Crystal of selenite (crystalline gypsum) half natural size. From the tenth level, Kingdon Mining and Smelting Company, Galetta, Ont.

CANADA
DEPARTMENT OF MINES
HON. CHARLES STEWART, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

MINES BRANCH
JOHN MCLEISH, DIRECTOR

The Gypsum Industry of Canada

BY

L. Heber Cole

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THE GYPSUM INDUSTRY OF CANADA

INTRODUCTORY

The gypsum industry of Canada is one of the more important non-metallic industries of the country, and one which in the past ten years has made rapid advances.

The Mines Branch of the Department of Mines in 1911, issued a report on the gypsum deposits of the Maritime Provinces, and another report in 1915, which dealt with the gypsum deposits of the whole of Canada. Previous to the issuing of these reports, descriptions of the gypsums of Canada were to be found only as incidental references in the reports of the Geological Survey; the Statistical Division of the Mines Branch, Department of Mines; and in the reports of the various provincial Bureaus of Mines.

While the report of 1915 endeavoured to cover the industry in Canada up to that time, it is now over fourteen years since it was published, and the changes and advance made in the industry during that time are quite marked, so that much of the material in that report is now out of date.

The present report is intended in part to replace the report of 1915 upon which it is based. Several sections of the old report, such as the chapters on Mineralogy and the Theories of Origin, have been omitted while new features have been added. Large-scale samples have been obtained from many of the properties and these have been tested for their plaster-making qualities and the results obtained should add materially to the value of the present report. An entirely new chapter on the gypsum industry, its possibilities in Canada and abroad, is included. New deposits have been described and the description of all deposits and statistics brought up to date, while the chapter on Technology has been rewritten. It is hoped that the rearrangement of the data taken in conjunction with the 1915 report will give a fairly complete review of the gypsum industry.

Acknowledgments

The writer gratefully wishes to acknowledge the assistance rendered by several members of the staff of the Mines Branch in the preparation of this report, notably R. A. Rogers of the Ore Dressing Division and H. A. Leverin of the Chemical Division.

R. A. Rogers, to whom was assigned the work of testing the samples collected, made all the calcining tests as well as the other tests given in this report and is the joint author of Chapter VIII.

H. A. Leverin has made all the chemical analyses given in the report unless otherwise specifically stated.

The thanks of the writer are also due to the several managers of the properties visited, for their many courtesies, kindnesses, and helpful suggestions, for the information regarding their mills and processes, and for the scrutiny of the manuscript of this report which deals with their own properties.

CHAPTER I

GYPSUM OCCURRENCES IN NOVA SCOTIA

INTRODUCTORY

The gypsum deposits of Nova Scotia are the largest at present known in Canada. They are of Carboniferous age and are closely associated with beds of anhydrite, limestone, and brick-red, argillaceous shales. In nearly all the deposits, the gypsum is found resting on beds of anhydrite or with lenses of this latter mineral enclosed in it with the greatest irregularity.

Although the deposits present many local differences in colour and texture they are, on the whole, very similar. The gypsum in the greater part of the deposits can be classed as compact to crypto-crystalline, and the colour varies from white to white mottled with grey. Selenite is sometimes found associated with the massive gypsum, in veins or masses up to a foot or more in thickness ,and with the usual transparency and cleavage, or as small, smoky-coloured crystals evenly disseminated throughout the massive material. The overburden is, in many of the deposits, of considerable thickness; thus the problem of its removal is one of great importance.

Outcrops are encountered throughout the whole of the northern half of the province, extending from the district about Windsor, Hants county, eastwards to the district around Antigonish, Antigonish county, and also throughout the northwestern half of the island of Cape Breton as well as along the east coast as far north as Aspy bay. In Cumberland county another gypsiferous area occurs near Nappan, to the south of Amherst; and the gypsum outcrops intermittently eastwards through Oxford as far as Malagash point in which place it is probably associated with the salt occurring at this place.

Many of these deposits have been operated or are being operated at present and the gypsum industry is next in importance to coal among the mineral industries of the province.

HISTORY OF THE GYPSUM INDUSTRY IN NOVA SCOTIA

The occurrence of gypsum in Nova Scotia has been known from the time of the earliest settlers but records of the early years of the industry are scarce. Gypsum from Nova Scotia in the lump form was a standard article of commerce in a small way at the time of the Revolutionary War, and for over forty years, dating from approximately 1770 down to 1810 or later, an important part of the supply of gypsum used in the United States came from Nova Scotia. One is able to follow in outline the course

of this material down the coast from the bay of Fundy to Portland and Boston, thence southwards on coasting vessels trading with Baltimore, Alexandria, and other southern points where the boats picked up flour and other commodities for transportation north.

The operators, in the early years of the industry, were principally farmers, the owners of the land on which the gypsum occurred, and they quarried the rock and hauled it to the nearest shipping point where it was either sold to local traders or else, when the tonnage was sufficient, a group of farmers would charter a small vessel and ship to some port on the Atlantic seaboard of the United States, at which place it was prepared and distributed for use as a fertilizer.

The war of 1812 between England and the United States interfered with the industry for the time being, but a few months after the close of the war shipments were evidently resumed since, according to How,[1] John De Wolf, of Windsor, N.S., contracted to supply 3,000 tons of gypsum, delivered at Eastport, Maine, for a price of $9.50 per ton.

Shortly after this time the industry, assuming larger proportions, was put on a better business basis, special attention being paid to production and exporting problems. Companies were formed for the special purpose of producing gypsum, and contracts were made in advance with the mill owners in the United States so that a market for all the material produced was assured.

Attempts to manufacture finished products from gypsum in Nova Scotia were made in the early days but in most cases were unsuccessful owing to the fact that the local demand for such products was small and as soon as the trade in the manufactured article with the United States assumed any importance, a prohibitive tariff was placed on such material by the United States Government and in consequence the mills had to close down.

Probably the first mill to operate in Nova Scotia was one at Windsor, which produced a small tonnage of "selenite cement" for home consumption.

On account of the large proportion of the gypsum produced in this province being exported in the crude state to the United States, the gypsum trade in the past fluctuated with conditions in that country. Production, on the whole, gradually increased, and in the year 1872 reached approximately 100,000 tons. From that year to the year 1905, the annual production remained with few exceptions between 100,000 and 200,000 tons.

The period between 1906 and 1913 saw an increased activity in the industry with production greatly increased, 1913 being a banner year with a production of 404,800 tons. The war years, namely from 1914 to 1918, hit the gypsum industry of the province hard, the greatest depression being in 1918 when only 49,365 tons were produced, the lowest production for over half a century.

Since the war, however, the gypsum industry has made a remarkable recovery and the production of 971,736 tons in 1928 set a record over all previous years, being nearly 100,000 tons greater than the total production of the whole of Canada two years previously (1926).

[1]Dr. How's notes to his Mineralogy of Nova Scotia.

OCCURRENCES

Gypsum outcrops are widespread over large areas in certain parts of Nova Scotia. It is obviously impossible, therefore, in the scope of this report, to mention in detail all the individual exposures. Brief descriptions of certain areas will be given by counties and detailed references will be made only to such properties in each area that are working, together with a few other typical outcrops. It should not, however, be assumed that these are the only deposits in an area that are of economic importance, many other localities being probably equally as good as those chosen for examination. An endeavour was made, however, in the time available, to choose and examine such deposits in each area as would be representative and typical of the whole area.

CAPE BRETON ISLAND

The island of Cape Breton has extensive exposures of Carboniferous rocks of the Windsor series in which gypsum is found, and in consequence gypsum outcrops are common. A reference to Figure 1 shows the wide distribution of the Windsor series on this island, and with many of the exposures being close to water transportation a number of gypsum quarries have been opened up in this district. Victoria, Richmond, and Inverness are the three counties from which the greater part of the gypsum production has been made.

Victoria County

Gypsiferous areas are well exposed in this county. In that part of the county lying between St. Patrick channel and the Bras d'Or lake a large area is underlain by beds of gypsum and anhydrite. In places, cliffs of gypsum or anhydrite over 100 feet high are exposed and a number of properties have been or are at present being operated. Exposures of gypsum are also to be seen on the north side of St. Patrick channel and up the Middle River valley, also extending easterly through Nyanza and Baddeck. At the head of Baddeck bay, almost as far east as Big Harbour, large areas of gypsum of excellent grade are to be found, the outcrops continuing northward to St. Ann harbour and the valley of the North river.

Along the east shore of the island from St. Ann harbour as far north as Wreck Cove, gypsum outcrops are found in a narrow belt along the shore. To the north of "Big Smoky," around Ingonish, another area of gypsiferous rocks is to be found, and still another at Aspy bay at the north end of the island.

Aspy Bay

A gypsiferous area some 8 square miles in extent occurs on the east shore of Cape Breton at Aspy bay. Two rivers cut through the gypsum beds at this point exposing cliffs from 40 to 60 feet high from which rock could be easily quarried.

The gypsum is massive and compact, mottled cream and white in colour, with only an occasional patch of anhydrite showing.

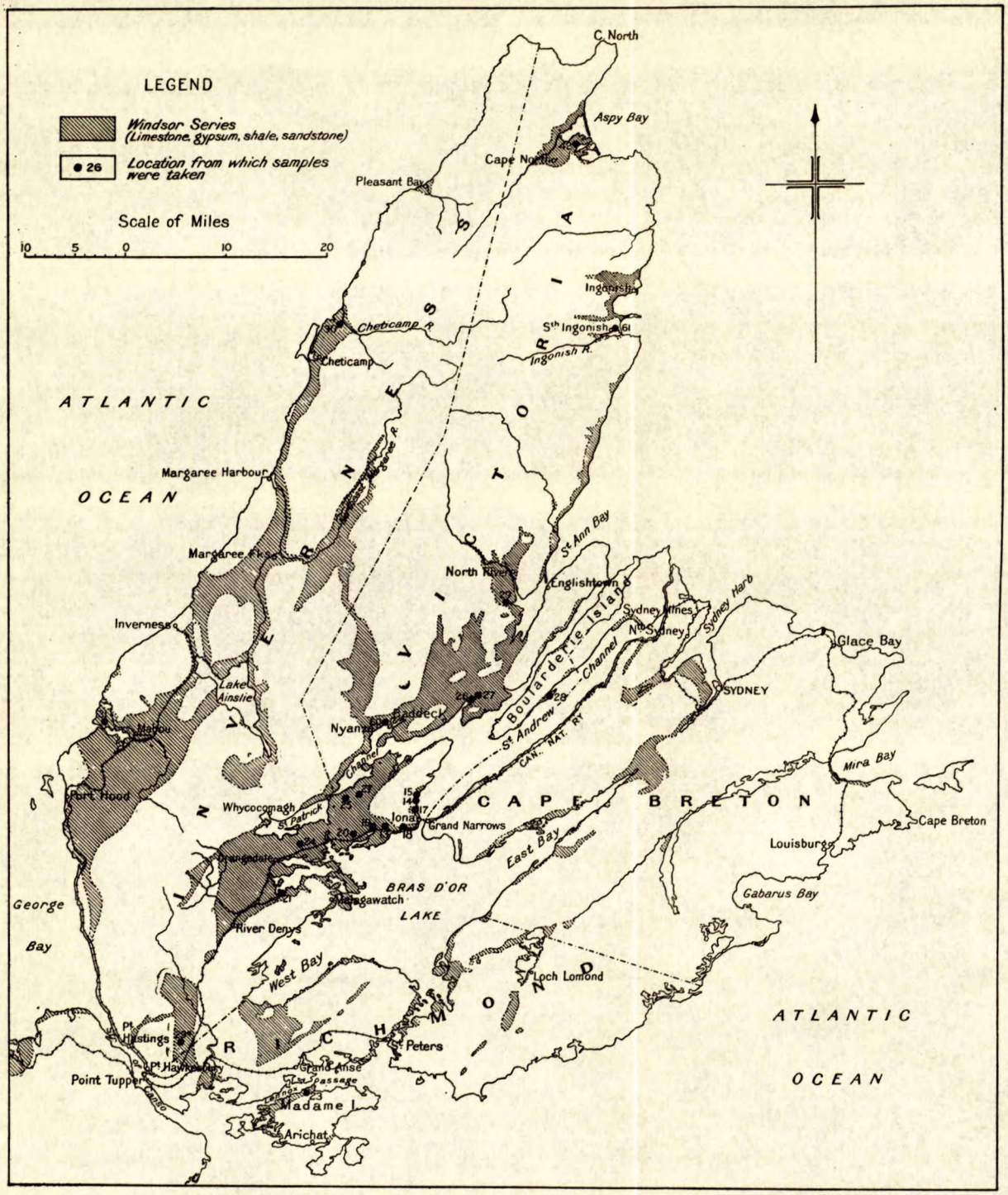


Figure 1. Sketch map showing gypsum occurrences in Cape Breton island, N.S.

A. Crushing plant of the Ingonish Gypsum Company, Ingonish, Victoria county, Nova Scotia.

B. Conveying-belt and shipping pier, Ingonish Gypsum Company, Ingonish, Victoria county, Nova Scotia.

To develop these deposits a channel through the bar at the mouth of the harbour would have to be dredged in order to give access to North pond at Dingwall. The water in this pond has sufficient depth for shipping purposes.

Sample No. 42 was taken from this area by J. W. McFarlane at the request of the writer.

Ingonish

The deposits near Ingonish have been operated for the past few years by the Ingonish Gypsum Company, Ltd., a subsidiary of the Canada Cement Company.

The quarry is on the north side of South Ingonish harbour, at Ingonish beach. The overburden is light except in potholes and this has been stripped off before quarrying the rock underneath. Open-cut methods are employed and the quarry has been worked to a depth of 35 feet, with a width of over 100 feet and a length of 600 feet or more. Considerable anhydrite has been encountered in the more recent workings.

The rock is drilled by jackhammer drills and 40 per cent dynamite is used for breaking. Three electrically operated, Marion No. 21 shovels with $\frac{3}{4}$-cubic yard buckets handle the stripping and loading operations. Tracks are laid throughout the quarry and cars of 9 tons capacity carry the material to the foot of the incline to the crusher plant. Three gasoline locomotives haul the cars in the quarry. A 25-h.p. electric hoist hauls the cars up the incline where they are dumped into a bin over the crusher.

Two Vickers, crude-oil engines having 240 and 120 h.p. capacity operate generators to supply electric current for the motors employed on the property.

In the crushing plant the rock is passed through a series of crushing units until it is reduced to 4 inches or finer in order to facilitate loading and unloading operations. From the crushing plant it is conveyed by a 24-inch belt, 200 feet long, to the 6,000-ton storage bin at the end of the shipping pier. From this bin it is loaded by gravity into steamers for shipment to Montreal and the United States.[1]

Sample No. 61 for testing was taken from the stock-pile at the shore end of the loading belt on this property.

Goose Cove, St. Ann Harbour

At Goose Cove, St. Ann harbour, the Victoria Gypsum Mining and Manufacturing Company, Ltd., operated extensive quarries for a number of years but active quarrying was suspended in 1916.[2]

A large amount of good rock is still available from this area and sample No. 29 was taken from the face of the abandoned quarries for testing.

[1]This property has been closed down and dismantled as the Canada Cement Company has recently made a long-term contract with the Atlantic Gypsum Products Company to obtain its requirements from Cheticamp, N.S.

[2]A description of these quarries is given in Mines Branch Report No.245, p. 35, covering operations up to 1913, and further details are to be found in Nova Scotia Mines Reports for 1911-1916, inclusive.

Island Point, Boularderie Island

An interesting exposure of gypsum occurs on the south side of Boularderie island at Island point, a narrow peninsula 2 miles long running parallel to the main part of the island. The point projects into St. Andrews channel and the bay between it and the main part of the island affords excellent facilities with deep water for transportation purposes. Gypsum bluffs, 40 to 50 feet high are exposed on this point and good opportunities for quarrying are afforded. Towards the north end of the point on the south exposure, limestone beds are exposed overlying the gypsum, but at the south end the overburden is loose clay and loam only a few feet in thickness. Many potholes and depressions occur but no anhydrite was visible in any of the outcrops examined.

The rock is massive and compact and in colour is a mottled grey-white.

According to a number of estimates that have been made by different engineers examining this property over 10,000,000 tons of gypsum are available above water level.

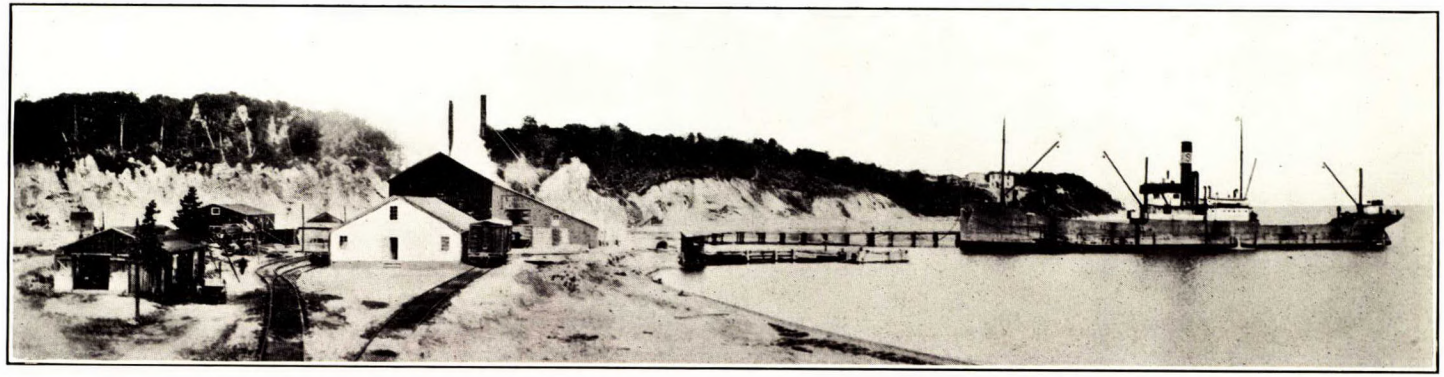
In 1928 the property was purchased by the Big Harbour Gypsum Syndicate with a view to opening up the deposit. Syndicate shares were sold on the understanding that an operating company would later be formed. Recently the Gypsum International Corporation, Limited, has obtained a charter from the state of Georgia, which charter is registered in Canada and plans are under way to erect a calcining plant at Savannah, Georgia.

Sample No. 28 was taken from several outcrops at the southwestern end of the point.

