p. 10.

Sedimentary rocks close to diorite and serpentinite intrusions are silicified and enriched in manganese and copper. The manganese is concentrated along certain horizons as 'nodules' of wad replacing a porous sandstone. An assay of a 6-pound grab sample showed 6.50 per cent manganese.

NEW BRUNSWICK

Locality 69. Tetagouche River - Middle River Region, Gloucester County

References: Hanson, 1932, p. 92.

Sidwell, 1952, pp. 12-37.

Skinner, R.; Preliminary map, Bathurst, Gloucester and Restigouche counties, New Brunswick, Geol. Surv., Canada, Paper 53-29, 1953.

Smith, C.H. (compiler); Bathurst-Newcastle area, Northumberland, Restigouche, and Gloucester counties, New Brunswick, Geol. Surv., Canada, Map 1-1957, 1957.

Tetagouche Falls, Tetagouche River - Manganite and pyrolusite occur as narrow seams and plates in quartz veins and as seamlets in red argillite; and manganese is dispersed in red and green argillite of the Tetagouche Group of Middle Ordovician age. Manganese silicate, probably rhodonite, and psilomelane (?) are present as concretions in the red argillite. The only body of large size contains less than 4 per cent manganese and about 10 per cent iron, although a sample across a workable 5-foot width of veins and red argillite contained 10.98 per cent manganese.

Middle River - A deposit of bog manganese occurs on Little River about 8 miles south of the Tetagouche Falls occurrence.

Locality 70. Quisibis River, Madawaska County

Reference: Lee, H.A.; Surficial geology of Edmundston, Madawaska and Temiscouata counties, New Brunswick and Quebec, Geol. Surv., Canada, Paper 55-15, 1955, p. 14.

Bog manganese of no present economic value forms the cement and fills the interstices in open-work gravel. The slates of the area are manganiferous.

Locality 71. Woodstock area, Carleton County

References: Sidwell, 1952, pp. 38-56, 166-168.

Trost, W.R.; 1958, pp. 98-117.

Anderson, F.D.; Manganese deposits of the Woodstock area, New Brunswick, Geol. Surv., Canada, Topical Report No. 1, 1954.

Anderson, F.D. and Poole, W.H.; Geology, Woodstock-Fredericton, New Brunswick, Geol. Surv., Canada, Map 37-1959, 1959.

Monture, G.C.; Woodstock manganese ores, Can. Mining J., vol. 78, No. 4, 1957, pp. 117-120.

Bedded deposits of manganese and iron are found in both Ordovician and Silurian strata. The Silurian deposits are relatively larger and richer and include manganiferous hematite and manganese minerals in beds or lenses that conform to the structure of the enclosing slates.

Five distinct units in which iron and manganese minerals have been deposited are: silicified slates, manganiferous hematite, red to purplish ferruginous slates, green chlorite slates, and brown cherty slates.

Manganiferous hematite, the highest grade unit, is cut by quartz stringers and veinlets of rhodochrosite, as well as by narrow stringers of the manganese silicate, piedmontite. The predominant manganese-bearing mineral in this unit is braunite; occasional blebs of axinite are also found.

The silicified slate contains rhodochrosite or manganiferous siderite, manganiferous chlorite and hematite, and a subordinate amount of the manganese silicate minerals, axinite, piedmontite, and rhodonite.

The manganese content ranges from about 7 to 19 per cent along with about 10 to 35 per cent iron. Six deposits west of Woodstock are estimated to contain 214,000,000 tons with an average metal content of 13 per cent iron and 9 per cent manganese.

Deposits of bog manganese are known to occur near Woodstock, Brummagon Brook and Glassville.

Locality 72. Lynnfield and Moore's Mills, Charlotte County

References: Hanson, 1932, p. 95.

Sidwell, 1952, p. 165.

Bog manganese occurs at both localities.

Locality 73. Fredericton Area

References: Hanson, 1932, p. 94.

Sidwell, 1952, pp. 163-165.

Bog manganese occurs throughout the area. In the vicinity of Fredericton a deposit is reported to contain 58.85 per cent manganese. A well known deposit at Currie Mountain contains pyrolusite. At Jones Forks nodules are found in soil, a specimen of which contained 27.04 per cent MnO_2.

Locality 74. Rocky Brook, York County

Reference: Poole, W.H.; Napadogan, New Brunswick, Geol. Surv., Canada, Map 11-1958.

Iron formation in rocks of Ordovician(?) and Silurian age consists of magnetite, siderite, and chlorite with thin stringers and disseminations of pyrite. A semi-quantitative X-ray spectrographic analysis of a specimen indicated 40 to 70 per cent iron and 1.0 to 5.0 per cent manganese.

Locality 75. Lower Birch Island, Southwest Miramichi River

Reference: Poole, W.H.; Hayesville and McNamee map-areas, York, Northumberland, and Carleton counties, New Brunswick, Geol. Surv., Canada, Paper 60-15, p. 10, 1960.