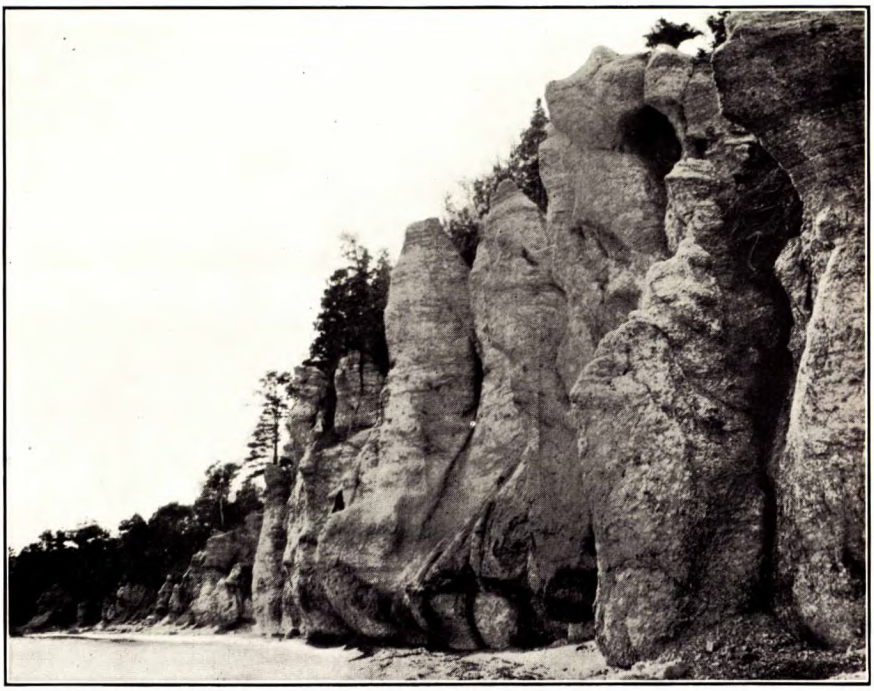
Baddeck Bay

Operations were commenced during the summer of 1927 on a gypsum property at the head of Baddeck bay. This property, owned and operated by the North American Gypsum Company, consists of 630 acres, practically all of which is underlain by gypsum with very little overburden. Several good quarry faces have been opened up at a distance of 1 to 1½ miles from tide water, and a standard gauge railway affords transportation facilities to the shipping dock, where the crushing plant is located.

The drilling is done by power augers operated by a portable gasoline compressor, and 40 per cent dynamite is used to break the rock. From the quarry face it is hauled by horse and cart to a loading platform from which it is loaded into 2-ton cars for haulage by a gasoline engine to the shipping wharf. At the crushing plant it is hauled up an incline and then passes through a Butterworth and Lowe jaw crusher which breaks to 4 inches, after which it passes to a gyratory crusher breaking to 2 inches. From the gyratory it goes over screens to remove the fines and the coarse is stored in an open stock-pile near the loading dock. This storage has a capacity of about 10,000 tons of crushed rock. A link belt loader conveys the rock from the stock-pile to a 36-foot link belt conveyer, thence to a 60-foot conveyer which loads directly into the vessel. These machines have a capacity of 200 tons per hour.



Quarry, mill, and shipping pier, Iona Gypsum Products Company, Grass Cove, Victoria county, Nova Scotia.



A. Gypsum cliffs on Island point, Boularderie island, Victoria county, Nova Scotia.

B. Gypsum quarry of the Connecticut Adamant Plaster Company, Cheverie, Hants county, Nova Scotia.

The rock is mottled white to alabaster white in colour and very little anhydrite was seen in any of the exposures examined. Three drill holes have been sunk on this property to depths of 30, 38, and 40 feet respectively, all in good clean gypsum with no traces of anhydrite.

Two samples were taken for testing:—

No. 26 from the Morrison quarry, one mile east of the head of Baddeck bay, and No. 27 from quarry No. 2, one-half mile east of the Morrison quarry.

Gypsum from this property is at present being shipped in the crude state to a number of firms on the Atlantic seaboard of the United States.

Iona: Grass Cove

At Grass Cove, 2 miles north of Iona station on the Canadian National railway, the Iona Gypsum Products Company, Ltd.[1] has been operating a quarry and mill since January, 1914. The mill is on the shore adjacent to the quarry and both are connected with the Canadian National railway by a spur owned and operated by the company.

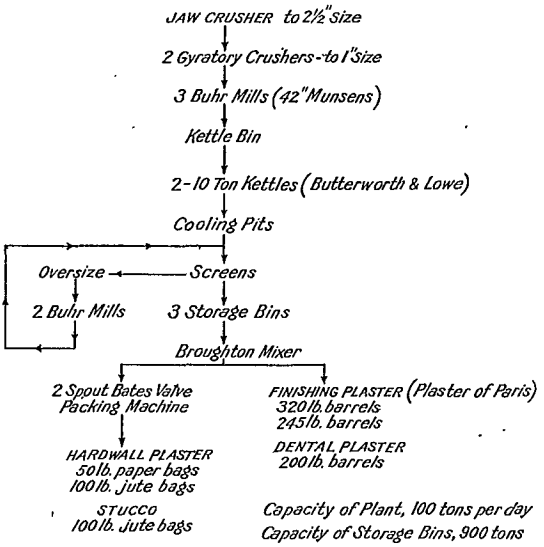


Figure 2. Flow-sheet of mill of the Iona Gypsum Products, Ltd., Iona, N.S.

The quarry is situated 500 feet from the mill and the face at present opened is 600 feet long with a height averaging between 25 and 30 feet. Very little overburden has had to be handled so far, and this is allowed to come down into the quarry, the shore being close at hand affords a good opportunity for the disposal of the waste and stripping. Very little anhydrite is encountered.

[1] Recently changed to Iona Consolidated Gypsum Corporation.

A recently built breakwater and pier affords excellent facilities for water shipment either of the crude rock or the calcined product.

The rock is drilled with hand augers and 40 per cent dynamite is used for breaking.

The broken rock is hauled in 1-ton horse-drawn cars on tracks laid to different parts of the face. On arrival at the mill the cars are pulled up an incline and dumped into a bin over the crusher. The flow-sheet of the mill is shown in Figure 2.

Markets for the products from this point have been found throughout the Maritime Provinces, Quebec, and Ontario, and some shipments have been made to the New York market in spite of adverse tariff. A certain tonnage has also been shipped to the New Zealand market.

In addition to the property being operated, the company owns other deposits adjoining on the north and south of the plant. It has been estimated that in the holdings of this company there is an available tonnage of gypsum in excess of 25,000,000 tons above water level.

Two samples, Nos. 14 and 15, were taken from the working quarry for testing, No. 14 being an average sample of the material used for hardwall plaster, and No. 15, the material used for plaster of Paris.

Iona: Plaster Cove

One-half mile to the north of Iona station on the main line of the Canadian National railway a plaster deposit has been operated by the Cape Breton Gypsum Company. The quarry face which is only 100 yards west of the mill has a face 30 feet high and 100 feet long, the material being hauled from the quarry to the mill in carts. The rock is a massive, compact gypsum, mottled grey-white in colour.

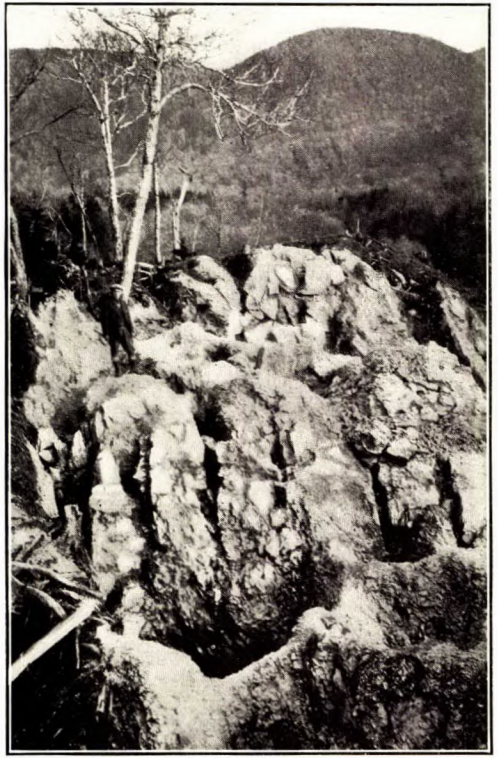
The plant consists of a jaw crusher, Allis-Chalmers hammer mill, and an 8-foot, calcining kettle of the Butterworth and Lowe type. Two vertical boilers supplied steam to a Leonard engine for power purposes. While in operation this plant prepared several grades of plaster, but has been idle now for several years. Sample No. 17 was taken from the quarry for testing.

Jamesville

Two miles west of Iona station on the Canadian National railway gypsum outcrops on the north side of the highway on the property of J. R. McNeil. No development work has been done on this property. The area is covered with slight overburden and the rock outcrops in many places. The rock is massive, greyish white in colour with occasional patches of anhydrite. Sample No. 18 was taken from this property.

Jamesville West

On the farm of Neil Campbell, Jamesville West, on the north side of the Canadian National railway, about 1 mile east of McKinnon Harbour station, precipitous cliffs of gypsum and anhydrite occur which can be seen from the railway. The property is controlled by the Newark Plaster



A. Stripped surface in the quarry of the Atlantic Gypsum Products Company, Cheticamp, Inverness county, Nova Scotia, showing cleaned out potholes. (*See* p. 12.)

B. Working face in the quarry of the North American Gypsum Company, Baddeck bay, Victoria county, Nova Scotia.

Company but has not been operated. A long narrow valley runs through this property with gypsum exposures on each side. In places the face is 80 to 100 feet high and the surface rock has broken down so that there is a lot of broken gypsum at the foot of the cliffs. The rock is massive and compact and a slight grey in colour. Sample No. 13 was taken from this deposit.

McKinnon Harbour

On the property of H. M. Gillis at McKinnon Harbour, gypsum outcrops for over a distance of a mile in the valley of a little creek to the north of the main highway. No work has been done on this property but a large tonnage of rock appears to be available. Although this property has a frontage on the water, shipment would have to be at some point farther to the west, probably at Ottawa brook, in order to get good harbour facilities. The rock is massive and compact and greyish white in colour with no anhydrite showing. Sample No. 19 was taken from this property.

Ottawa Brook

One-half mile to the north of the trestle on the Canadian National railway, 500 yards west of Ottawa Brook station, are extensive quarries owned by the Newark Plaster Company. There are three main faces, and for the past few years work has been carried on during the winter months. The faces vary from 25 to 35 feet in height, and the broken rock is hauled by carts to a loading platform from which it is transported over a narrow gauge railway to the company's shipping pier at the entrance of McKinnon Harbour, a distance of 1¼ miles. Steamers take the material to Newark, N.J., for calcination.

At the wharf the rock is crushed to 3-inch size and screened to remove fines, the oversize going to storage bins of 2,500 tons capacity. From the storage bins the rock is loaded by 6 hoppers to a belt conveyer which empties directly into the boats, a 2,000-ton boat being loaded in 9 hours.

The rock from this quarry is massive and compact, creamy white in colour. Considerable anhydrite and limestone are found associated with the gypsum in parts of the quarries. Sample No. 20 was taken from the stock stored in the shipping bin.

Little Narrows

In the area to the south of St. Patrick channel from Little Narrows to South Cove, running south to the Washaback river, many outcrops of gypsum and anhydrite are to be found, in some places exposed in cliffs 100 feet in height. Several of these outcrops have been worked from time to time but at present none are being operated.

McAskill Property. Two miles east of Little Narrows, gypsum outcrops on the west bank of a small creek running into St. Patrick channel and half a mile south of the shipping wharf. The deposit was worked a few years ago, but is idle at present. An old trestle enabled the rock to be trammed to the shipping wharf from which it was loaded into vessels for shipment.

The rock is exposed in a face 100 feet in length and 40 feet in height. It is massive and compact and mottled grey-white in colour. Sample No. 25 was taken from this deposit.

Hazeldale. To the east of the highway running from Little Narrows to McKinnon Harbour and about 2 miles directly south of Hazeldale, there is an extensive outcropping of gypsum on the east side of a small creek running into St. Patrick channel. The largest outcrop rises in a cliff 60 to 70 feet high and is exposed for over 300 yards in length. The rock on the surface is badly disintegrated but when a fresh face is exposed, it is compact, massive, and creamy white in colour. No anhydrite was noticed and a large tonnage of gypsum is available. The area all around this main outcrop is noticeably gypsiferous and it is probable that other outcrops nearer the water will be found. Sample No. 22 was taken from fresh faces in the main outcrop.

Nyanza

On the north side of the highway from Whycocomagh to Baddeck, one-half mile east of Nyanza, many outcrops of gypsum associated with limestone are found on the McRae property. These outcrops are only one-half mile from the waters of Indian bay, an arm of St. Patrick channel. The outcrops in places lie 30 feet above the level of the creek which runs through the property and higher faces could probably be developed farther back from the water. The rock is massive and compact, and mottled grey and cream in colour. Sample No. 60 was taken from this deposit.

Richmond County

In Richmond county, gypsum deposits are to be found at West bay on the north side of Madame island to the south of Lennox passage and on the south side of Great Bras d'Or lake in the vicinity of Campbell, Hay, and McNab coves.

Madame Island

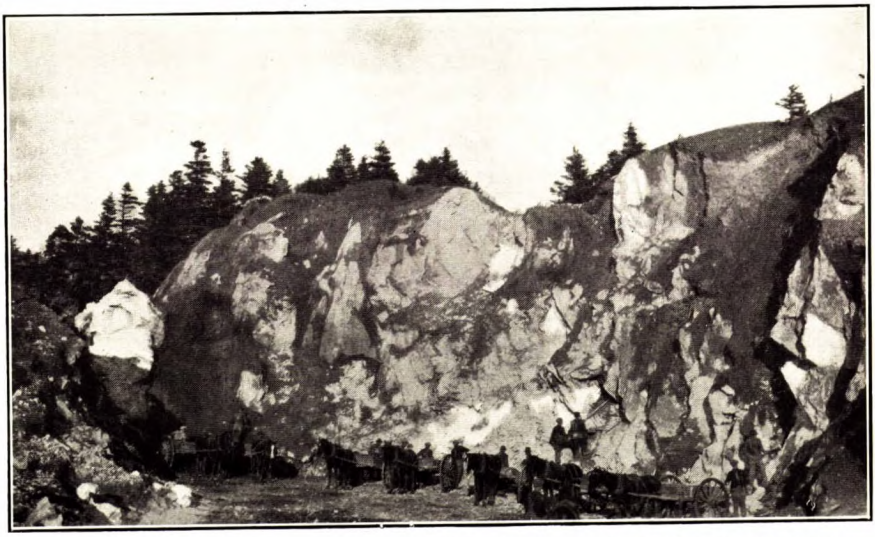
Probably the largest gypsiferous area in this county is that occurring on the north shore of Madame island to the south of Lennox passage. The area is over 3 square miles in extent and the most prominent outcrops occur one mile back from the shore $1\frac{1}{4}$ miles west of the bridge to the island from the mainland. Crude rock was exported from these deposits in large quantities to the United States a number of years ago by H. C. Higginson of Newburgh, N.Y., but the property is now idle.

The rock is massive and compact to granular, grey in colour, and associated with anhydrite which occurs in irregular patches in the outcrops. Narrow gauge tracks were run from a wharf on Lennox passage to a number of working faces but these tracks have all been torn up and only the road-bed remains. Sample No. 23 was taken from several faces for test.

Inverness County

Gypsum deposits are widespread in Inverness county, some being very favourably situated with respect to water transportation. The main deposits occur near Cheticamp, Margaree, Mabou, Inverness, Alba, River Denys, Askilton, and Port Hastings.

A. Stock-pile, North American Gypsum Company, Baddeck bay, Victoria county, Nova Scotia.



B. Working face in the quarry of the Nova Scotia Coal and Gypsum Company, Mabou, Inverness county, Nova Scotia.

Askilton

About 5 miles northeast of Port Hastings a gypsum area 2 miles in extent occurs on the Macdonald property, one mile west of the River Inhabitants road and 3½ miles from the nearest point on the Canadian National railway main line. The gypsum occurs in steep bluffs 30 feet high on each side of a small creek. Very little overburden is present but no work has been done on the property. The rock is massive and in places sugary to compact and mottled grey and white in colour. No anhydrite was visible.

Sample No. 29A was taken from this property.

River Denys

A deposit of gypsum occurs in cliffs on the east bank of the bay into which Denys river empties. These cliffs rise abruptly 30 feet from the water's edge. The surface of the land for over a quarter of a mile back from the water is full of potholes indicating that it is underlain with gypsum with little overburden. The rock is massive and compact, mottled grey and white in colour, with no anhydrite showing. Sample No. 21 was taken from this deposit.

Alba

Two miles to the northwest of Alba, a station on the main line of the Canadian National railway, gypsum outcrops in a number of places on both sides of a valley from the western boundary of the farm of John N. Matheson eastwards for over half a mile; the typical hummocky topography of land underlain by gypsum indicates that the tonnage of material is large. As one follows the outcrops southeasterly towards Alba the elevation gradually drops until half a mile from the water the creek runs through a meadow not more than 20 feet above sea-level. A narrow gauge railway could readily be built from the water to serve this deposit.

At one point in the bottom of this valley the creek has eroded away the overlying gypsum, exposing heavy beds of hard blue anhydrite, but above this elevation the rock appears to be completely free of anhydrite.

The rock is massive and compact, and creamy white in most of the exposures, but in several places the sugary or granular type was encountered and where this was seen it was very white. A general sample, No. 24, was taken from this deposit.

Mabou

On the north side of the mouth of Mabou harbour, the Nova Scotia Coal and Gypsum Company, a subsidiary of the Gypsum, Lime and Alabastine, Canada, Ltd., have operated, during the past two years (1927-1928), a large gypsum quarry from which they produced over 35,000 tons.

The quarry face is over 50 feet in height and as the overburden is first removed by horse and cart the quarried rock is clean. The broken rock is trammed in small cars to the crusher at the storage shed 200 yards distant. There is ample room for extension of the quarry and by means of only a short tunnel another large area of gypsum, facing on a deep bay to the east of the present workings, could be made readily available.

The rock from the quarry is hauled up an incline and dumped into a hopper from which it feeds into a jaw crusher set to 3 inches. From the crusher it is elevated to a belt which deposits it in a storage shed of 10,000 tons capacity. A conveyer belt (24-inch), running in a tunnel underneath the storage shed enables the rock to be loaded directly into vessels.

The mouth of the harbour has been dredged to enable the passage of 4,000-ton boats.

The rock in this quarry is massive and compact, mottled grey-white in colour, and no anhydrite was noticed. Sample No. 31 was taken from different parts of the storage shed which was full at the time the sample was taken.

Shipments were made from this quarry to the mill of the Gypsum, Lime and Alabastine, Canada, Ltd., at Montreal.

Cheticamp

At Bellemarche, Cheticamp district, the Atlantic Gypsum Products Company are operating the property once owned by the Great Northern Mining and Railway Company and later by the P. M. O'Neil Gypsum Company. The gypsum area in which the quarries are situated, is 3 miles east of the village of Cheticamp and covers 3 square miles, and is estimated to contain several million tons of a good grade of gypsum.

Three faces are being operated which, when development work is completed, will place the company in an excellent position to quarry in the most economical manner large tonnages to meet any demand.

The upper quarry has two faces, each 150 feet in width and over 90 feet high. The overburden is light, not more than 3 feet except in the potholes, and the surface is kept cleaned off for a sufficient distance back from the face to enable quarrying of clean rock to be continuous. This work is done by hand, and each individual pothole is cleaned out until it becomes so narrow that a shovel cannot be conveniently used. *See* Plate VA. The cost of stripping is extremely low per ton of rock mined, and the expense involved is amply repaid by the cleanliness of the product and the time saved in quarrying, eliminating as it does the sorting and picking required where the overburden is allowed to slump down in the quarry with the good rock. It also enables the recovery of a certain tonnage of good rock which under other methods is unavoidably lost with the refuse material carted to the waste dump.

The No. 1 lower quarry has been opened up 900 feet to the north of the old quarry and on a level approximately 100 feet below the floor of the upper quarry. Here a face of over 100 feet of gypsum has been exposed for a length of 400 feet with possibility of extension both east and west for several hundred feet in each direction. An electric shovel handles the broken rock in this quarry and work is now in hand to extend the standard gauge railway to the east running parallel to the face.

The No. 2 lower quarry has been recently opened on the western face for a length of 100 feet and a height of over 100 feet and eventually will be extended northward and eastward to join with No. 1 quarry. A steam shovel handles the rock from this quarry into the cars.

No anhydrite was to be seen in any of the workings. The rock is massive, compact to slightly crystalline, and grey to mottled greyish white in colour.

The broken rock from the upper quarry is hauled by horse and cart to a loading chute on the edge of the escarpment which carries the rock directly into railway cars.

Three portable Sullivan compressors deliver compressed air to the Ingersoll-Rand jackhammer drills which employ $\frac{7}{8}$- and 1-inch steel drill holes up to 20 feet in depth. An Ingersoll-Rand, Leyner sharpener prepares all the drills for use.

A standard gauge railway $2\frac{1}{2}$ miles in length affords transportation facilities to the company's crushing and storage plant at Cheticamp. Train loads of 12 to 15 cars each, with a capacity of 10 tons per car, can be hauled at a time by a gear-driven steam locomotive. The following is a flow-sheet of the plant at the docks. (Figure 3.)

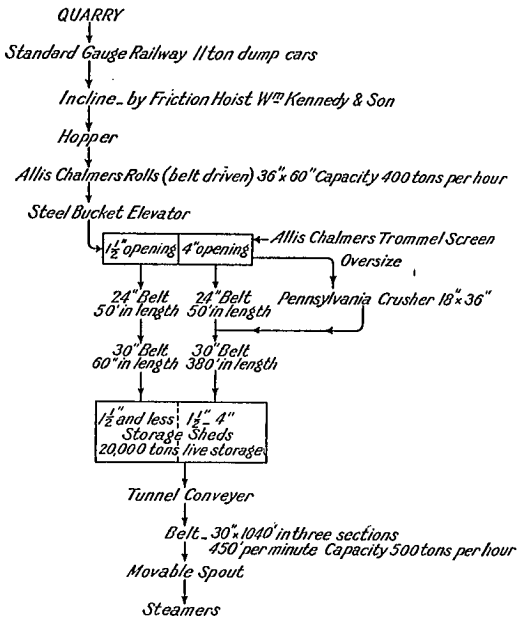


Figure 3. Flow-sheet of crushing plant, Atlantic Gypsum Products Company, Cheticamp, N.S.

The power plant consists of a 6-cylinder Diesel engine developing 360 h.p. and this is sufficient to generate all the electric power necessary for the whole plant, each unit having its own motor.

Sample No. 30 was taken from the storage pile of several thousand tons on the dock at Cheticamp.

NOVA SCOTIA MAINLAND DISTRICT

The deposits of gypsum located on the Nova Scotia mainland may be roughly divided into three main areas, viz., Antigonish, Cumberland, and Hants counties. Of these, the area in Hants is probably the largest and best known, and from it the greatest tonnage has been shipped. The other two areas, while smaller, nevertheless contain extensive deposits of good grade rock and have also produced in the past.

Antigonish County

A large area of Antigonish county is underlain by gypsum beds of considerable thickness. The gypsiferous area is estimated to be over 100 square miles in extent. The rock is well exposed in the northern part of the area, especially around the shores of the harbours of Antigonish, Pomquet, and Tracadie, but extensive bluffs as high as 200 feet are also to be found along the northwestern boundary in the vicinity of Brierly Brook. Here the cliffs rise abruptly from the east side of the creek and are exposed for a length of nearly half a mile. *See* Plate VII B.

Antigonish

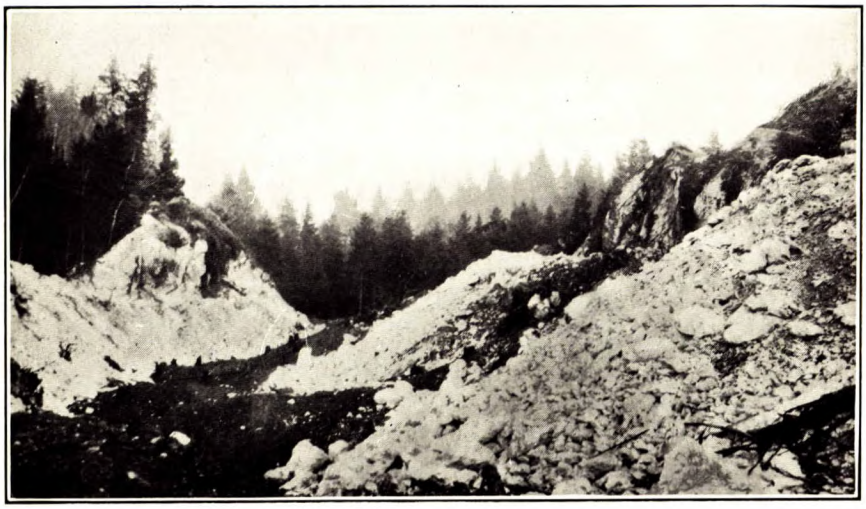
On the west side of the mouth of Antigonish harbour the Nova Scotia Gypsum Company, a subsidiary of the Canada Cement Company, acquired a large tract of land supposedly underlain by gypsum, and during the year 1927, thoroughly prospected their holdings by a churn drill as well as a diamond drill. A small amount of trenching was also done, and the results of this prospecting proved in every way satisfactory.

In 1928 extensive operations were carried on at this property preparatory to production on a large scale. A channel was dredged through the sand bar at the mouth of Antigonish harbour of sufficient size and depth to permit the passage of 5,000-ton vessels, and a shipping pier was built. A road-bed for a railway was excavated and graded from the pier to the quarries 1 mile distant, where a number of faces had been prepared ready for quarrying. The steel was also laid. A concrete power house has been built near the shipping pier, and a large Diesel engine with electric generators installed. Excavation and foundations for the crushing plant are also completed.

However, the property has been closed down recently as the Canada Cement Company has made arrangements to obtain its requirements for a number of years from the Atlantic Gypsum Products Company at Chéticamp. In consequence, the Antigonish property is being held in reserve and will be ready to operate on short notice when required.

The overburden will not be more than a few feet. The rock on this property is massive and compact, the colour varying from a mottled cream and white to a grey-white and, in some places, pure white. The hardness seems to vary from soft to very hard and two samples were taken from this property for testing—No. 32, soft material, and No. 33, hard.

No anhydrite was noticed in any of the outcrops exposed and several million tons of rock are available.



A. Cutting in gypsum, Canada Cement Company's property, Antigonish harbour, Antigonish county, Nova Scotia.

B. Gypsum cliffs, 150 feet high, near Brierly Brook, Antigonish county, Nova Scotia.

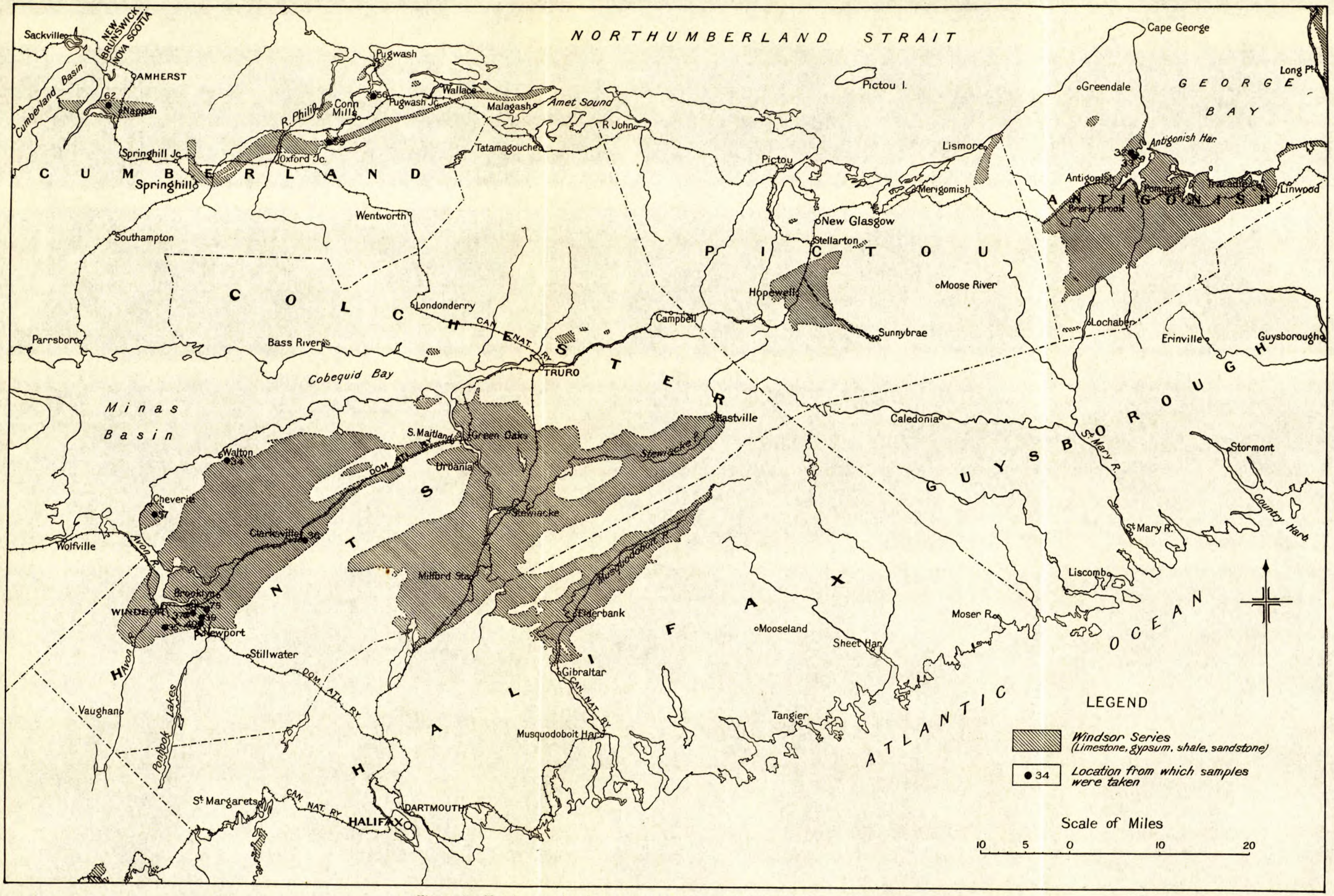


Figure 4. Sketch map showing gypsum occurrences in Nova Scotia mainland.

Cumberland County

In Cumberland county, a narrow belt of rocks of the Windsor formation extends from Malagash point in a westerly direction through Wallace station, Conn Mills, Oxford, Salt Springs station, and Black River station. Outliers of this same formation also occur at Nappan; on the east side of river Philip, at Canfield creek, south of Pugwash; and near the mouth of Pugwash river. In this formation a number of gypsum outcrops occur, but outside of the area at Nappan, very little work has been done on any of them.

Canfield Creek

At Canfield creek, 2½ miles directly west of Pugwash Junction, on the Canadian National railway branch from Oxford Junction to New Glasgow, extensive outcrops of gypsum occur in the steep banks of the creek and around the shores of several small bays and lake in the vicinity. The beds strike eastward and dip vertically with a laminated structure having shaly parting-planes. The rock is very soft, greyish brown-white in colour, and varies in places from compact to sugary or crystalline. No anhydrite was noticed but large masses of very clear selenite are exposed in places around one of the bays at water level.

Sample No. 56 was taken from an old quarry face, 20 feet wide and 40 feet high, from which rock has been taken in past years for the manufacture of fertilizer.

Hansford

On the west side of the road, a quarter of a mile south of the crossroads at Hansford there is a deposit of gypsum several acres in extent, the surface of which is a series of typical gypsum potholes. Practically no overburden is present on part of this deposit and the white gypsum is exposed on the surface. The potholes are very symmetrical and vary in diameter from 2 to 10 feet with a depth of over 10 feet. A face from which a small amount of rock has been taken lies facing east, 100 yards from the road, and sample No. 59 was taken from this exposure. The rock is massive to compact, in places crystalline or sugary, and is mottled grey and white in colour.

Nappan

One mile north of Nappan, a station on the main line of the Canadian National railway, and about 5 miles south of Amherst, a property was operated a number of years ago by the Maritime Gypsum Company. The operations were carried on in an open pit in the gypsum to 40 feet below the level, and below the drainage level of the surrounding country. The pit is at present completely filled with water but a large area in which gypsum outcrops has not been worked. A general sample, No. 62, was taken from this area.

The rock is massive and compact to slightly crystalline and is mottled brown and white in colour, although patches occur in which the rock is pure white and very compact. No anhydrite was noticed.

Hants County

Windsor

Probably the most widely known gypsiferous area in Nova Scotia and the one from which the largest tonnage has been shipped is that starting on the Avon river a few miles southwest of the town of Windsor and running northeasterly in almost a continual series of outcrops and sink-holes on each side of the Dominion Atlantic railway (C.P.R.) to Shubenacadie river at South Maitland. The area has a width in places of over 10 miles and a length of nearly 40 miles, and the area supposed to be underlain by gypsum is over 150 square miles in extent. The beds are very massive and compact and thicknesses of over 100 feet have been worked. A small outlier about 5 square miles in extent occurs to the south of Cheverie. It is in the Windsor area that some of the largest quarries in the province are situated, and it is here that the gypsum industry of the province had its beginning since many of the properties are within easy reach of tidewater from the bay of Fundy. In consequence, these were the most accessible deposits from which to obtain rock for shipment to the United States.

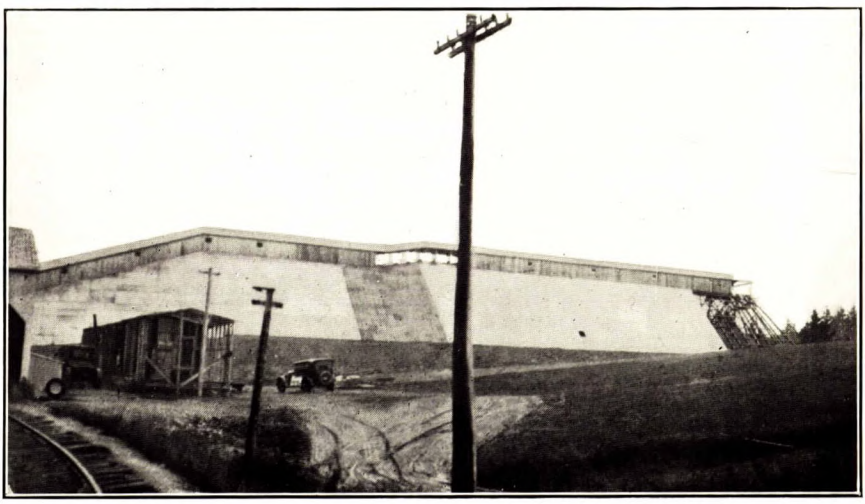
In the valleys of the Shubenacadie and Musquodoboit rivers other large areas of the Windsor series occur and gypsum deposits in these valleys are widespread. Although these deposits are of large extent and of splendid quality, the difficulties of transportation have militated in the past against their operation, and for the time being, at least, they should be looked upon as a large potential reserve to be drawn from at some future date.

The Windsor Plaster Company. The Windsor Plaster Company is the only company operating a calcining mill in this district. The mill is situated in the town of Windsor and rock is obtained from two quarries, the Wilkins quarry situated just outside the town limits to the southeast, and the other at Clarksville, a station on the Dominion Atlantic railway (C.P.R.) about 18 miles northeast of Windsor.

The Wilkins quarry lies on the south side of the Windsor-Halifax highway about a mile and a half to the southeast of the town. At this quarry the operations are simple, consisting of drilling the rock with hand augers and breaking with 40 per cent dynamite. The broken rock is then hauled in motor trucks to the mill at Windsor where it is stored in a 2,000-ton shed. The rock is massive and compact and mottled grey-white in colour. Sample No. 35 was taken from the stock-pile of material at the storage shed.

The Clarksville quarry is situated a quarter of a mile to the south of the railway and about half a mile west of Clarksville. Here, the quarry face is exposed for a height of over 50 feet and the broken rock is hauled in carts to the railway where it is loaded into cars for shipment to the mill at Windsor. Sample No. 36 was taken from rock in the storage shed at the mill in Windsor. It was massive and compact and mottled greyish cream to white in colour, burning to a clean white after calcination. Figure 5 gives flow-sheet of the mill.

A. Quarry of the Windsor Gypsum Company, Windsor, Hants county, Nova Scotia.



B. Storage sheds of the Atlantic Gypsum Products Company, at shipping pier, Walton, Hants county, Nova Scotia.

The product from the mill finds a ready market locally throughout the Maritime Provinces and as far west as Montreal.