Manganiferous carbonate nodules and lenticular beds occur in thin bedded argillite, slate, and chert, of Middle or Late Ordovician age. The nodules consist of quartz, rhodochrosite, and barite. Argillite samples without nodules contain 3 and 5 per cent iron and 0.1 and 0.5 per cent manganese as determined by semi-quantitative X-ray spectrographic analysis. The nodules contain between 1 and 5 per cent iron, 30 and 40 per cent manganese, and 10 per cent barium.

Locality 76. Miramichi Valley, Northumberland County

References: Hanson, 1932, p. 94.

Sidwell, 1952, pp. 129-143.

Shaw, E.W.; Little Southwest Miramichi - Sevogle Rivers area, New Brunswick, Geol. Surv., Canada, Mem. 197, p. 13, 1936.

A soggy mass of manganese oxides is partly covered with moss and grass. The eight known bog manganese deposits are found at the outlet of springs, which come from grey sandstone of Pennsylvanian age. The manganese is underlain by a boulder clay and does not extend into the bedrock.

Manganese oxide locally stains the Pennsylvanian sediments of the area.

Locality 77. See Prince Edward Island

Locality 78. Richibucto, Kent County

Reference: Sidwell, 1952, p. 162.

A deposit of bog manganese has been reported in the area.

Locality 79. Adamsville Station and Canaan River, Kent and Westmorland Counties

References: Hanson, 1932, pp. 81-84.

Sidwell, 1952, pp. 155-162.

Manganese bogs lie below the orifices of a series of mineral springs and appear somewhat like blisters between the grass and tree roots and the original surface of sand, gravel, or clay. The underlying rocks of the region are Carboniferous in age.

Ignited material from the Canaan River occurrence contains an average of 40.45 per cent manganese and 10.49 per cent iron.

Locality 80. Petitocodiac Area, Westmorland County

References: Hanson, 1932, p. 93.

Sidwell, 1952, pp. 121, 122.

At the Davis Farm, pyrolusite, with a little barite and calcite is found in joints and solution cavities within limestone, sandstone, and conglomerate of Carboniferous age. At one locality, a manganese vein occurs near the contact between Mississippian limestone and gypsum. Nodules of manganese have also been reported in the area.

Locality 81. Jordan Mountain, King's County

References: Hanson, 1932, pp. 84-86.

Sidwell, 1952, pp. 57-69, 165.

Stockwell, C.H., editor; Geology and Economic Minerals of Canada, Econ. Geol. Ser. No. 1, 1957, p. 196.

The main manganese deposit occurs in a shear zone as a lenticular mass, conformable to the strike and dip of enclosing conglomerate of pre-Carboniferous age. Manganese also fills fractures in Precambrian(?) felsites. Pyrolusite, psilomelane(?) manganite, and hausmannite were found on the dumps. Barite was the only gangue mineral seen. Analysis of a bulk sample indicates that the main vein contains 19.03 per cent manganese, 1.34 per cent iron, 50.11 per cent silica, with minor copper, phosphorus, and sulphur. Prior to 1887 production amounted to 400 tons. A small tonnage of ore was extracted in 1943.

Locality 82. Quaco Head, Saint John County

References: Hanson, 1932, pp. 90-92, 94.

Sidwell, 1952, pp. 123-128.

Alcock, F.J.; Geology of Saint John region, New Brunswick, Geol. Surv., Canada, Mem. 216, 1938, pp. 48, 49.

Precambrian volcanic rocks and Carboniferous limestone, sandstone, and conglomerate are unconformably overlain by Triassic sandstone, shale, and conglomerate.

Manganese occurs as small, irregular veins and nodular masses in a fault zone that brings the limestone against the conglomerate. Manganese also occurs in the conglomerate zone on one side of the fault, and as small veins in the limestone on the other. The minerals in the deposit are psilomelane, pyrolusite, manganite, barite, and calcite. Several hundred tons of ore were mined between 1870 and 1889.

Surface indications of manganese are reported at Henry Lake.

Locality 83. Albert County and Surroundings

References: Hanson, 1932, pp. 70-81, 86-90, 93, 94.

Sidwell, 1952, pp. 70-120, 144-151, 154.

From seven of the twenty manganese occurrences of any significance in the area, approximately 30,000 tons of ore were mined prior to 1941. The most notable mine in the province, at Markhamville, produced about 23,000 tons of manganese ore from 1868 to 1891.

The manganese minerals, which include pyrolusite, manganite, psilomelane, hausmannite, and braunite, occur mostly in Horton-Windsor rocks of Mississippian age as nodules, vein-like masses, and irregular replacements in limestone and as pebbles in conglomerate. Limonite, hematite, calcite, and barite are accompanying minerals at the Markhamville mine. In places a residual clay containing nodules of manganese has formed from the weathering of the limestone.

At Gowland Mountain, however, manganese oxides occur in a vein that lies in altered rock associated with greenish schist that has been intruded by granite. All these rocks are older than the sediments of Carboniferous age within the area. A few hundred tons of ore were mined in the past.