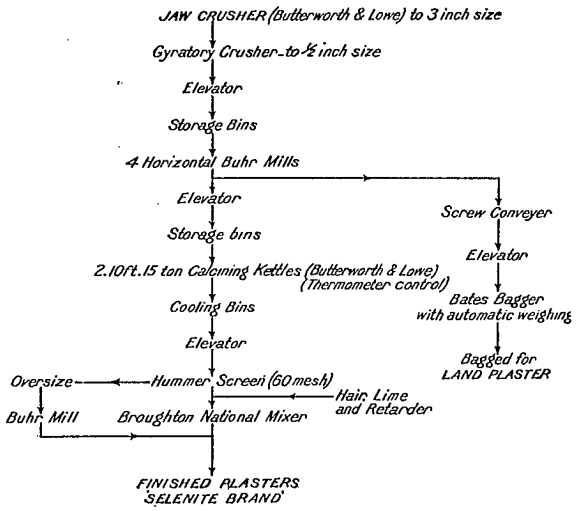


Figure 5. Flow-sheet of mill, Windsor Plaster Company, Windsor, N.S.

The Windsor Gypsum Company. A quarry located one mile to the northwest of Newport, a station on the Dominion Atlantic railway (C.P.R.), Windsor to Windsor Junction branch, is being operated by the Windsor Gypsum Company. This quarry is known locally as the Mosher quarry.

The property covers an area of 225 acres, and the present working face on the north of the quarry is over 350 feet in length with a height of 40 feet. The overburden, which averages 20 feet, is stripped off by a steam shovel and hauled to a waste dump by a Fordson tractor operating on narrow gauge tracks. However, on account of numerous potholes occurring on the surface of the deposit a small amount of the overburden is unavoidably dropped down into the quarry and this is hauled away in horse-carts.

The rock is broken to man size and hauled to a loading platform for loading into standard gauge open cars on tracks laid into the quarry from Newport station. Train loads are hauled over these tracks to Newport and from there to the company's wharf at Windsor, where it is loaded onto steamers for shipment to Newburgh, N.Y.

The rock is massive and compact, mottled grey to creamy white in colour. At the time of visiting two kinds of rock, varying in hardness, were being quarried. Two samples were taken for testing, No. 39 being the hard variety and No. 40 the soft. On testing, however, little difference was shown in these two samples, both making a good commercial plaster of high quality.

Canadian Gypsum Company. The largest operating company in the Maritime Provinces is the Canadian Gypsum Company, a company controlled by the United States Gypsum Company with head office at Chicago, Ill.

This company operates two quarries on a very large scale, namely the "Meadows" and "Cables" quarries.

The Meadows quarry is situated about 3 miles to the east of Windsor and 1½ miles northwest of Newport station. The face is 40 feet in height and has been opened up for a length of over 400 feet. The beds of gypsum lie horizontally and show little disturbance. The overburden varies greatly; the large number of potholes in the surface of the gypsum makes clearing expensive and accounts for a considerable wastage on the part cut. Anhydrite occurs in this quarry in irregular patches and when encountered is removed to a waste pile.

The rock as blasted is loaded into cars by a gasoline shovel and loaded trams are hauled to the loading wharf where the rock is reduced to 6-inch size so that it can be handled by the loading equipment into vessels.

Sample No. 37 was taken from several parts of this quarry. The rock is massive and compact, grey in colour with white mottling.

The Cables quarry is about 1 mile to the north of the Meadows. It is over 1,000 feet in length, 500 feet wide and has an average depth of 80 feet. The overburden which averages 50 feet in thickness is removed by large steam shovels operating on caterpillar tractors. After the surface is thoroughly cleaned, two well-boring drills are used to put down a series of 4-inch vertical holes to a depth of 60 feet. The holes are loaded with dynamite and fired simultaneously by battery. Any material too large to handle is bulldozed, using Ingersoll-Rand pluggers and a low strength dynamite. The broken rock is removed from the quarry either in cars lowered down an incline, or by means of an aerial cable similar to those used in the asbestos mines of Quebec. The cable trays are dumped directly into 7-ton cars which are hauled to the shipping pier. The stone is put through "nippers" and broken to hand sizes and loaded into ships for transport to the north Atlantic ports of the United States. Sample No. 38 was taken from this quarry. The rock is massive and compact and mottled grey-white in colour.

At the loading plant the cars are automatically dumped by means of an air lift, into a jaw crusher which is set at 6 inches and which has a capacity of 200 tons per hour. Each car is 7 tons capacity and the cars pass the crusher and are dumped at the rate of 1 per minute. The rock after going through the crusher passes onto 30-inch conveyer belts and into the storage building which has a capacity of 25,000 tons, or else to chutes and loaded directly into vessels. When loading from the storage shed a conveyer belt underneath enables the rock to be fed onto it and thus loaded into the vessel.

In order to enable shipments to be made throughout the whole year a second storage shed has been built at Deep Brook, Annapolis basin, in which sufficient rock can be stored during the summer months to enable regular shipments to be made throughout the winter.

This company transports the rock to its mills on the Atlantic seaboard of the United States, on its own fleet of four steamers each of 5,000 tons capacity. These boats are called the *Gypsum King*, the *Gypsum Queen*, the *Gypsum Prince*, and the *Gypsum Empress*. The boats also have a limited passenger accommodation and have catered to this trade between Windsor and New York to such an extent that the available accommodation is booked well in advance of each trip.

The tonnage produced by this company each year is approximately half of the total production for the whole of Canada.

St. Croix Gypsum Mining and Manufacturing Company, Ltd. This property lies on the north side of the St. Croix river, $2\frac{1}{2}$ miles from Newport station on the Dominion Atlantic railway (C.P.R.) and $\frac{1}{2}$ mile from the main highway leading from Windsor to Brooklyn. It contains about 70 acres, with tidewater flowing up against the rock. At this point there is a face of 80 feet of soft compact rock, mottled grey and white in colour, and the ground continues to rise to a height of 150 feet with only an average of 6 feet of overburden.

A small experimental mill has been erected in which experiments have been made on the manufacture of special wall plaster (similar to Keene's cement) as well as special classes of bricks.

The rock can also be shipped in the crude lump form in regular vessels for a low cost per ton.

A general sample, No. 75, from this property, was furnished by Mr. J. W. Smiley, manager of the company, at the request of the writer.

Cheverie

Near Cheverie there is a gypsiferous area about 5 square miles in extent in which gypsum quarries have been operated for a number of years. The gypsum is exposed in the cliffs along the shore near the shipping wharf as well as beneath the road at the west end of the village, but considerable anhydrite has been encountered in this part of the deposit, in fact about 5,000 tons of anhydrite is mined each year from this locality for shipment to the southern states where it is ground and used as a fertilizer by the peanut growers.

The gypsum quarries at present being operated are $1\frac{1}{2}$ miles to the south of the shipping wharf to which they are connected by a narrow-gauge railway. The quarries are owned and operated by the Connecticut Adamant Plaster Company and the rock is shipped to their own mills at New Haven, Conn.

The quarries have been opened along a distance of about 400 yards. The gypsum face is from 20 to 25 feet high and the floor of the quarry is good rock. The overburden varies from a few feet up to 20 feet; the surface of the gypsum is broken by a number of potholes. Stripping is done by a gasoline shovel.

The rock, which is massive and compact, is mottled grey and white in colour. It is broken and taken by dump carts to a loading platform where it is dumped directly into 4-ton railway cars. Eight cars are hauled

at a load to the wharf by a gasoline locomotive, and stored until a steamer docks. It is then loaded by dump carts, a 2,000-ton steamer being loaded in 2 days.

A general sample, No. 57, was taken along the working face.

Walton

Gypsum quarries have been operated in the vicinity of Walton for many years. Those at present being worked are operated by the Atlantic Gypsum Products Company. The quarries are extensive and a face of over 50 feet is quite common; the overburden is removed by steam shovel. A portable compressor is used to supply air to jackhammer drills in the quarry. The rock is massive and compact, mottled grey and white in colour, with occasional patches of anhydrite. This latter material is mined for shipment separately from the gypsum.

A narrow gauge railway, 1 mile long, with three locomotives and side-dump cars of 4 tons capacity, affords transportation to the crushing plant and shipping dock at Walton village.

The rock on arriving at the crushing plant is passed through crushers and reduced to 3-inch size after which belts and conveyers carry it to the storage shed until such time as a steamer is to be loaded. Belts beneath the shed enable the rock to be carried to chutes which distribute it in the hold of a vessel at the rate of 350 tons per hour. A 2,500-ton vessel can thus be loaded between tides.

A sample, No. 34, for testing was taken from the rock in the storage shed.

With the rapid advance made by the gypsum industry in Nova Scotia during the past 10 years it is probable that the next few years will see many other properties opened up and developed to the production stage. With such extensive deposits as are available in this province conveniently situated to water transportation, the demand for gypsum from Nova Scotia should rapidly increase.

CHAPTER II

GYPSUM OCCURRENCES IN NEW BRUNSWICK

INTRODUCTORY

The gypsum industry in New Brunswick has, for many years, been one of the mainstays of the province, the deposits in the vicinity of Hillsborough having been worked continuously for over 80 years.

In the "History of New Brunswick", by James Hannay[1], reference is made to an act in the year 1816 concerning the plaster from the quarries of New Brunswick and Nova Scotia, so that it is evident that at this time the industry was of considerable importance.

The Lower Carboniferous formation, which has an extensive distribution in the province, carries all the gypsum which has so far been found.

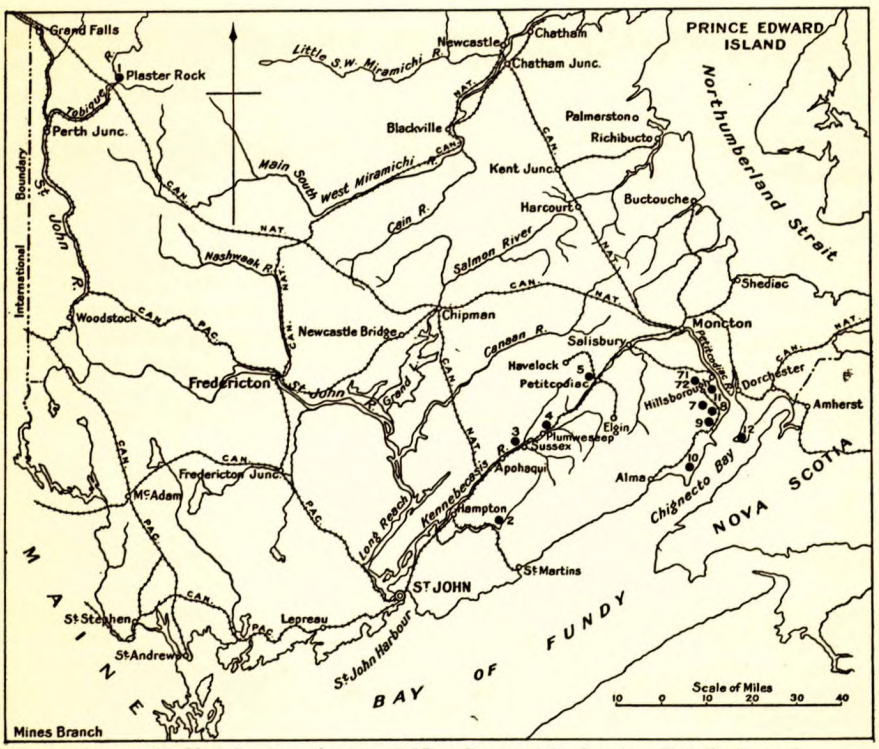


Figure 6. Sketch map of part of New Brunswick showing distribution of occurrences of gypsum.

[1]Hannay, Dr. James; "History of New Brunswick", Vol. I, published at St. John, New Brunswick, by John A. Bowes, 1909, p. 336.

It has its greatest development in the southeastern part, and with the exception of a small isolated area in the north at Plaster Rock, in Victoria county, all the more valuable deposits of gypsum are situated in St. John, Kings, Westmorland, and Albert counties.

Outside of the Hillsborough deposits, none have been extensively developed, so that very little information regarding their extent and character is available. From their surface indications, however, several of the larger among them would well pay for systematic prospecting with some form of core drill. Prospecting in this manner is to be strongly encouraged, as it leaves no room for doubt as to the value of a property both as regards its quality and extent.

OCCURRENCES

Victoria County

Plaster Rock

In the northern part of the province, an area of Lower Carboniferous rocks occurs near Plaster Rock on the Tobique river, Victoria county. The presence of extensive deposits of gypsum in these rocks has been known for a long time; small shipments have been made intermittently for many years.

The gypsum is found interbedded with shale in steep bluffs on the south side of the Tobique river, extending both up and down the river from the town of Plaster Rock. Above the town the beds are exposed in a cliff 145 feet high and again on the road that runs down to the river level above the town. Drill holes put down back from the top of the cliff, the first at 200 yards and the second at 400 yards from the river, encountered gypsum from 71 to 85 feet in the first and from 88½ to 107 feet in the second. Sink-holes for a quarter of a mile back from the river indicate the presence of gypsum underneath.

Other outcrops are also to be seen for a distance of 4 miles up the Wapskehegan which flows into the Tobique one mile below Plaster Rock. On the north side of the river at Plaster Rock the gypsum is again seen in the cliff on the roadside.

The rock is of the coloured variety, little pure white material being noticed. It occurs in beds seldom more than one foot in thickness, of varying colour, mainly grey, red, mottled green and cream, with numerous veins of fibrous gypsum. The texture is granular in places, the granules being cream-coloured in a matrix of red or grey gypsum.

A spur from the Canadian Pacific railway has been extended along the river bank to a point beneath the gypsum beds.

Previous to the year 1880 a small mill was erected in this district at which the gypsum was ground and sold to the farmers in the vicinity of the upper St. John, and in Aroostook county in the state of Maine, for use as a fertilizer. In this connexion a railway was built, now known as the Plaster Rock branch of the Canadian Pacific railway, from Perth Junction, opposite Andover on the St. John river, to Plaster Rock, a distance of 28 miles. In the year 1893 the Tobique Valley Gypsum Mining

A. Gypsum cliffs on the Tobique river at Plaster Rock, Victoria county, New Brunswick.

B. Gypsum outcrops on the Hammond river, Kings county, New Brunswick. This deposit occurs to the south of Upham station.

and Manufacturing Company, Limited, was incorporated, and erected a large mill, adjacent to the railway, for the crushing and grinding of gypsum. For a few years a good sale was obtained for the land plaster thus prepared, but owing to difficulties the plant was closed down.

Later the Stinson-Reeb Supply Company, with headquarters at Montreal, operated quarries at this point. They had a small crushing plant, and the gypsum was quarried and shipped in the crushed state to the cement works.

Mr. J. Stewart, of Andover, N.B., also quarried about 1,000 tons each year from this district.

Within the past few years Mr. Donald Fraser has been operating these deposits. A quarry has been opened up in the face of the cliff, and the broken rock after preliminary crushing is transferred to cars by gravity. The product is used for fertilizer and is finding a local market.

For testing purposes, a large sample (160 pounds), No. 1, was taken from representative parts of the deposit. Results of the test are given in Chapter VIII.

Kings County

Upham

A gypsiferous area, where little work has so far been done, occurs to the south of Upham station on the St. Martins railway, a short line connecting with the Canadian National railway near Hampton station. Very few outcrops occur and its approximate extent can be judged only by the presence of numerous ponds and typical gypsum sink-holes taken in conjunction with the outcrops.

The outcrops in some places stand up in ridges up to 30 feet high with very little overburden, and in other places on the side hill covered with clay and loam to as much as 10 feet.

Small quantities were quarried from one of the outcrops in this area in 1907 and shipped to St. John, but operations were soon abandoned.

The rock where seen in the outcrops is white and fractured on the surface, but beneath the several feet of the weathered top it is massive in structure and very compact. Anhydrite was noticed in a number of places. Further prospecting of this area might yield results of commercial importance since it is within easy access of railway facilities and a number of places in the area would lend themselves readily to quarrying operations. Sample No. 2 was taken from this deposit for testing.

Another small gypsiferous area, consisting of 40 acres, is to be observed at Martin head, on the bay of Fundy, 20 miles northeast from St. Martins the terminal of the St. Martins railway. The rock in these exposures is greyish white in colour and is associated with fibrous gypsum and heavy beds of marl. It is on tidewater but on account of the exposed coast it would be difficult to provide protection for shipping.

Apohaqui

Prominent outcrops of gypsum occur in a ridge running in a northeasterly direction for a distance of several miles, the western exposures being approximately 2 miles to the northeast of Apohaqui station on

the Canadian National railway. The gypsum is to be seen exposed in outcrops along the side of a ravine on the farm formerly owned by Robert White, and a quarry face of 40 feet could readily be obtained. A good working face is found on the farm to the east of this, formerly known as the Colonel Montgomery Campbell place.

No exposures of anhydrite were visible in the outcrops examined. Sink-holes are widespread in the district, indicating that the area underlain by the gypsum is of considerable extent.

The rock is greyish white and massive when the soft weathered surface is removed. Sample No. 3 was taken from outcrops on the White farm.

Mount Pisgah

Another area in which gypsum outcrops and sink-holes occur, and which may prove of economic importance after detailed prospecting, lies to the west of Mount Pisgah in a narrow band over 2 miles in length, and from 1½ to 2 miles northwest of Plumweseep station on the Canadian National railway. Most of the area is drift covered and heavily wooded, but where the gypsum is exposed it is white and massive.

A number of localities show anhydrite but these are mostly in low ground and where the rock was examined in the ridges it was all gypsum.

Sample No. 4 was taken from the farm of G. Norden from exposures in the face of a low bank half a mile back from the road and 2 miles from Plumweseep station.

Westmorland County

Petitcodiac

In the parish of Salisbury, Westmorland county, about 2½ miles to the northwest of Petitcodiac station on the Canadian National railway, a long narrow gypsiferous area is to be found. Outcrops occur in a number of places along Fawcett's brook and the deposit can be traced for a distance of 2½ miles with an average width of 600 feet. The gypsum in places is from grey to white in colour and granular to massive. Small selenite crystals are scattered throughout the gypsum in certain parts but no anhydrite was noticed in any of the outcrops visited. A number of places in the deposits would lend themselves readily to quarrying operations and the Havelock branch of the Canadian National railway cuts through the deposit. Sample No. 5 was taken from an outcrop of this deposit at its southern end near the schoolhouse.

Cape Maringouin Deposits.

On the southwestern peninsula of Westmorland county which juts out into Chignecto bay and terminates in cape Maringouin, gypsum is exposed in low banks for a considerable distance along the shore. This locality is locally known as the "Pink Rocks" due to the prevailing reddish-pink colour of some of the gypsum beds. The deposits have been worked in past years by the Albert Manufacturing Company and a substantial

wharf has been built at the property, from which shipments have been made from time to time.

The gypsum occurs in association with anhydrite and varies from the white to pink and grey varieties. It is mostly massive but small quantities of the coarse granular form are to be noticed in several places.

Sample No. 12 was taken from the outcrops exposed along the shore to the west of the shipping wharf.