A small number of bog manganese occurrences are known in the area. One of the best known bog deposits in Canada, at Dawson Settlement, consists chiefly of manganese dioxide and limonite more or less mixed with peat from which more than 3,500 tons of ore were mined between 1893 and 1930.

PRINCE EDWARD ISLAND

Locality 77. North Cape

Reference: Hanson, 1932, p. 95.

Sandstones and shales are cemented by manganese oxides.

NOVA SCOTIA

Locality 84. Cumberland County

References: Hanson, 1932, pp. 37, 38, 66.

Johnston, 1915, p. 234.

Douglas, G.V.; Manganiferous bog iron at Wallace Highlands, Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1942, p. 93.

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1941, p. 51.

Pugwash sheet, Geol. Surv., Canada, Nova Scotia Map Series 61 (Publication No. 795), 1906.

Bog manganese and other small manganese occurrences appear scattered over a wide area. The only known bedrock deposit of any importance occurs on the road from Amherst to Salem. Here manganese oxide was found in pockets, irregular cavities and along fractures and joints in Windsor limestone.

Locality 85. Parrsboro - Londonderry - Onslow Area

References: Hanson, 1932, p. 66.

Lindeman and Bolton, 1917, vol. II, pp. 169-174.

Smitheringale, 1928, pp. 112, 124-129.

Weeks, L.J.; Londonderry and Bass River map-areas, Colchester and Hants counties, Nova Scotia, Geol. Surv., Canada, Mem. 245, 1948, p. 77.

Geol. Surv., Canada, Ann. Rept., vol. IV, pt. T, 1890, p. 64; vol. X, pt. S, p. 157.

Stockwell, C.H., editor; Geology and economic minerals of Canada, Geol. Surv., Canada, Econ. Geol. Ser. No. 1, 1957, pp. 193, 194.

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1938, p. 161; 1940, p. 59.

Psilomelane, pyrolusite, and manganite occur as seams, veinlets, and small pockets in volcanic rocks, sandstone, and shale of Triassic age near Parrsboro and Lower Five Islands.

Small bog deposits occur here and there over the area.

A little manganite and manganese stain occurs in shaly sandstone of the Riversdale Group of Pennsylvanian age.

The iron deposits of the Londonderry area are oxide enrichments of lenticular masses of iron-bearing carbonates, of which ankerite and siderite are the more common. These deposits occupy irregular fissures in Devonian strata. Analysis of iron ore indicates 11.63 to 54.00 per cent iron and 0.413 to 3.177 per cent manganese. Locally, through secondary action, the proportion of manganese has been increased up to 14 per cent MnO_2.

Locality 86. East Mountain Area, Colchester County

References: Hanson, 1932, pp. 33-37.

Smitheringale, 1928, pp. 113-121.

Stevenson, I.M.; Truro map-area, Colchester and Hants counties, Nova Scotia, Geol. Surv., Canada, Mem. 297, 1958, pp. 103-112.

Two of the four deposits in the area produced more than 2,100 tons of ore from 1877 to 1895. In 1941, 7,500 pounds of metallic manganese were manufactured from ore from the East Mountain manganese mine.

Most of the deposits are of the replacement type in limestone and limestone conglomerate of the Macumber and Pembroke Formations of the Windsor Group of Mississippian age. Pyrolusite, psilomelane, and manganite occur mostly as large irregular or nodular masses. However, at the Manganese Mines property, pyrolusite occurs as masses and veinlets along bedding and joint planes, and cements breccia in underlying Horton sandstone of Mississippian age. Small manganese grains are also present. Minor amounts of barite are found intermingled with the manganese of the area.

The rocks near these deposits have been faulted.

Locality 87. South Shore of Minas Basin, Hants Co.

References: Boyle, R.W.; Geology of the barite, gypsum, manganese, and lead-zinc-copper-silver deposits of the Walton-Cheverie area, Nova Scotia, Geol. Surv., Canada, Paper 62-25, 1963.

Crosby, D.G.; Wolfville (east half), Hants and King's counties, Nova Scotia, Geol. Surv., Canada, Paper 52-18, 1952.

Crosby, D.G.; Wolfville map-area, Nova Scotia, Geol. Surv., Canada, Mem. 325, 1962, pp. 62-64.

Hanson, 1932, pp. 38-51, 67-69.

Lindeman and Bolton, vol. II, 1917, p. 182.

Smitheringale, 1928, pp. 121-124, 130-159.

Stevenson, I.M.; Truro map-area, Colchester and Hants counties, Nova Scotia, Geol. Surv., Canada, Mem. 297, 1958, pp. 110, 111.

Stevenson, I.M.; Shubenacadie and Kennetcook map-areas, Colchester, Hants, and Halifax counties, Nova Scotia, Geol. Surv., Canada, Mem. 302, 1959, pp. 62, 63.

Weeks, L.J.; Londonderry and Bass River map-areas, Colchester and Hants counties, Nova Scotia, Geol. Surv., Canada, Mem. 245, 1948, pp. 63-81.

Windsor Sheet, Geol. Surv., Canada, Nova Scotia Series Map No. 73 (Publication No. 1037), 1909.

Walton Sheet, Geol. Surv., Canada, Nova Scotia Series Map No. 74 (Publication No. 879), 1906.

Approximately forty occurrences of manganese are known in the area. These can be grouped into three general types: replacement deposits in Windsor limestone; fissure fillings in shale and sandstone, mostly of Horton age; and manganese as cement in Triassic conglomerate. Most of the deposits of the first two types occur in faulted or shattered zones.

The replacement deposits occur at or near the contact of Horton and Windsor beds of Mississippian age. They are mostly replacements of limestone conglomerate of the Pembroke Formation, but minor occurrences are found as fracture fillings in shaly limestone of the underlying Macumber Formation. Both formations belong to the Windsor Group.

At the Tennycape mine pyrolusite with minor amounts of manganite and psilomelane are associated with varying amounts of calcite, hematite, limonite, barite, and selenite, as lenses, blebs, nodules, and pockets in limestone conglomerate, and as irregular veins in shaly limestone. From 1880 to 1900 the mine produced about 4,000 tons of manganese oxides. Production of not more than 1,000 tons of ore is recorded from ten other deposits in the area.

Fissure fillings in sandstone and shale, mostly of Horton age, have never been of appreciable economic importance. About 25 tons of ore came from eight occurrences where shafts or pits were sunk.

From the two known occurrences where manganese oxides form the cement in Triassic conglomerate the total output has been slightly more than two tons.

Small bog manganese occurrences and limonite occurrences containing minor manganese are known in the area.

Locality 88. Kentville - Torbrook Area, King's County

References: Crosby, D.G.; Wolfville map-area, Nova Scotia, Geol. Surv., Canada, Mem. 325, 1963, pp. 62-64 (geological setting).

Hanson, 1932, p. 52.

Johnston, 1915, p. 187.

Lindeman and Bolton, 1917, vol. II, pp. 191-193.

Bancroft, M.F.; Manganese occurrences in King's county, Nova Scotia, Dept. of Mines, Ann. Rept. on Mines, 1942, pp. 97-118.

Smitheringale, 1928, pp. 175-178.

Smitheringale, W.G.; Geology of Nictaux-Torbrook map-area, Annapolis and Kings counties, Nova Scotia, Geol. Surv., Canada, Paper 60-13, 1960.

Stockwell, C.H., editor; Geology and economic minerals of Canada, Geol. Surv., Canada, Econ. Geol. Ser. No. 1, 1957, pp. 133, 150-153 (geological setting).

What were formerly known as the Dictyonema slates, now believed to be part of the Meguma Group of Ordovician age, have been considered the chief manganese-bearing strata in the area.

Several small uneconomical bog manganese occurrences have been found in the Kentville-Torbrook region.

Bishop's Brook - At Bishop's Brook 2 miles south of Kentville ferruginous, manganese-bearing beds, lenses and concretions are interstratified with bands of grey phyllite. An intimate intergrowth of pyrolusite, manganite, and psilomelane is associated with hematite and some magnetic oxide. Bulk channel samples, including slate, contained 2.16 to 3.38 per cent manganese and 3.43 to 5.08 per cent iron. Many years ago a few barrels of nodules of pyrolusite were obtained from surface soils and clay bands.

Deep Hollow Road and Pine Brook - About 3 miles southwest of Wolfville pyrolusite fills cracks and cements shattered areas in folded and faulted quartzite, and occurs in irregularly distributed pockets along quartzite beds. The mineralized quartzite contains 12.1 to 30.3 per cent manganese and 2.4 to 7.1 per cent iron.

Nicholsville Deposit - Lenses and stringers containing pyrolusite, psilomelane, iron oxides, calcite, and siderite follow the general strike of quartzites, phyllites, and slates. The deposit lies near the contact of a gabbro dyke.

Ford Farm Prospect - Pyrolusite and psilomelane form crusts over grey quartzite 2 miles southwest of Wolfville. Samples of the crust contain 9.27 to 26.5 per cent manganese. Manganese-bearing erosional remnants of Horton sandstone rest on the quartzite.

Torbrook - A small manganese showing about 2.5 miles south-southeast from Torbrook is associated with a basalt member of the White Rock Formation of Silurian age or earlier.

At the Leckie mine, which produced 137,269 tons of iron ore, a bed of compact red hematite contained an average of 0.470 per cent manganese and 49.20 per cent iron.

Near Nictaux Falls an occurrence contains 6.19 to 13.44 per cent manganese and 6.08 to 30.84 per cent iron.

Locality 89. New Ross, Lunenburg County

References: Hanson, 1932, pp. 53-62.