Albert County

Hillsborough

Among the deposits of gypsum found in New Brunswick, those which occur in Albert county, in the vicinity of Hillsborough, are by far the largest and most important, producing considerably over 80 per cent of the total output of the province. The deposits are closely associated with the rocks of the Lower Carboniferous formation and generally overlie beds of crystalline limestone and anhydrite. Anhydrite occurs in extensive beds with the gypsum and is to be found underneath the gypsum with no definite dividing line between them, or else extending into the gypsum bed in the form of lenses. The thickness of the gypsum varies in the different localities, and the beds are undulating, conforming to the general topography of the district. The overburden consists of a varying thickness of residual soil, but in a number of the deposits the gypsum is covered unconformably by quartz conglomerates and beds of greyish, coarse-grained freestone of Millstone Grit.

The gypsum is noted for its purity, and large quantities of pure white alabaster are found and mined for use as terra alba. The colour of the gypsum varies from a colourless to the grey pink varieties. Small amounts of impurities occur, such as calcium carbonate and vegetable matter, but only in small isolated areas which can readily be avoided in mining and quarrying. In places the gypsum has a distinctly bedded structure, which is accentuated by seams of darker gypsum of a semi-translucent crystalline nature. The gypsum is usually of the massive variety, but occasionally other varieties are encountered. Crystals of selenite, from $\frac{1}{2}$ inch to 3 inches in length, are found embedded in parts of the deposits.

The topography of the district is typical of the occurrence of gypsum, being undulating and with many sink-holes. The total gypsiferous area is supposed to be about 14 square miles in extent, but the actual outcrops of gypsum are limited to a district of only $1\frac{1}{2}$ square miles. It is in this area that all the principal quarries are at present being operated.

Of the first discovery of gypsum of the district adjacent to the town of Hillsborough very little is known. Evidence of very early work having been carried on is shown by the signs of excavation and small deposits of waste now covered over by small undergrowth.

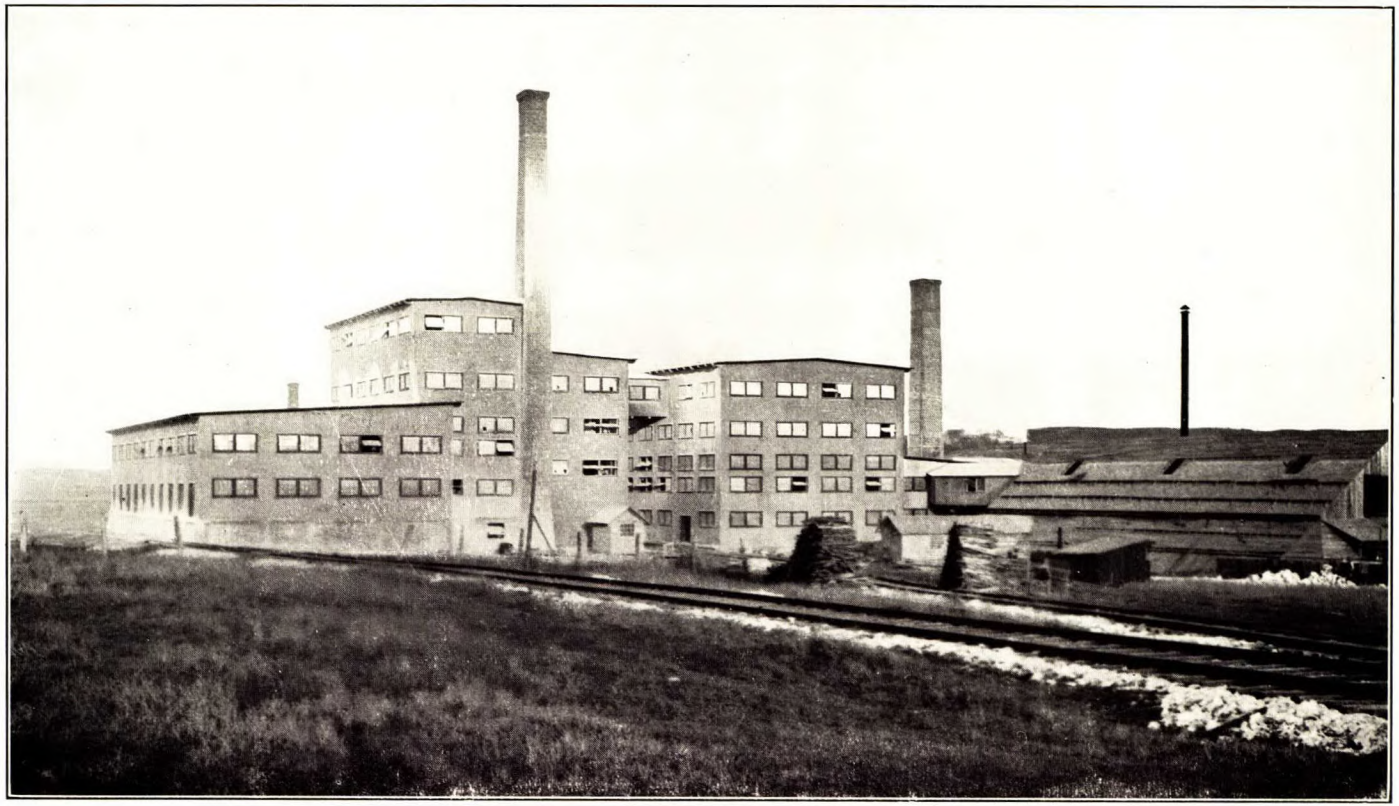
The shipments made previous to the year 1847 were mostly by farmers of the district. These shipments were taken from points where the gypsum was easiest to obtain and hauled by sleds, in the winter, to the nearest shipping point on the Petitcodiac river. It was purchased in the summer by the masters of small coasting vessels, who made a profitable revenue by selling the crude gypsum to the calcining mills situated on the Atlantic seaboard of the United States. The freight on these cargoes of gypsum was very little, owing to the fact that the coasting vessels would otherwise have to return to the United States empty. The principal destination of this gypsum was Lubec in the state of Maine, where Messrs. Fowler Brothers had plaster mills in operation. About the year 1847, these gentlemen obtained the rights for some of the properties in the Hillsborough district and operated them for a number of years. They constructed a plank road, 3½ miles in length, from the principal quarry, later known as the Fowler quarry, to the Petitcodiac river. This enabled shipments to be made both in summer and winter, but the production never exceeded more than 3,000 tons in any one year.

In the year 1854 more active operations were commenced, when Mr. Calvin Tompkins of New York obtained the rights to the properties owned by the Fowler Brothers, and also rights for railways, buildings, docks, and other purposes. He established a company known as the Albert Manufacturing Company, and had it incorporated in the same year. This company erected a large milling establishment, and also laid tracks to the several quarries, as well as to the river, where wharves and timber beds for the accommodation of vessels were also constructed.

The mill was the largest of its kind then operating in Canada. It contained a very complete plant for crushing, grinding, and calcining gypsum, and was operated by steam, using wood, obtained locally, as fuel. In addition to this mill there was a small mill for sawing logs, and another for grinding grain.

At this time the Canadian market was not available to the Hillsborough producers, as they could not compete, owing to the excessive freight rates, with the gypsum quarried and shipped from Antigonish and other points in Nova Scotia. Moreover, on account of the very low rate of duty then imposed on manufactured plaster entering Canada from the United States the mills at Grand Rapids, Michigan, were able to deliver plaster in Toronto and Montreal at a cost very much lower than the producers of Hillsborough could possibly do. Consequently they had to depend entirely on the trade with the United States, and on whatever small local trade could be obtained. About the year 1873 the Albert Manufacturing Company was further handicapped by the total destruction of its mill and adjacent buildings by fire, but a new mill was built and placed in operation in the year 1875. In spite of these decided drawbacks the industry progressed, and when in 1876 the Intercolonial railway was completed the Canadian market was made available.

The new mill built by the Albert Manufacturing Company in 1875 ran continuously until March 16, 1911, when it was completely destroyed by fire. Preparations were at once made for the erection of another and more modern mill, which was placed in operation a year later. This mill



Mill and buildings of the Albert Manufacturing Company, Hillsborough, N.B.

with many additions and improvements is the one in operation at the present time. A view of this mill is shown in Plate X.

At the present time there is only one company operating in this district, namely, the Albert Manufacturing Company. The property and plant are located in Albert county, near the town of Hillsborough, on the Petitcodiac river. This town is distant 39 miles by rail from Moncton, a divisional station on the main line of the Canadian National railway, and 95 miles from St. John. The shipping pier of the company is approximately 635 miles, by water, from New York.

The mill of the company is situated in the town of Hillsborough, and is connected with the quarries and shipping pier by a narrow-gauge railway, 4 or 5 miles in length. The gypsum is obtained both by quarrying and by mining. Quarries are about 3 miles to the west of the town.

Several quarries are being operated, from which the greater bulk of the material treated at the mill is taken. These quarries also supply the material which is shipped in the crude state to New York and other points in the United States.

In some of the quarries very little stripping has to be done, and consequently the material is shipped in a very clean condition. The usual auger bits are employed in boring the holes for blasting the rock and black powder or a very low strength of dynamite is used. After the gypsum is quarried it is broken by hand into convenient size for handling, and is then carted by single horse, Scotch carts to the nearest siding of the narrow gauge railway and dumped directly into 3½-ton cars. One locomotive makes about 6 trips per day, taking 30 cars at each trip. Another locomotive shunts the cars at the wharf. The face of the quarries varies from 10 to 60 feet in height, according to the general contour of the country, the gypsum being found to follow the undulating character of the ground with considerable uniformity. The quality of the rock also varies, and almost any variety from dark grey to pure white alabaster can be found. The different grades are kept separate at the quarries and are handled separately both there and at the mill.

During the winter months mining operations are carried on to the north of these quarries, where gypsum of a very pure white variety of alabaster is mined. The rock is broken down and allowed to slide by gravity, or else hauled to the main haulage tunnel, whence it is taken by cars to a siding of the company's railway and transported to the mill and used in the manufacture of terra alba. This rock is found in limited quantities and only in this district. The mining is carried on by the chamber and pillar method of mining, the pillars generally being composed of the poorer grade of rock.[1]

The present mill of the Albert Manufacturing Company was completed during the spring of 1912, to replace the mill destroyed by fire the previous year. It is equipped with all the latest machinery for the milling and calcining of gypsum. (*See* flow-sheet, Figure 7.)

A recent addition to this plant is the concrete bins and loading equipment placed at the company's wharf to facilitate the loading of the crude

[1]About 2,500 tons of pure white gypsum are shipped each year to the United States for use in the manufacture of paper.

rock for water shipment. *See* Plate XI. These two bins are circular, concrete structures, each capable of holding 1,800 tons of crushed gypsum. Elevators are so placed that rock brought down from the mill after crushing can be stored in either bin and the material can be drawn from either bin to a belt conveyer and loaded directly on steamers at the wharf. A 2,000-ton vessel can be loaded in 3 hours.

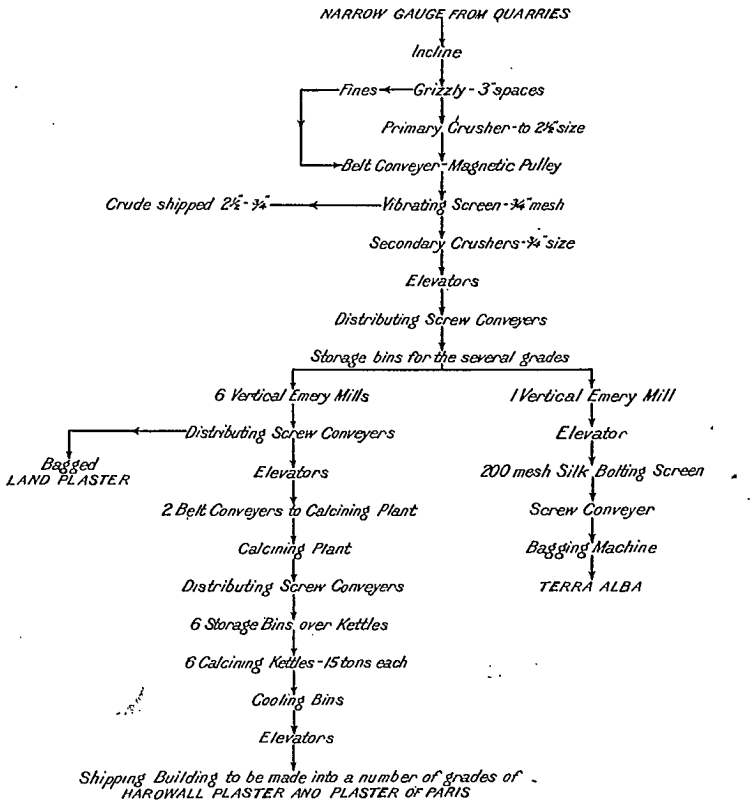
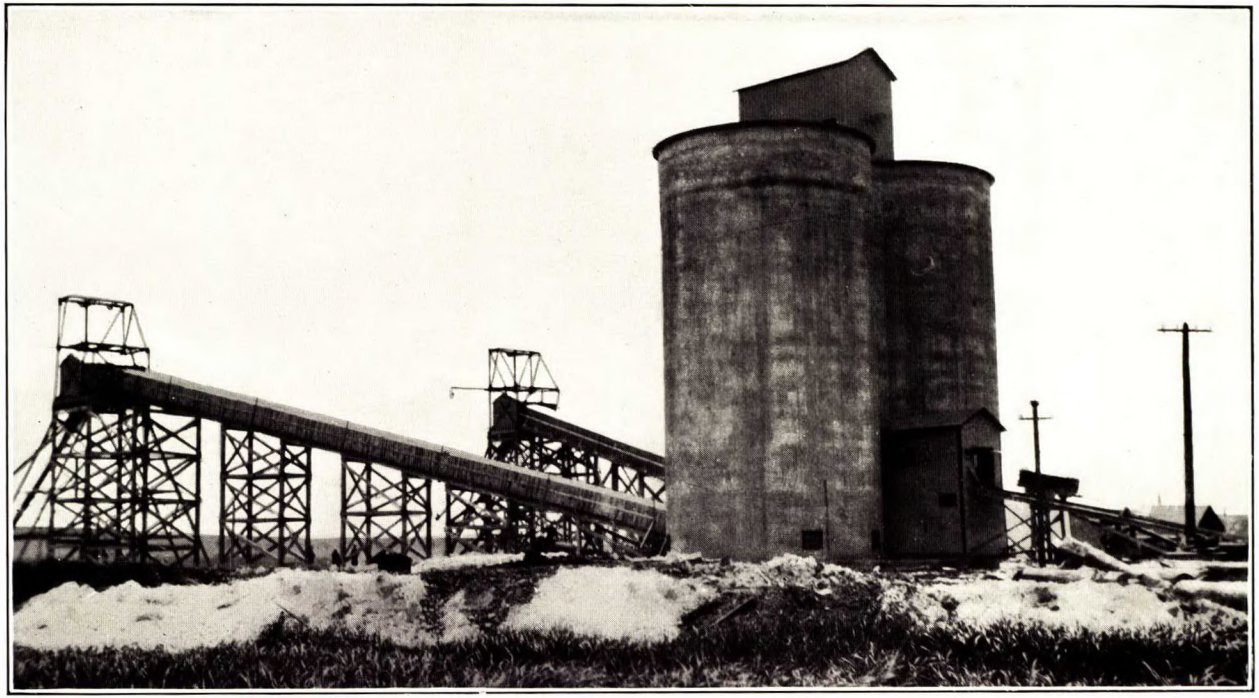


Figure 7. Flow-sheet of mill of Albert Manufacturing Company, Hillsborough, N.B.

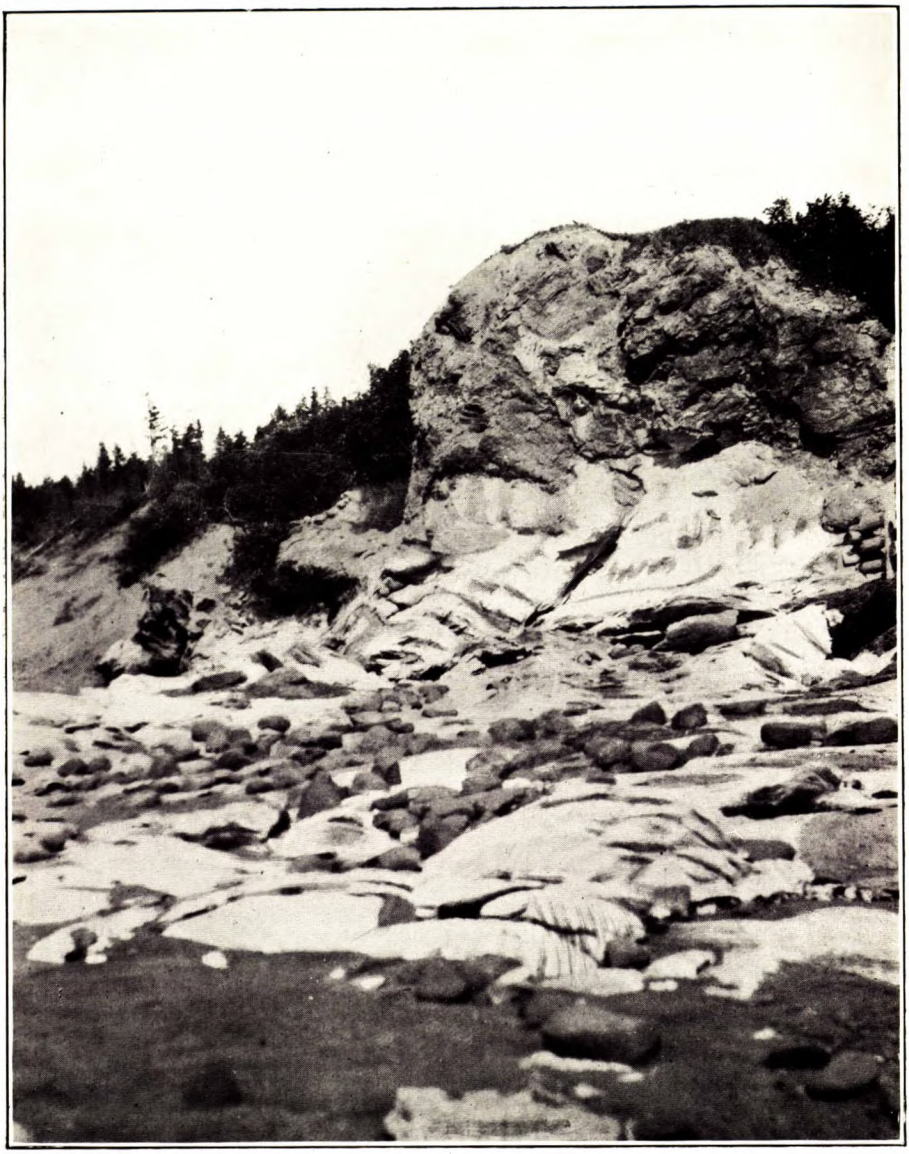
Sample No. 71 is a general sample of the average material run through this plant while No. 72 is a sample of "Hammer Brand" plaster as prepared in this mill.