Goranson, E.A.; Mineral deposits at New Ross, Indian Path, Middle River and Meat Cove, Nova Scotia, Geol. Surv., Canada, Sum. Rept. 1931, pt. D, 1932, pp. 40, 41.

Smitheringale, 1928, pp. 162-174.

Weeks, L.J.; Manganese, New Ross, Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1945, pp. 135-166.

Pyrolusite, manganite, and psilomelane, with calcite, barite, manganiferous carbonate, iron oxides, and country rock occur in lenticular veins lying in faults or crushed zones within Devonian granite.

Prior to 1921 about 1,850 tons of manganese ore were produced and about 500 tons were produced in 1940.

Locality 90. Shelburne, Shelburne County

References: Faribault, E.R.; Investigations in Western Nova Scotia, Geol. Surv., Canada, Sum. Rept. 1917, pt. F, 1918, p. 19.

Smitheringale, 1928, p. 175.

Bog iron, manganese, and white clay have been reported.

Locality 91. Lunenburg County

References: Hanson, 1932, pp. 62, 69.

Smitheringale, 1928, pp. 162, 163, 174.

Mahone Bay sheet, Geol. Surv., Canada, Nova Scotia Series Map No. 88 (Publication 2153) 1929.

Bridgewater sheet, Geol. Surv., Canada, Nova Scotia Series Map No. 89 (Publication 2154) 1929.

Minor occurrences of bog manganese are scattered throughout the county. The most westerly occurrence is at Pleasant River in Queens county.

Locality 92. St. Margaret Bay, Mount Uniacke, Lower Sackville, Halifax County

References: Hanson, 1932, p. 67.

Johnston, 1915, p. 234.

Malcolm, W.; Gold fields of Nova Scotia, Geol. Surv., Canada, Mem. 20, 1912, p. 292.

Smitheringale, 1928, p. 161.

Minor occurrences of pyrolusite, manganite, and wad have been reported.

Locality 93. Lake Charlotte Area, Halifax County

References: Hanson, 1932, p. 65.

Jenkins, W.S.; Beneficiation tests on manganese ore from Lake Charlotte area, Halifax county, Nova Scotia, Mines Branch, Dept. Mines, Tech. Surveys Internal Report IR 61-110, Sept. 26, 1961.

Nova Scotia Dept. of Mines, Ann. Report on Mines, 1955, pp. 54, 55; 1956, p. 72.

Smitheringale, 1928, p. 161.

Trost, 1958, p. 119.

Manganiferous slates and phyllites in the Meguma Group of Ordovician age contain from 8 to 33 per cent manganese. Rhodochrosite in cherty rocks and rhodochrosite in shales and slates are known in the area.

A sample containing 6.03 per cent manganese submitted to the Mines Branch for examination contained a finely disseminated manganese mineral, probably cryptomelane ($(Mn^{+4}, Mn^{+2})_8O_{16}$).

Wad is reported to occur at Jeldore and pyrolusite at Musquodoboit and as veinlets of pyrolusite in granite at Slip Harbour.

Locality 94. Hants and Halifax Counties

References: Stevenson, I.M.; Shubenacadie and Kennetcook map-areas, Colchester, Hants and Halifax counties, Nova Scotia, Geol. Surv., Canada, Mem. 302, 1959, pp. 56-63.

Geol. Surv., Canada, Ann. Rept., vol. IV, pt. T, 1890, p. 54.

Windsor Sheet, Geol. Surv., Canada, Nova Scotia Series Map No. 73 (Publication No. 1037), 1909.

Nova Scotia Dept. Mines, Mineralogical and Geological Guide Book, 1954, p. 131.

Minor occurrences of pyrolusite, psilomelane, and manganite have been reported in Windsor limestone.

At the Gay River lead-zinc deposit, manganese oxide is present, in small but persistent amounts within Lower Windsor limestone.

Bog has been reported near Hartshorne Lake east of the above occurrences.

Locality 95. Sheet Harbour, Halifax County

Reference: Johnston, 1915, p. 234.

Wad has been reported.

Locality 96. Caledonia, Guysborough County

Reference: Tate, M.W.; Gravity concentration and flotation tests on a manganese ore from Huclif Porcupine Mines Ltd., Guysborough county, Nova Scotia, Mines Branch, Dept. Mines, Tech. Surveys, Investigation No. M.D. 3033, 1954.

Wad is associated with a gangue of dark grey quartz and spessartite garnet.

Locality 97. Pictou County

References: Hanson, 1932, pp. 64, 65.

Lindeman and Bolton, 1917, vol. II, pp. 174, 175.

Smitheringale, 1928, pp. 108-112.

Nova Scotia, Dept. Mines, Ann. Rept. on Mines, 1942, pp. 36-38.

Small deposits of hematite, limonite, and goethite, with the manganese minerals manganite and psilomelane are found above the contact of Lower Carboniferous limestone with Silurian and Ordovician rocks. Several of the iron deposits contain some manganese. The limonite in all the deposits near East River contains manganese. At the Cameron mine, a representative sample of limonite on the dump averaged 0.54 per cent manganese and 50.79 per cent iron. A selected sample of manganiferous ore averaged 31.80 per cent manganese and 27.92 per cent iron. About 10,000 tons of iron ore were produced from the mine in the past.

Bog manganese occurs in a few localities in the county.

Locality 98. Antigonish County

References: Hanson, 1932, p. 64.

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1940, p. 58; 1942, p. 38.

Minor occurrences of bog manganese are scattered throughout the county.

Locality 99. Rocky Lake, Guysborough County

References: Maltby, P.D.R.; Recovery of manganese from a sample of spessartite from Rocky Lake, Nova Scotia, Submitted by G.P. Mackay and Associates, Toronto, Ontario; Mines Branch, Dept. Mines and Tech. Surveys, Ottawa, Investigation Report IR 61-76, July 11, 1961.

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1960, p. 80 and 1961, p. 71.

Geological Map of the Maritime Provinces, Geol. Surv., Canada, Map 910A, 1949.

Rocky Lake is 3 miles northwest of Liscomb. The principal minerals in a sample of spessartite-bearing rock are spessartite, rhodonite, and quartz. Other minerals include rhodochrosite, pyrophanite ($MnTiO_3$), mica, hornblende, magnetite, and pyrrhotite. The region is underlain by rocks of the Meguma Group of Ordovician age.

Locality 100. Roachvale, Guysborough County

Reference: Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1954, p. 54.

Pyrolusite occurs as veinlets and segregations in shales and breccia.

Locality 101. Lazy Point, Guysborough County

References: Trost, 1958, pp. 118-123.

Stevenson, I.M.; Geology of Chedabucto Bay, N.S.; Geol. Surv., Canada, Map 3-1959, 1959 (geological setting).

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1961, p. 71.

A fine-grained metasedimentary rock is almost wholly composed of spessartite, chlorite, and quartz with minor amounts of feldspar, magnetite, hematite, zircon, apatite, and possibly rhodonite. This rock probably formed by medium to low grade metamorphism of manganiferous sedimentary rocks, perhaps similar to cherts and slates containing rhodochrosite of the Meguma Group in the Lake Charlotte region (locality 93).

Locality 102. Loch Lomond Area, Cape Breton Island

References: Hanson, 1932, pp. 29-32, 63.

Smitheringale, 1928, pp. 96-104.

Weeks, L.J.; Southeast Cape Breton, Nova Scotia, Geol. Surv., Canada, Mem. 277, 1954, pp. 106-108.

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1942, p. 37.

Four of the nine reported occurrences in the area are considered significant. Total production, which was prior to 1890 is said to have been 300 tons. Much of the ore was taken from soil as loose masses from weathered shales and limestone.

The manganese minerals, mainly pyrolusite and some manganite, occur in Horton-Windsor rocks of Mississippian age, as nodular masses in limestone and as fracture fillings in shale. Associated minerals are hausmannite, calcite, rhodochrosite, barite, and selenite.

Locality 103. Gabarus Harbour and Catalone, Cape Breton County

Reference: Johnston, 1915, p. 234.

Wad is reported to occur at Gabarus and pyrolusite is found in sand and clay about 12 miles to the northeast at Catalone.

Locality 104. Boularderie Island and Beaver Cove, Cape Breton Island

References: Hanson, 1932, pp. 28, 63.

Smitheringale, 1928, pp. 104-108.

Nova Scotia Dept. Mines, Ann. Rept. on Mines, 1938, p. 155.

Bog manganese occurs mixed with limonite and vegetation overlying Carboniferous sediments. Three samples assayed 18 to 30 per cent manganese and 4.30 to 18.70 per cent iron.

Localities 105, 106. Middle Head (105) and Cheticamp (106), Cape Breton Island

References: Hanson, 1932, p. 64.

Nova Scotia Dept. Mines, Mineralogical and Geological Guide Book, 1954, p. 133.

Wad is reported to occur at Middle Head and workable quantities of manganese at Cheticamp were reported in 1898.

NEWFOUNDLAND

Locality 107. Codroy

Reference: Geological Map of the Island of Newfoundland, Geol. Surv., Canada, Map 1043A, 1955.

No descriptive information was found about this occurrence.

Locality 108. Red Indian Lake

Reference: Snelgrove and Baird, 1953, p. 89.

Manganese was discovered in rocks of probable Ordovician age.

Locality 109. Badger Bay and Fortune Harbour Areas, Notre Dame Bay

References: Snelgrove and Baird, 1953, p. 89.

Espenshade, G.H.; Geology and mineral deposits of the Pilleys Island area, Geol. Surv., Newfoundland, Bull. No. 6, 1937, p. 45.

Heyl, G.H.; Geology and mineral deposits of the Bay of Exploits area, Geol. Surv., Newfoundland, Bull. No. 3, 1936, pp. 52-55.