Edgett Landing.

At Edgett Landing, 2 miles south of Hillsborough, another large gypsum quarry controlled by the Hillsborough Plaster Quarrying and Manufacturing Company was operated until a few years ago, since which time it has been idle. The company is a subsidiary of the Canadian Gypsum Company who have other properties in Nova Scotia which they deem more expedient to work at the present time, although judging from the results of the tests on material from this property a large amount of good material is still available. None of the material from



Storage bins, loading belts, and shipping pier, Albert Manufacturing Company, Hillsborough, N.B.



Gypsum outcrop at "Pink Rocks," cape Maringouin, Westmorland county, N.B. (*See* page 24)

this property was treated in Canada, the rock being shipped by boat in the crude state to the Atlantic seaboard of the United States. Sample No. 11 was a representative sample from this quarry.

Curryville.

The Demoiselle Creek deposits of Curryville, controlled by the Albert Manufacturing Company and the Hillsborough Plaster Quarrying and Manufacturing Company, lie along the line of the Salisbury and Albert branch of the Canadian National railway, at the headwaters of Demoiselle and Wilson creeks. These deposits have been operated for many years both by quarrying and mining methods, but at present are idle, although the deposits are by no means worked out.

In the underground working of the Hillsborough Plaster Quarrying and Manufacturing Company a tunnel has been driven into the deposit, and pillars have been left to support the roof. The rock, which is massive in character, rests on a floor of anhydrite, and is covered by an overburden or roof of varying thickness, carrying the characteristic pebbles of Millstone Grit. In these deposits the surface waters have dissolved out a large subterranean cavern or lake, said to be some 6 acres in extent.

The rock from the mine was hauled by rail a distance of 18 miles to the company's shipping pier at Gray Island wharf on the Petitcodiac river, a few miles above Hillsborough. The crude gypsum was loaded on vessels of 2,200 tons capacity and shipped to the United States. On account of the mine being closed down the workings could not be examined and sample No. 8 was taken from the stock-pile of several hundred tons at the mouth of the tunnel.

The operations of the Albert Manufacturing Company in this area consist of open quarrying, a face of nearly 60 feet with little overburden having been developed. Sample No. 7 was taken from the exposed face in this quarry.

The rock from this area is very similar to that found in the Hillsborough district, being white and compact and of excellent grade.

Hopewell Hill.

About 15 miles to the south of the Hillsborough district, a gypsiferous area occurs in the vicinity of Woodworth settlement and extends southerly to Hopewell Hill. The deposits were operated in a small way a number of years ago but the excavations are all covered with bushes at present and very few outcrops are to be seen. A tunnel has been driven into the side of one hill but the rock exposed in the tunnel is mostly anhydrite. The gypsum where exposed is white and granular and fairly compact. Sample No. 9 was taken for testing from several localities in this area.

New Horton.

At Hopewell cape in the New Horton district there are two other small gypsiferous areas but these are drift covered for the most part and very little work has been done on either of them, so that little information is available. The rock in the few outcrops visible is compact and of good white colour. Sample No. 10 is representative of the material from these areas.

CHAPTER III

GYPSUM OCCURRENCES IN QUEBEC

Magdalen Islands

The only deposits of gypsum in the province of Quebec so far known are those situated in the Magdalen islands, in the gulf of St. Lawrence, some 120 miles north of Pictou, Nova Scotia. Whether the gypsum deposits occurring in the basin of the Moose river in northern Ontario extend easterly across the Ontario-Quebec boundary remains to be proved.

On account of the time involved in reaching the Magdalen islands the writer was unable to visit the deposits and the following description of their occurrence is taken from Jennison's report[1]:—

Situation. The Magdalen islands are situated about the middle of the Gulf of St. Lawrence, and are within the parallels of 47 degrees and 30 minutes and 47 degrees and 5 minutes north latitude, and between 61 degrees and 8 minutes and 62 degrees and 12 minutes longitude, and at a distance of about 150 miles from the coast of Gaspe; 60 miles from Meat cove, Cape Breton, where they are connected by submarine cable with the mainland; and 120 miles from Pictou, Nova Scotia, from which port the mail steamer makes connexions twice each week during the open season on the Gulf of St. Lawrence.

Description. There are ten distinct islands in the group, now designated on all charts, and in public documents, under the names of Entry, Amherst, Deadman, Grindstone, Alright, Wolfe, Grosse Isle, Coffin, and Brion, and the grant also included the Bird islands. Four of these, namely, Entry, Deadman, Brion, and the Bird islands, are isolated, having no connexion with each other, or with the principal group. The other six islands, namely, Grosse Isle, Coffin, Alright, Wolfe, Grindstone and Amherst, comprised in the Letters Patent under the collective name of Magdalen islands, are united to each other by sand dunes and in some places lagoons of considerable extent are formed by the sand dunes.

Harbours. The principal harbours are Amherst, House, and Grand Entry.

The steamer also calls at the breakwaters at Amherst and Grindstone, and the landing places at Alright island, Coffin island, and Etang du Nord.

By reference to the Admiralty Chart of these islands, it will be seen that these harbours are safe and sufficient for small draught vessels, and the recent addition to the breakwaters gives ample protection to all ordinary shipping.

Topography. The low lands, which border the sea coast, present a uniform appearance, generally undulating or level. The centre of the islands is made up of numerous conical shaped hills, some as high as 580 feet above sea-level.

No rocks are observed protruding through the soil, which extends from the highest to the lowest levels, and every foot of land is available for cultivation, except a small part of the low lands, which are occupied by swamp.

These islands are not the barren, isolated spots conceived by some; but on the contrary, the best authorities assert that the soil of the Magdalen islands is well suited for agricultural purposes, and richer than that of Prince Edward Island, which is considered the Garden of the Gulf.

[1]Mines Branch, Dept. of Mines, Report No. 84, 1911, pp. 98-102.

Inhabitants. The population is about 7,000, principally of French descent. The exceptions are: Entry island, which is Scotch, and Coffin island, which is English. The people are of good moral character, cheerful and industrious. The men are capable of enduring great fatigue, and unsurpassed as able seamen. They are expert as fishermen, which, with farming, is their principal occupation.

Roads. The islands are furnished with good roads, well maintained, and good accommodation for driving can be secured at reasonable rates, at almost any point.

Gypsum Deposits. It would be very much a repetition of what has already been said to deal at length with the geology of the deposits on these islands. They occur practically as those of Nova Scotia and New Brunswick, in the Lower Carboniferous measures, and associated with the deposits of carbonate of lime. It might be said, that here they are in a closer position to the irruptive rocks—dolerite and diabase—which make up the many conical-shaped hills, and are the nucleus of the whole geological structure of the Magdalen islands; and in many places they form the lower members of the Lower Carboniferous group.

The most important deposits occur on Grindstone, Alright, Amherst, and Entry islands.

On Entry island the gypsiferous area, consisting of 208 acres, occurs on the south coast, near the lighthouse. It is well exposed on the seashore, in the immediate vicinity of the irruptive rocks, overlaid by heavy beds of marl, containing boulders of dark limestone and gypsum, with veins of the fibrous variety cutting through it in many directions.

Some of the fibrous gypsum is very pure and white. The gypsum is a soft granular variety, varying in colour from white to dark grey.

At Amherst it occurs in considerable dimensions in the same position with the older rocks, on the coast at Pleasant bay, east of Demoiselle hill, and has a total area of 720 acres. It extends inland almost to the southern coast, a distance of nearly 1½ miles, and skirting the hill appears again on the coast west of Demoiselle. The deposits are well exposed on the coast and are traceable inland by deep depressions or sink-holes. Some of these depressions are an acre or more in area, and from 40 to 50 feet deep. In the larger of these the gypsum may be observed. The rock is a white compact variety, with parts of it showing red streaks.

An area of similar appearance, consisting of about 400 acres, occurs on the northwest of this island, extending from Southwest cape to West point. The gypsum here outcrops on the coast, and has associated with it marls carrying fibrous gypsum.

Grindstone island has the largest area (5·20 square miles) and most prominent exposures of all the islands. It occurs on the sea coast a short distance north of cape Meule in high cliffs of marl and limestone and extending northwardly 1½ miles, where it again outcrops on the Arseneau property with considerable prominence. It has a dark dirty grey colour, and a large portion of it has a granular texture. From the shore it can be traced westwardly, following the contour of the hills, by outcrops and depressions, to Etang du Nord, where it outcrops on lot 184, in a prominent ridge, and also on the adjoining lot, in a depression which forms a pond of water, and where cliffs may be seen on one side from 40 to 60 feet high. Again, about midway between the coast and Etang du Nord, on vacant lands, more outcrops are observed. The rock presents many varieties both of colour and texture, as will be noted below in the table of analyses.

Again, skirting the irruptive cliffs near cape Alright on Alright island, another very similar gypsiferous area is seen. The high cliffs at this point are only the remnants of one or more irruptive hills, that form the base of the gypsum deposits, and, therefore, the exposures of gypsum on the sea coast are not extensive. Inland, however, the same conditions are observed, and outcrops are seen in several places on the higher grounds, and where the depressions have left the gypsum exposed. This area extends westwardly across the island to Little bay, but here the land is low and the gypsum concealed.

The following are the results of analyses taken from the different deposits:

—	I	II	III	IV	V	VI
	%	%	%	%	%	%
Lime	32·61	30·50	32·73	32·70	32·63	32·30
Magnesia	trace	0·25	trace	trace	.....	0·46
Ferric oxide and alumina	0·10	1·36	0·20	0·20	0·16	0·82
Sulphuric anhydride	46·37	43·94	45·38	45·51	45·72	44·69
Carbonic anhydride	.....	0·27	0·79	1·20	0·57	1·33
Water, loss on ignition	20·60	19·75	20·50	20·30	20·25	20·35
Insoluble mineral matter	0·20	3·62	0·10	0·10	0·36	0·30
	99·88	99·69	99·70	100·01	99·69	100·25

—	VII	VIII	IX	X	XI
	%	%	%	%	%
Lime	32·93	31·98	32·29	32·49	32·67
Magnesia	trace	0·59	0·40	.....	trace
Ferric oxide and alumina	0·24	0·46	0·41	0·18	0·12
Sulphuric anhydride	44·93	46·16	44·86	46·41	46·03
Carbonic anhydride	0·86	.....	1·23	tr.	.....
Water, loss on ignition	20·00	20·10	20·00	20·36	20·82
Insoluble mineral matter	0·60	0·80	1·12	0·12	0·32
	99·56	100·09	100·31	99·55	99·96

No. I. From lot No. 100, Alright island: a very pure white compact rock.
" II. Fibrous gypsum associated with the gypsum, Alright island.
" III. From lot No. 184, Etang du Nord, has rather a slaty structure, with a greyish white colour.
" IV. White compact gypsum taken from an exposure in the wall of a sink-hole or depression at Etang du Nord, near lot No. 184.
" V. Sample of pink rock associated with the marls in cliffs near cape Meule, Grindstone island.
" VI. A dirty greyish granular rock from Arseneau lot, Grindstone island.
" VII. An average sample taken from vacant lands on Grindstone island, greyish white, with compact texture.
" VIII. A dark bluish rock from Ryan cove, Grindstone island.
" IX. Dark greyish with selenitic crystals, occurring on the shore near cape Meule.
" X. Fibrous gypsum from Entry island.
" XI. White compact gypsum, with some streaks of red, occurring on the shores near Demoiselle hill, Amherst island.

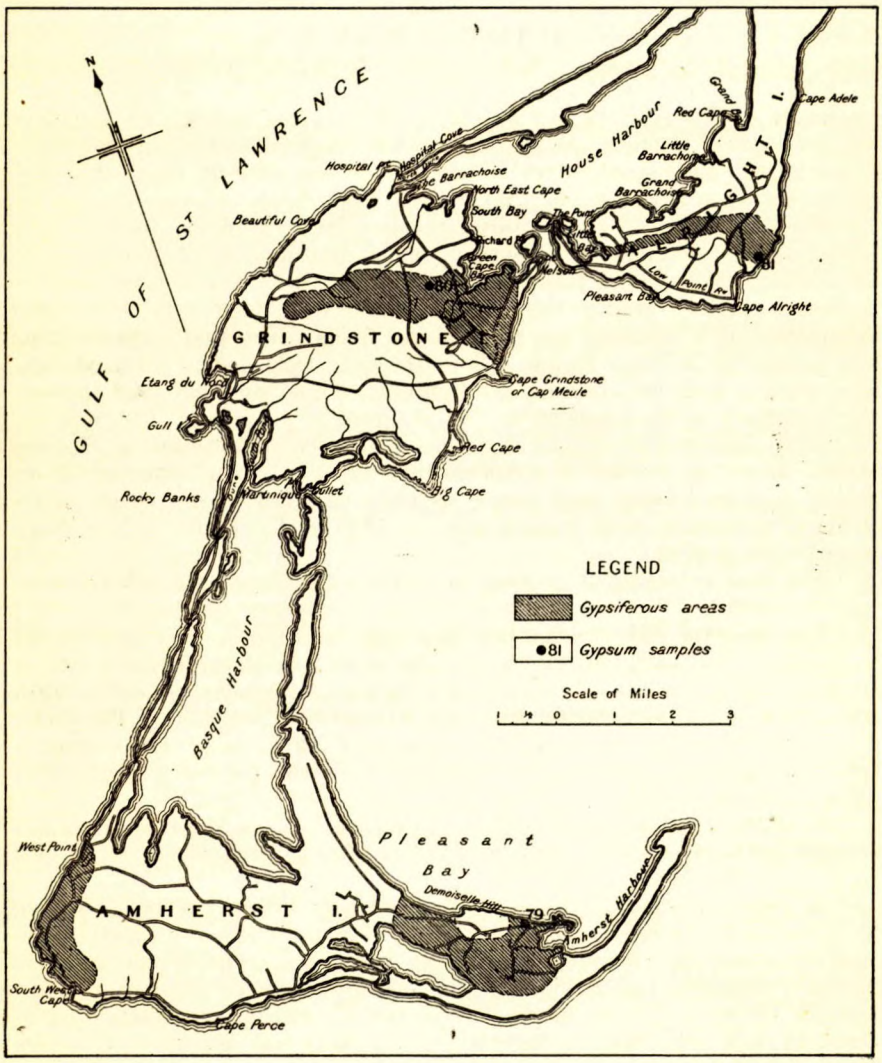
Through the courtesy of Mr. K. M. Cameron, Chief Engineer, Department of Public Works, Ottawa, three large-size samples were obtained from three representative localities, one each from Amherst, Grindstone, and Alright islands. These samples were taken by Mr. Joseph Lafrance, Foreman, Public Works Department, stationed at House Harbour, Magdalen islands, and forwarded to Ottawa for testing. Localities of samples are marked on the map.

Sample No. 79. Taken from deposits one-half mile from Government wharf, Amherst island. This outcrop is 25 feet high by 150 yards long and extends inshore for some distance.

Sample No. 80. Taken from deposit 2 miles from Government wharf, Grindstone island. At this locality there were no outcrops on the surface but sample was taken from under 5 feet of overburden and seems quite extensive.

Sample No. 81. Taken from deposit three-quarters of a mile from Government wharf, Alright island. This outcrop on the shore where sample was taken is about 100 feet high and is exposed for 60 yards. The deposit appears to run inland for about 3 miles and can be traced by outcrops and sink-holes for that distance.

The results of the tests on these samples are given in Chapter VIII.



(After Jennison)

Figure 8. Map of the Magdalen islands showing gypsum areas.

CHAPTER IV

GYPSUM OCCURRENCES IN ONTARIO

INTRODUCTORY

Gypsum has been found in a number of localities in the province of Ontario. However, in two localities only are the deposits of any considerable extent, namely the deposits in the Moose River basin and those occurring in the Grand River area. Up to the present time, the only deposits worked are those occurring in the latter area.

The beginning of the Ontario gypsum industry dates back to the beginning of the nineteenth century, when gypsum was first discovered near where the town of Paris now stands. At first it was used entirely as "land plaster" among the local farmers, who made use of it quite extensively as a fertilizer for their clover fields. The first gypsum mine was opened by William Holmes about the year 1822 and in the next year he erected a mill for grinding the gypsum. Thus the year 1922 marked the centenary of the industry in this province.

It is interesting to note that this discovery of gypsum in Ontario stands fourth in the list of gypsum discoveries in North America, Nova Scotia gypsum having been mined as early as 1770, if not earlier, New Brunswick deposits were worked prior to 1816, and deposits in New York were found in 1792.

The first calcining of gypsum in Ontario was done at the Martindale mine in 1846.[1]

The gypsum industry in this province has had a long and varied history and has now become one of the chief non-metallic industries of Ontario. It has in its time included a number of producers, but in 1916 the only companies operating were the Alabastine Company of Paris and the Crown Gypsum Company. On January 1, 1917, these two companies were amalgamated to form the Ontario Gypsum Company with head office at Paris, Ontario.

In 1926, this company erected a calcining mill in Montreal and also secured gypsum areas in Nova Scotia, at Mabou, from which it shipped rock to its Montreal mill.

In 1928 a further extension of this company occurred when it secured by purchase the interests of the Manitoba Gypsum Company in Manitoba and its subsidiary company the British Columbia Gypsum Company in British Columbia, and reorganized its operations under the name of the Canada Gypsum and Alabastine, Ltd., the head office still remaining at Paris, Ontario. In 1930 the name of this company was changed to Gypsum, Lime and Alabastine, Canada, Ltd.

[1] A detailed history of the different mines and plants operated in Ontario up to the year 1913, is given in "Gypsum in Canada" Mines Branch Rept. No. 245, Chapter VII.

OCCURRENCES[1]

The only deposits that have been exploited in Ontario are those in the southern part of the province, but the deposits in the Moose River basin are of good grade and large extent, and are only waiting the extension of the railway for their development.

Grand River District

The district in which gypsum is found in the southern part of the province lies in the valley of the Grand river north of the eastern end of lake Erie. The properties which have already been exploited lie in an area on both sides of the Grand river extending from a point 1 mile northwest of the town of Paris to a point 4 miles southeast of the town of Cayuga, although, according to the detailed work by Dyer[2], the possibilities of finding gypsum over a greatly extended area in both directions is quite promising. The accompanying sketch map, after Dyer, gives the boundary of the area probably underlain by gypsum.