Williams, H.; Botwood (West Half) map-area, Newfoundland, Geol. Surv., Canada, Paper 62-9, 1962.

Low-grade manganiferous cherts are commonly associated with bedded ferruginous cherts and pillow basalts of Ordovician age. The manganiferous chert at the Sweeney, one of five properties in the area, averages 2.66 per cent manganese and 18.37 per cent iron.

Locality 110. Lake St. John (outlet)

References: Snelgrove and Baird, 1953, pp. 89, 90.

Hayes, O.A.; Geology of the area between Bonavista and Trinity Bays, Eastern Newfoundland, Geol. Surv., Newfoundland, Bull. No. 32, pt. 1, 1948, pp. 28, 29.

Wad fills spaces between boulders on the bottom of the Terra Nova River at the outlet of Lake St. John. An analysis of sample of the material showed 41.55 per cent manganese dioxide and 26.66 per cent water.

Locality 111. Smith Pond and Random Sound

References: Christie, A.M.; Geology of Bonavista map-area, Newfoundland, Geol. Surv., Canada, Paper 50-7, 1950, p. 39.

Jenness, Stuart E.; Tèrra Nova and Bonavista map-areas, Newfoundland, Geol. Surv., Canada, Mem. 327, 1963, p. 138.

Manganese has been found at three localities in the region. Manganiferous dolomitic ferruginous shale and siliceous conglomeratic manganiferous limestone are early Middle Cambrian in age. An average sample of a shale bed 38 inches thick at Smith Point contains 25.6 per cent manganese oxide.

Locality 112. Trinity Bay

References: McCartney, W.D.; Dildo, Avalon Peninsula, Newfoundland, Geol. Surv., Canada, Map 13-1956, 1957.

McCartney, W.D.; Whitbourne map-area, Newfoundland, Geol. Surv., Canada, Memoir (in press).

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Manganese has been found in at least nine localities. Manganiferous carbonate and slate beds, at the base of the Middle Cambrian section, resemble and are equivalent to those reported in Smith Sound (locality 111) and to the generally thicker beds in Conception Bay (locality 113).

Locality 113. Conception Bay

References: Snelgrove and Baird, 1953, pp. 73, 88, 89.

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Low grade, unmetamorphosed manganiferous beds form the base of the Middle Cambrian series along a strike length of about 10 miles.

Exposures at six localities give limited information on probable variations along strike and down dip. Facies vary from nodular, manganiferous shale represented at Manuels and Kelligrews to manganiferous shale with massive, generally thin beds of manganese carbonate. The manganese iron ratio also varies, with manganese normally dominant. Despite surface oxidation, manganese-bearing carbonates are believed to be the principal or only manganese mineral at shallow depth. In southeast Conception Bay, the beds dip uniformly to the northwest at 13 degrees.

Bulk samples from Manuels represent a width of 10 feet of nodular shale and contain about 10 per cent manganese and 5.5 per cent iron. Similar grade and thickness are indicated at Kelligrews Brook. At Brigus South Head, a bulk sample from the central 1 1/2 feet of a manganiferous zone 15 feet thick contains 33.35 per cent manganese, 3.80 per cent iron and 18.69 per cent silica. This untreated material yielded silico-manganese in a single-stage electric smelting test and in other tests was concentrated by a sink-float process to yield a roasted sink product containing 57.06 per cent manganese.

Locality 114. Trepassey

Reference: Snelgrove and Baird, 1953, p. 89.

A deposit of bog manganese is said to contain 32 per cent manganese.

Locality 115. Black Head, Lawn Harbour area

Reference: Van Alstine, R.E.; Geology and mineral deposits of the St. Lawrence area, Burin Peninsula, Newfoundland; Geol. Surv., Newfoundland, Bull. No. 23, 1948, p. 42.

Dark, sandy, manganiferous shale occurs in Cambrian beds. The manganese minerals are rhodonite and manganese oxide. Analysis of the best grade material showed 8.82 per cent manganese oxide.

Brown, disc-shaped manganese oxide concentrations were found on the bed of Overland Pond, at Little St. Lawrence.

Table 4

Occurrences of Mineralogical Interest
(Not plotted on the Metallogenic Map)

Mineral or Material	Location	References
Alabandite (MnS)	Contact claims, near Cassiar, B.C. (NTS 104 P/4)	American Mineralogist, vol. 39, Nos. 5 and 6, pp. 527, 528; Geol. Surv., Canada, Mem. 319, p. 120.
Columbite ((Fe, Mn) (Cb, Ta)$_2$O$_6$)	Huron claim, Pointe du Bois, Manitoba. Lat. 50°15' and Long. 95°30' (2.17% MnO)	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 166, 270, 271.
	Woodcox mine, Monteagle tp., Ontario (9.06% MnO)	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 211, 260, 261.
	Lyndoch tp., Ontario (10.22% and 10.24% MnO)	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 230, 260, 261.
	New Ross Corner, Nova Scotia.	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 257, 260, 261.
Concretions	Nova Scotia Lakes, north of Halifax (Fe_2O_3 16.56% MnO_2 35.29%)	Trans., Royal Soc. of Canada, vol. XXIX, Sec. III, 1935, pp. 163-180.
Cummingtonite and other silicates containing manganese	Mount Reed-Wabush Lake area, Quebec-Labrador.	Klein, Cornelis, McGill Univ. M.Sc. thesis, 1960. Kranck, Svante, H., Mass. Inst. Technol., Ph.D. thesis, 1959.
Danalite (3(Fe, Zn, Mn) $BeSiO_4$.ZnS)	Walrus Island, Paint Hills Islands, James Bay (Lat. 52°56'; Long. 79°00') (approx.).	Geol. Surv., Canada, Paper 60-21, 1960, p. 27.
Franklinite (Fe,Zn, Mn)O.(Fe, Mn)$_2$O$_3$	Madoc township, Hastings Co., Ont.	Ont. Bur. Mines, vol. 9, 1900, p. 198.
Helvite (3(MnFe) $BeSiO_4$.MnS)-Danalite	Needlepoint Mountain, McDame area, B.C. (Lat. 59°08'; Long. 129°46').	Geol. Surv., Canada, Paper 60-21, 1960, p. 6.

Hematite	Wabana deposits, Bell Island, Nfld. (0.06 to 3.12% MnO)	Geol. Surv., Canada, Mem. 78, 1915.
Hematite and manganese oxide as veinlets	Shippigan Island, N.B.	Geol. Surv., Canada, Paper 57-2, 1957, pp. 17-19.
Iron ore containing manganese	Gunflint Lake, Thunder Bay district, Ontario. Lat. 48°06'; Long. 90°40' (approx.).	Hanson, 1932, p. 104.
Lepidolite Chiefly ($(OH,F)_2KLi Al_2Si_3O_{10}$)	Bear claim, Pointe du Bois, Manitoba. Approximate Lat. 50° 15' and Long. 95°30' (2.05% MnO).	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 156, 264, 265.
	Leduc mine, Wakefield township, Quebec (4.19% MnO).	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 240, 264, 265.
Lithiophyllite ($Li_2O.2(^{Fe}_{Mn})0.P_2O_5$)	Bernic Lake, Man. Lat. 50°25'; Long. 95°25' (approx.).	Geol. Surv., Canada, Paper 57-3, 1957, p. 21.
	Bear claim, Pointe du Bois, Manitoba, N.E. of Lat. 50°15' and Long. 95°30'. (45.18% MnO).	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, 1932, pp. 156, 164, 165.
Psilomelane ($BaMn^2Mn4_8O_{16}(OH)_4$)	Ilgachuz Mountains, B.C., Lat. 52°45'; Long. 125° 15' (approx.).	Geol. Surv., Canada, unpublished information.
Rhodonite ($MnSiO_3$)	Contact group, near Cassiar, B.C. (NTS 104P/4).	Geol. Surv., Canada, Mem. 319, p. 120.
	Boulder Creek, North Thompson River, B.C.	Geol. Surv., Canada, mineral collection.
	Mount Reed property, Mount Wright, Que., Lat. 52°05'; Long. 68° 05'.	Kranck, Svante H., Mass. Inst. Technol., Ph.D. thesis, 1959.

Schefferite (manganese pyroxene)	Head of Marshall Creek, Dezadeash area, Yukon. (Lat. 60°58'; Long. 137° 24').	Geol. Surv., Canada, Mem. 268, p. 28.
Spessartite ($3MnO.Al_2O_3.3SiO_2$)	Parry Sound district, Ontario.	Geol. Surv., Canada, Sum. Rept. 1921, pt.D, p. 60.
	Villeneuve Mica Mines, Quebec. (Lat. 45°50'; Long. 75°30') (approx.).	Can. Rec. Sci., vol. IV, 1890-91, p. 226.
	Fiquery township, Quebec, Lat. 48°30'; Long. 78°10' (approx.).	Que. Dept. Mines, P.R. 257, 1951, p. 15.
	Fiedmont area, Quebec, Lat. 49°00'; Long. 78° 10' (approx.) (38% MnO).	American Mineralogist, vol. 38, Nos. 1 and 2, 1953, p. 35; Geol. Surv., Canada, Mem. 253, p. 47.
Triphyllite ($Li_2O.2(^{Fe}_{Mn})O.P_2O_5$)	Huron claim, Pointe du Bois, Manitoba (N.E. of Lat. 50°15' and Long. 95°30')(21.13% MnO).	Geol. Surv., Canada, Econ. Geol. Ser. No. 11, pp. 166, 270, 271.
Wolframite ($(FeMn)WO_4$)	Fiddler claims, Alaska Highway, Yukon Territory, Lat. 60°08'; Long. 130°26' (approx.). (12.6% MnO).	Geol. Surv., Canada, Paper 44-25, 1944, p. 17.

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