The only actual mining that is being carried on at present is at Caledonia, 16·2 miles from Hamilton on the Canadian National railway, or 13·5 miles south of Hamilton by highway, and at a mine 1 mile north of Lythmore station on the Windsor to Buffalo branch of the Michigan Central railway, 6 miles east of Hagersville.

Caledonia Deposit

The Mine. The Caledonia mine, owned and operated by the Gypsum, Lime and Alabastine, Canada, Ltd., is about one-quarter of a mile north of the town of Caledonia, Haldimand county. The land owned and leased by the company lies on both sides of the Hamilton-Port Dover highway and the holdings include 337 acres on lots 9 and 10, range 1, Seneca township, as well as leases on several farm lots adjoining.

The mine was first opened up in the fall of 1905, by the Alabastine Company of Paris, Ont., production commencing early in 1906 when a crushing plant was erected near the Canadian National tracks west of the station.

Three levels have been opened up in the mine as follows:—

—	Depth from surface	Thickness of bed
	feet	feet
First level	65	8
Second level	87	11
Third level	107	3

[1]A detailed description of the gypsum industry in Ontario by Geo. E. Cole, and of the geology of the gypsum deposits of southwestern Ontario by W. S. Dyer, is given in Ontario Dept. of Mines Report, vol. XXXIV, pt. II (1925).

[2]Ont. Dept. of Mines Report, vol. XXXIV, pt. II (1925).


SKETCH MAP
OF
SOUTHWESTERN ONTARIO
(after Dyer)
SHOWING THE DISTRIBUTION OF
GYPSUM AND ANHYDRITE
Scale of Miles
10 0 10 20 30 40 50
Shaded portion represents area underlain by gypsum.
The area to the southwest of the shaded portion is underlain by anhydrite.
LAKE HURON
MICHIGAN
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
LAKE ST CLAIR
L. Simcoe
BRUCE
GREY
SIMCOE
HURON
DUFFERIN
WELLINGTON
PERTH
PEEL
YORK
WATERLOO
HALTON
LAMBTON
MIDDLESEX
OXFORD
BRANT
WENTWORTH
LINCOLN
ELGIN
KENT
ESSEX
NORFOLK
HALDIMAND
WELLAND
NEW YORK
CANADA
UNITED STATES
Southampton
Owen Sound
Collingwood
Walkerton
Geological boundary
Saugeen R.
Salina
Guelph
Goderich
Maitland R.
Harriston
Guelph
TORONTO
Stratford
Kitchener
Galt
Sarnia
St. Clair R.
R. Ausable
Ailsa Craig
Woodstock
London
Paris
Brantford
HAMILTON
Sydenham R.
River
Thames
Grand R.
Caledonia
Welland R.
St. Catharines
DETROIT
WINDSOR
Detroit R.
St. Thomas
Lythmore
Simcoe
Niagara Falls
Niagara R.
Chatham
Tilbury
Dunville
Welland
Colchester
Selkirk
Port Rowan
BUFFALO

Figure 9.

An inclined adit affords access to the mine. At the present time work is being done only on the second level. This bed is divided into two distinct parts by a horizontal slip and only the lower part, that below the slip, is being mined. The upper part, although of very good gypsum, is not quite so high grade as the lower, and is being held in reserve. The parting along the slip forms an excellent back to break to, requiring no timbering and leaving the broken rock clean and ready to be loaded directly into the skip without any hand-sorting. The room and pillar method of mining, somewhat similar to that employed in coal mining, has been followed, pillars being left every 20 feet to support the roof. The rooms have a width of 20 feet and the pillars, 12 feet. Crosscuts are driven every 200 feet for haulage and ventilation purposes. After an area has been blocked out and the rooms driven between the crosscuts, certain sections of the pillars are robbed between the rooms leaving a series of pillars 12 by 12 feet. This method of mining has been found to be very satisfactory and economical, the rock being won at an extremely low cost, with no caving or sagging of the ground above the workings.

Drilling is done by 7 Jeffrey electric drills, 2-inch fish-tail bits, 3, 6, and 9 feet in length being used. The breaking is done by a low strength dynamite, 60 tons being broken per round of twelve 9-foot holes.

The rock is hauled in 3½-ton cars by mules from the working faces to the foot of the incline where it is weighed and hauled to the surface by a hoist near the crushers in the mill.

Electric power supplied by the Ontario Hydro-Electric Commission is used in the mine for lighting, pumping, and ventilating.

A vertical shaft some distance to the west of the incline affords a second or emergency outlet from the mine as well as for ventilation purposes. The main ventilation fan, 72-inch disk, is placed at the head of this shaft, and is reversible so as to meet summer or winter conditions. The temperature in the mine is thus kept fairly constant throughout the year ranging from 55° to 60°F. A second, or booster, fan (60-inch) is placed 800 feet east of the incline.

Centrifugal pumps keep the mine free from water, which accumulates at the rate of from 200 to 400 gallons per minute according to the season.

The gypsum rock mined at Caledonia is of the grey massive variety, and is intergrown with thin streaks of dolomite, thus presenting either a mottled or banded structure. The following analyses, furnished by the company, indicate the average run of material shipped for use as a retarder in cement manufacture:—

—	1	2	3
CaO	36·76	32·40	33·95
SO_3	36·11	39·31	36·96
H_2O	16·27	17·69	16·39
Fe_2O_3 and Al_2O_3	0·20	0·30	0·21
MgO	2·11	3·07	3·03
CO_2	6·43	4·83	7·20
SiO_2	2·12	2·40	2·31
	100·00	100·00	100·00
Gypsum present	77·67	84·52	79·50

Two other samples were obtained for testing in 1928 and numbered 54 and 55, the results of the tests being given in Chapter VIII.

The Mill. The first mill connected with the Caledonia mine was erected, as already stated, in 1906, and was a grinding mill only, the crushed material being shipped to Paris for calcining. In 1910, con-

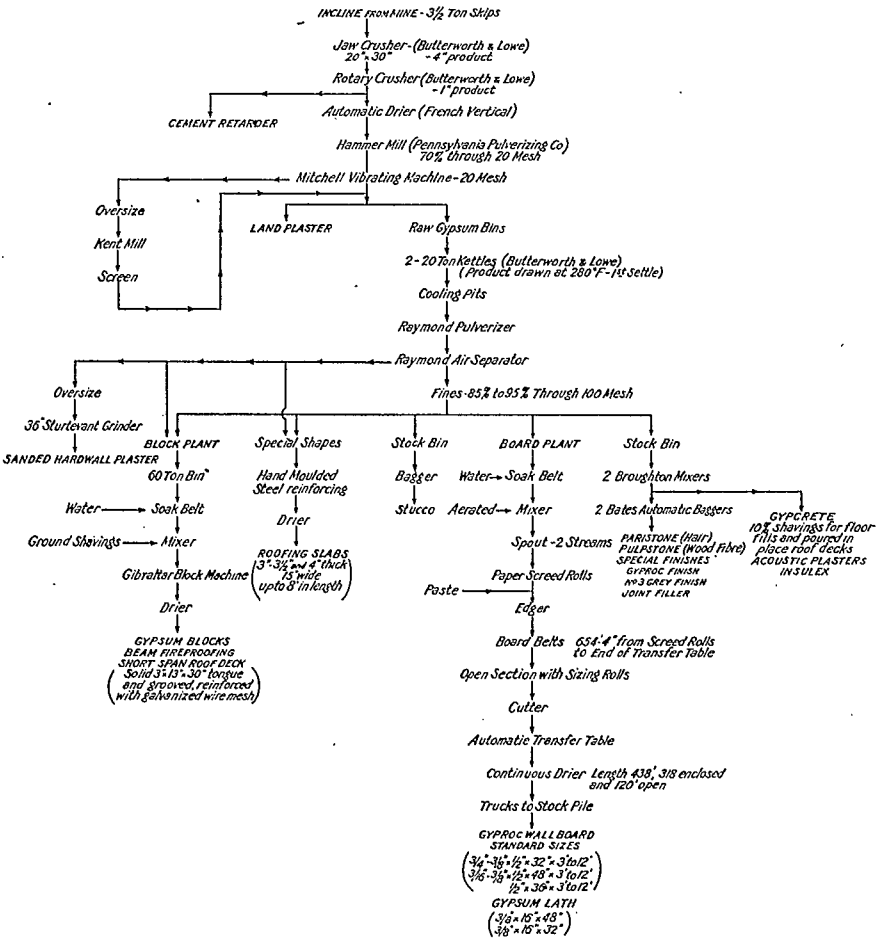
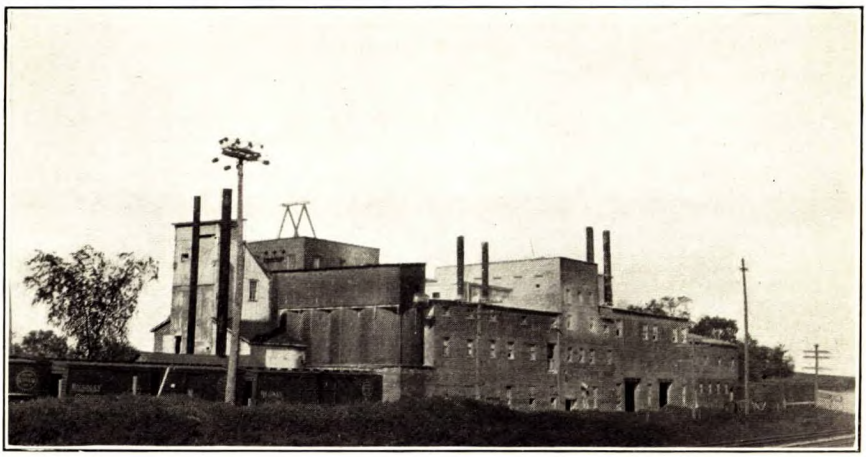


Figure 10. Flow-sheet of Caledonia mill, Gypsum, Lime and Alabastine, Canada, Ltd., Caledonia, Ont.

struction was commenced on a 1-kettle mill and this was completed in 1911, the shipment of wall plasters and plaster of Paris commencing in July of that year. Shortly afterwards a second kettle was added, and in 1913 other additions were made to the shipping room so that railway cars could be placed on either side. The siding makes connexion with the Canadian National railway tracks at Caledonia.



A. Mill of the Gypsum, Lime and Alabastine, Canada, Ltd., Lythmore, Ont.

B. Face in quarry of the Gypsum, Lime and Alabastine, Canada, Ltd., Gypsumville, Manitoba. Note contortions of the bed and fractured nature of the rock.

In 1919, the Canada Plaster Board Company began the work of making wallboard at Caledonia, obtaining its calcined gypsum from the Alabastine Company. In the following year this plant was taken over by the Ontario Gypsum Company who greatly extended the operations.

In 1921 the Alabastine Company, under whose management the property was then being operated, added a plant for the manufacture of gypsum blocks, but in 1922 this phase of the operations was taken over by the Ebsary Gypsum Company and a storage shed built for the storage of the blocks which had previously been stored in the open. A part of the output of this plant was sold by the Ontario Gypsum Company but the interests of the Ebsary company were later acquired by the Ontario Gypsum Company in 1925.

At the present time (1930) the several phases of the gypsum industry at Caledonia are carried on under the management of the Gypsum, Lime and Alabastine, Canada, Ltd. and the whole plant has been greatly extended and improved to meet the increasing demand for gypsum products throughout the country.

The present operations of this company are best explained by the flow-sheet given in Figure 10.

Lythmore Deposit

The mine at present being operated by the Gypsum, Lime and Alabastine, Canada, Ltd. to supply its mill at Lythmore is on lots 55 and 56, concession V, Oneida township. It is connected with the mill by a narrow gauge track 1¼ miles in length.

A 2-compartment vertical shaft taps the gypsum beds at a depth of 70 feet; the bed is 4 feet in thickness and is all being mined.

The rock is white in colour and massive and fairly free from dolomite and other impurities.

Rounds are drilled by two air-driven, auger drills and low strength dynamite is used to blast the rounds. The broken rock is trammed from the working faces to the shaft in 1-ton cars which are hoisted to the surface in the skip. These cars are dumped into a crusher which breaks the rock to 3-inch size after which it is stored in bins ready for loading into trains for the mill. It is hauled in 3-ton cars in train loads by an electric locomotive to the calcining mill situated 1¼ miles to the south.

The Mill. The mill was erected in 1911 after the previous mill had been destroyed by fire. The building is of brick, steel, and concrete construction and is equipped with the most modern machinery for grinding, drying, and calcining gypsum, as well as preparing special plasters for the market. An addition has been added in the past few years in which to manufacture special insulating and acoustic plasters for the trade.

Power for the mill is obtained from the Ontario Hydro-Electric Commission, coming into the mill at 13,500 volts which is stepped down to 550 volts for use in the separate motors. The machinery is so arranged that with the use of individual or group drives all the different processes of manufacture are independent of one another. The flow-sheet of this mill is given in Figure 11.

In 1926, the operations of the Ontario Gypsum Company had expanded to such an extent that necessity was felt for additional mill capacity so that in that year a modern mill for the manufacture of gypsum plasters and wallboard was erected in the east end of Montreal. This mill commenced operations in 1927 and has been working at capacity ever since

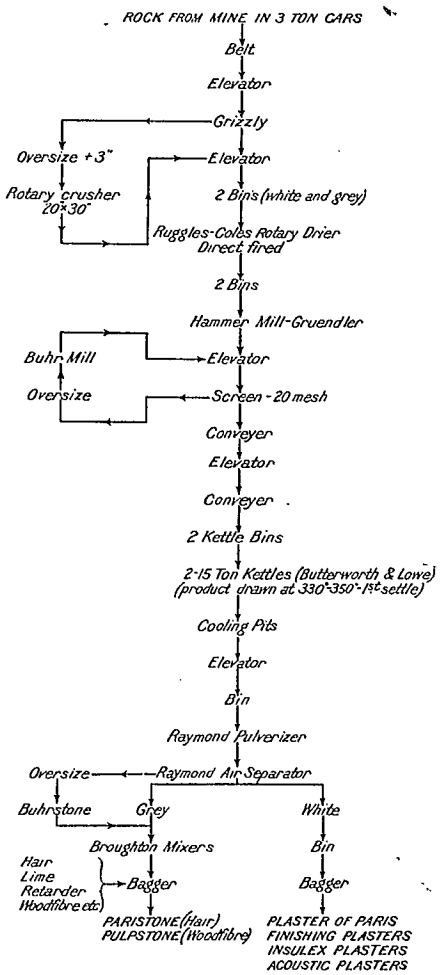


Figure 11. Flow-sheet of Lythmore mill, Gypsum, Lime and Alabastine, Canada, Ltd., Lythmore, Ont.

supplying the building trade of the province of Quebec as well as working up a profitable export business. The rock for this mill has been obtained from both Caledonia and from Nova Scotia, that from the latter province coming from either the Ingonish property of the Canada Cement Company or the company's own deposit at Mabou. Recent arrangements have been

made to obtain rock for a number of years from the quarry of the Atlantic Gypsum Products Company at Cheticamp, Inverness county, Nova Scotia.

A full line of gypsum products is made at this plant and the flow-sheet is given in Figure 12.

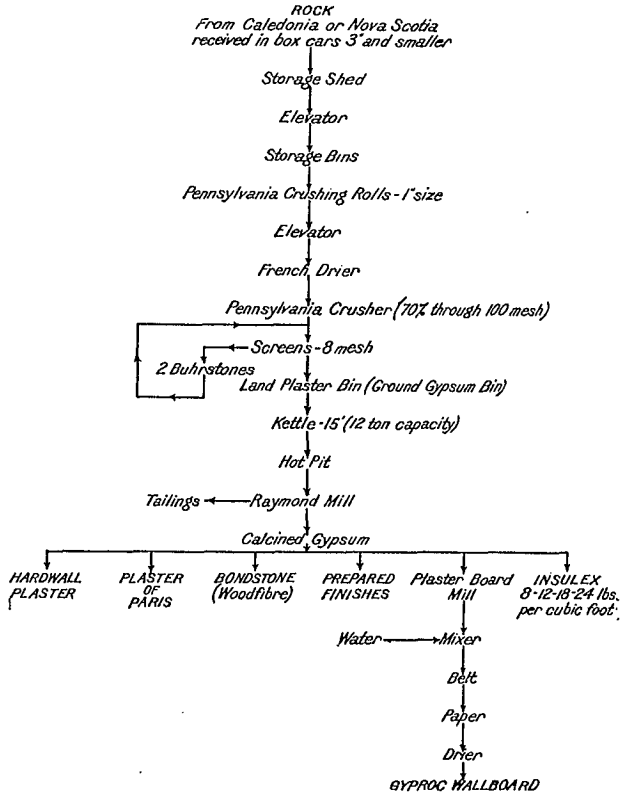


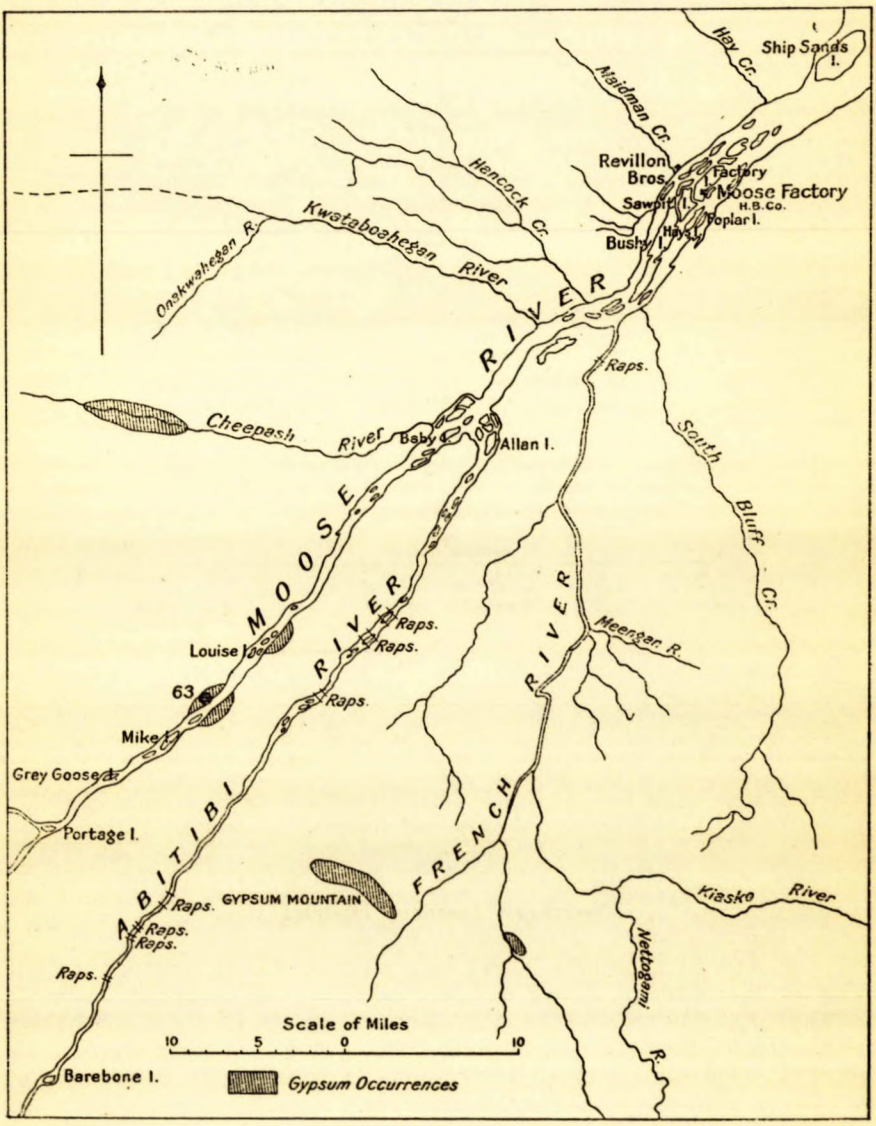
Figure 12. Flow-sheet of Montreal mill, Gypsum, Lime and Alabastine, Canada, Ltd., Montreal, Que.

Northern Ontario District[1]

The mineral gypsum is found in a number of localities in the area lying to the south of James bay and north of the Canadian National railway. It forms three series of exposures along the shores of the Moose river. One of them extends 2½ miles along the Moose river and can be followed along the Cheepash river 15 miles north of its occurrence on the Moose almost continuously for 6 miles. A large exposure occurs in

[1]Owing to the writer's being unable to visit personally the deposits in northern Ontario, Dr. W. S. Dyer, Geologist of the Ontario Department of Mines, Toronto, has kindly furnished an advanced copy of that section of his report on "The Geology and Economic Resources of the Moose River Basin" which deals with the gypsum occurrences in the area. His complete report is being published as vol. XXXVII, pt. VI, Ontario Dept. of Mines, 1929, and this section is prepared in an abridged form from Dr. Dyer's report, in many parts verbatim. The writer wishes to acknowledge in full Dr. Dyer's courtesy in thus making this information available for inclusion in this report.

Gypsum mountain between the Abitibi and French rivers and a smaller one on the central branch of the French. Gypsum has also been reported from the Harricanaw river near the Quebec boundary. The gypsum probably extends intermittently between all these exposures.



(After Dyer)

Figure 13. Sketch map showing gypsum occurrences in northern Ontario.

The beds in places are exposed for a thickness of 15 feet, but in most cases they extend below water level so that their total thickness has never

been observed. The overburden is generally thin, that on the Moose river averaging 25 feet, 15 feet of which is boulder clay, and 10 feet brecciated gypsum and selenite mixed with limestone and shale.

At present the terminus of the Temiskaming and Northern Ontario railway is 40 miles to the south of the deposit on the Moose, so that transportation of the gypsum to outside markets is out of the question. These deposits, for the time being, can be looked on as a great potential reserve of this mineral for future use.

The Moose River deposit was briefly described by Robert Bell[1] in 1875 and later mentioned by Borron[2]. J. M. Bell[3] gives full descriptions of the Moose River and Gypsum Mountain deposits as well as short references to the French River and Harricanaw River occurrences.

Part of the Moose River deposit was staked in 1911 by W. Tees Curran and a party of engineers en route to the islands of Hudson bay on behalf of the Ungava Miner's and Trader's, Limited. The claims were allowed to lapse and a second attempt to hold the ground also failed, but a third attempt in 1923 by the Curran Brothers and R. M. P. Hamilton of Montreal, proved successful, and all assessment work has been completed to date.

Moose River

Descending the Moose river the first outcrop of gypsum appears 11 miles below Portland island in the northwest bank opposite the middle of Murray island, and can thence be followed downstream almost continuously for 2½ miles. On the southern side of the river the gypsum is found in two series of exposures; the first of these extends 1½ miles along the shore opposite Smith island, and the second for one mile opposite Wait island, 5 miles below Smith island. No gypsum was found on the large islands in midstream.

The outcropping gypsum beds have the appearance of a series of alternating anticlines and synclines. In the anticlines the gypsum stands up in cliffs 10 to 15 feet high, whereas the synclines are filled with gypsum breccia, limestone, limestone rubble, boulder clay, and at one place with interglacial lacustrine silts, the whole presenting an even crest line.

The maximum observed thickness of the gypsum is 15 feet above water level. Lanning[4] reports that 4 drill holes were sunk into the gypsum to depths ranging from 25 to 47 feet, none of which succeeded in reaching the bottom of the beds. It is quite possible, therefore, that only the upper part of the beds shows above water level and that if the whole series could be seen a much more uniform and massive appearance would be presented.

The gypsum is usually granular or finely crystalline and snow white in colour, but grey, pink, green, and brown gypsum occurs, and a greyish variety with coarsely crystalline, star-shaped clusters of selenite about one inch in diameter is not uncommon. The upper beds are commonly laminated and more coarsely crystalline, and may have beds of shale

[1]Robert Bell: Geol. Surv., Canada, Report of Progress 1875, p. 321.
[2]E. B. Borron: Report on the Basin of Moose River, Toronto, 1890, p. 61.
[3]Ontario Bureau of Mines, vol. XIII, pt. I, pp. 156-58 (1904).
[4]Lanning, J.: Can. Min. Jour., Dec. 10, 1926, p. 1173.

and limestone interbedded with them, but the lower beds are purer, more massive, and finely crystalline. An interesting feature of the deposits is the occurrence of a breccia overlying the gypsum beds. The breccia consists of angular blocks of gypsum, transparent selenite, and limestone embedded in a matrix of grey shale.

The greatest thicknesses of gypsum above water level are found on the northwest side of the river: half a mile above the Curran cabin, 12 feet; at the Curran cabin, 12 feet; and from 2 to 2½ miles below the Curran cabin, a continuous thickness of from 12 to 15 feet. The beds of gypsum in the upper exposure on the southeast side are very similar to that on the opposite side, though in general the quality does not appear to be so good and the proportion of gypsum breccia is greater. The beds opposite Wait island are composed for the most part of greyish crystalline gypsum with spots of brownish selenite and are not so cavernous or pillared as the beds farther upstream, but occur as sloping banks. The maximum thickness here is about 13 feet.

Cheepash River

On the Cheepash river, a small stream that flows eastward into Moose river near the mouth of the Abitibi, an even better series of gypsum exposures occurs. The first gypsum is seen on the south bank 16 miles up the river and can thence be followed upstream continuously for 6 miles. It presents much the same appearance as on the Moose, forming intermittent white cliffs on the sides of the river, separated by low banks of boulder clay and limestone talus. The observed thickness of the beds is greater than on the Moose, the maximum thickness measured being 20 feet; in many places there are cliffs ranging from 10 to 17 feet high, but here, as on the Moose, the beds extend below water level and their total thickness could not be determined.

The quality of the gypsum is excellent, much of it being snow white and finely crystalline, but other varieties consisting of aggregates of selenite crystals, each averaging a quarter to a half inch in diameter, or of crystals of selenite in a matrix of fine crystalline gypsum, were also quite abundant. Very little brecciated gypsum was seen, and there is a smaller proportion of interstratified shale than on the Moose.

Throughout the whole length of the deposit the gypsum is overlain by boulder clay or sand, ranging in thickness from a few inches to 20 feet; no limestone nor shale being seen in place. It is very likely that this deposit forms part of the same series as that occurring on the Moose, and the gypsum may be continuous or nearly so between the two rivers.

Gypsum Mountain

The gypsum deposit at this locality was first described by J. M. Bell[1] in 1904 and by Dyer in 1928. The deposit is located midway between the French and Abitibi rivers, about 8 miles north of the point where Niven's Line crosses the French. According to Bell the width of the deposit along this line is 2,300 yards, and at right angles to the line westward the beds

[1]Ont. Bureau of Mines, vol. XIII, pt. I, p. 158 (1904).

extend about 350 yards. East-southeast from the line, according to Bell, gypsum beds were traced for three-quarters of a mile. They showed no signs of giving out but had increased in thickness. They probably do not extend to the west branch of the French river, as no gypsum was seen in its banks.

The surface of the land within the limits of the gypsum is rough and uneven, caverns, natural bridges, and many deep holes partly filled with water were observed. Gypsum mountain was named by Bell, not because of its great height but because of the contrast between it and the almost interminable muskeg around it. It is probable that limestone overlies the gypsum, as it does on the Moose river, but none was seen.

The gypsum is of good quality and very similar in appearance to that of the Moose river. The thickness of the beds could not be determined, since neither the top nor the bottom was seen; but cliffs 20 feet high were observed.

French River

On the central branch of the French river, gypsum is first encountered on the east bank 6 miles above the mouth. It outcrops intermittently (seven times) in half a mile, and one small exposure was seen on the west bank opposite the upper end of the exposures on the east side. The maximum thickness measured was 12 feet. The gypsum is of both the grey and white crystalline varieties and has a considerable amount of selenite mixed with it. It is overlain by limestone.

Harricanaw River

The occurrence of gypsum on the Harricanaw river has been described by J. M. Bell[1] as follows:—

A deposit of gypsum appears on the Harricanaw river on the western side of and near the head of Gordon island. The deposit is only of interest scientifically, as it is too small to be of any economic value. Overlying a horizontal limestone, sometimes exceedingly porous and dark in colour, again more compact and lighter in colour, is a bed of hard, dark crimson clay. Within this clay are small patches of beautiful red crystalline selenite, and in the lower part of the stratum, just above the limestone, are a number of small layers of satinspar gypsum, none of which exceed four inches in thickness. The hard red clay extends along the river for about half a mile, and has a maximum thickness of perhaps ten feet. Reddish clay, similar to that in which the gypsum occurs, is also exposed opposite the foot of Gordon island, on the mainland.

At the request of the writer, Mr. W. Tees Curran kindly brought out a sample of the white gypsum from his claims on the Moose river and this was tested as sample No. 63, the results obtained being given in Chapter VIII.

Manitoulin Island

The following extract from Dr. Robert Bell's report in the Geological Survey of Canada, 1863-66, page 178, indicates the presence of gypsum on the east end of Manitoulin island:—

Gypsum.—This mineral is said to occur in promising quantities on the east end of the island, about three miles south of Wequemakongsing, but as this information

[1]Bell, J. M.: Ont. Bureau of Mines, vol. XIII, pt. I, p. 158 (1904).

was only communicated to me as we were leaving the island, it was found impossible to visit the locality. In the same geological position, on the east side of West Bay, about a mile and a half from the Metch-je-wedchong, small quantities of gypsum occur in the limestone, near the junction of the Hudson River and Clinton formations.

No further reference is made to this deposit in any Survey reports, and no definite information as to its probable extent is at hand. It is quite possible, taking into account the formation and character of the rocks on this island, that a deposit of economic importance may be located and developed.

Other Occurrences

Gypsum also occurs as part of the vein material associated with lead and apatite. It may occur either as massive gypsum or the transparent crystalline form of selenite. In the massive variety it has been noted in the McLaren mine, North Burgess township[1], while selenite occurs sparingly in the Foxton apatite mine[2], Loughborough township; both these occurrences being of mineralogical importance only.

In a description of the occurrence of anhydrite and gypsum found in the " 100-ton pit " McLaren phosphate mine, lot 4, concession VIII, North Burgess township, Lanark county, Ferrier[3] says in part:—

> The anhydrite is in cleavable masses of a light purple or lilac colour, and show alteration to a snowy white gypsum, being in places, traversed by a network of little cracks filled by that mineral (gypsum), a process of alteration apparently analogous to that of the serpentinization of olivine. Sometimes the alteration has taken place only in the direction of the cleavage planes, giving rise to a most beautiful banded structure, anhydrite and gypsum arranged in alternate layers.
>
> Some good sized masses of fine-grained white gypsum occur with the anhydrite, probably derived from its alteration.
>
> Both the anhydrite and gypsum occur in crystalline limestone, associated with apatite, and their presence in the Laurentian limestones is of special interest, opening up, as it does, many interesting questions regarding the origin of these limestones.

An occurrence of selenite, but on a larger scale, is to be found in the Kingdon mine at Galetta. At this property transparent masses of selenite and selenite crystals occur as vein filling in irregular patches in a number of the workings on the 500-foot and lower levels. These selenite masses, in places occupy a width of 5 feet and extend along the vein in a lenticular shape for from 10 to 15 feet. Blocks of this mineral 1-foot square and up to 5 inches in thickness have frequently been obtained so clear and transparent that the finest printed matter could be read through the block without the slightest trouble. It is quite possible that material sufficiently transparent for optical uses could be obtained from this deposit. A photograph of one of the crystals from this mine is shown in the Frontispiece.

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[1]Canadian Record of Science, vol. IV, p. 476.
[2]Ontario Bureau of Mines, vol. IX, p. 208.
[3]Canadian Record of Science, vol. IV, p. 476.

CHAPTER V

GYPSUM OCCURRENCES IN MANITOBA

INTRODUCTORY

The existence of gypsum in commercial quantities in Manitoba has been known for more than forty years. It was not, however, until about the year 1888 that any steps were taken to determine the possibilities and extent of any of these deposits, when J. B. Tyrrell made a survey of the Lake St. Martin district and gave a description of the gypsum deposits of this area in his report to the Geological Survey.

The districts in which gypsum is known to occur in Manitoba, comprise an area of about 56 square miles,[1] located principally in tp. 33, range 8; tp. 33, range 9; N. ½ tp. 32, range 8; N. ½ tp. 32, range 9, all west of the Principal Meridian. Gypsum was encountered at a depth of 325 feet, in drill holes 18 miles east of Dominion City in southern Manitoba. During the past six months Winnipeg newspapers have reported gypsum being encountered in drill holes at Charleswood just west of Winnipeg.

EARLY HISTORY OF INDUSTRY IN NORTHERN MANITOBA

Although the deposits in this northern country have been known for many years, it was not until the year 1901 that any active development work was carried out. In that year the Manitoba Union Mining Company, composed of Canadian and American capitalists, staked out a large area of land supposed to be underlain by gypsum, and erected a crushing and calcining mill at the head of Portage bay on lake Manitoba.

The deposits were worked as open quarries. The rock was transported by team over a bush road to the mill, 12 miles distant. At this mill it was crushed by burrstones and calcined in kettles and shipped down the lake in the company's steamer to be distributed throughout the western country from the station of Westbourne. The fact of having to ship by water confined the shipping season to the summer months. For the first few years the output from this mill would average, during the shipping season, about 70 tons per week. This consisted of hardwall plaster, fibre plaster, and a small quantity of plaster of Paris.

The late D. B. Dowling, of the Geological Survey staff, who visited these quarries in the summer of 1902, gave the following description[2].—

The bedded character of the gypsum is well seen in the quarries opened by the company. The one first worked is probably on the ridge followed by Mr. Tyrrell, and is in or near section 13. In this a quarry 55 yards long has been opened and shows an average depth of ten feet. From this, judging by the cross section of the ends,

[1] A detailed description of the topography of the northern Manitoba gypsum deposits is given in Mines Branch Rept. No. 245, Chap. VII, pp. 77-81.

[2] Dowling, D. B.: Geol. Surv., Canada, Ann. Rept., vol. XV, pt. A, p. 190.

there has been removed about 1,800 cubic feet of rock. Nearby, another quarry not so well worked out, is about 40 yards long. Prospecting pits showing white anhydrite near the surface have not determined its depth, and, judging from the nodular and lenticular inclusions in the face of the quarry near, some of these prospecting holes may have touched some of the thin beds and so do not necessarily preclude the presence of gypsum beneath. Other quarries are to be opened farther to the east and north.

A few years after commencing operations, a narrow gauge tram line from the mill to the quarries was built.

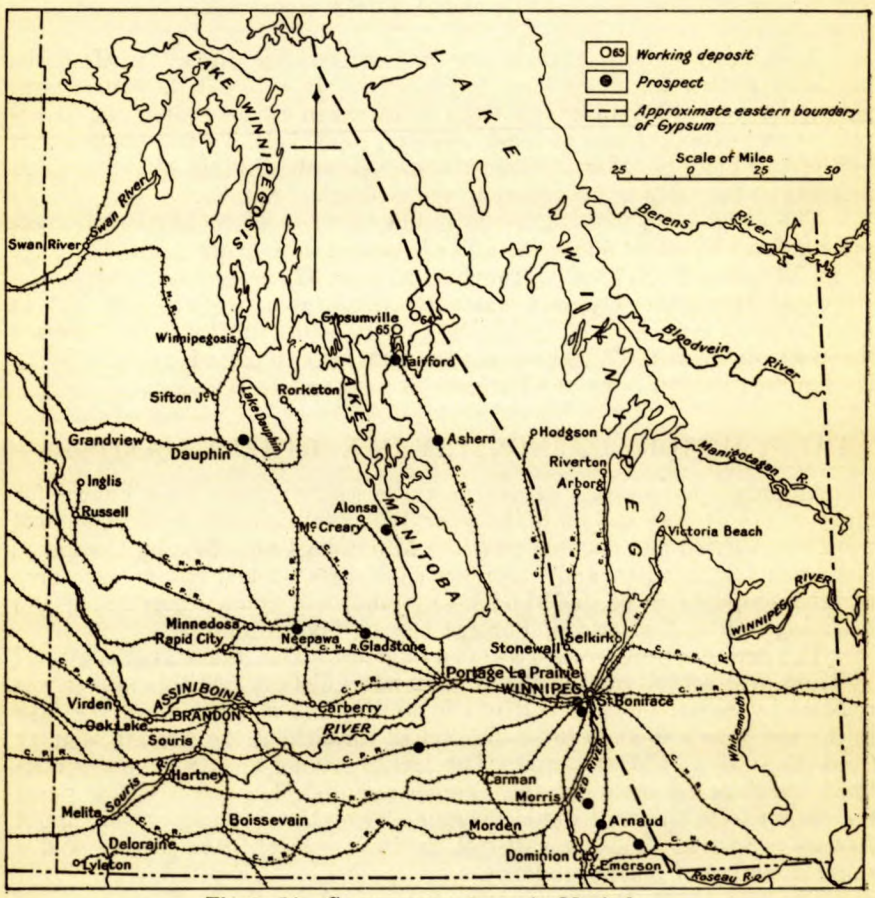
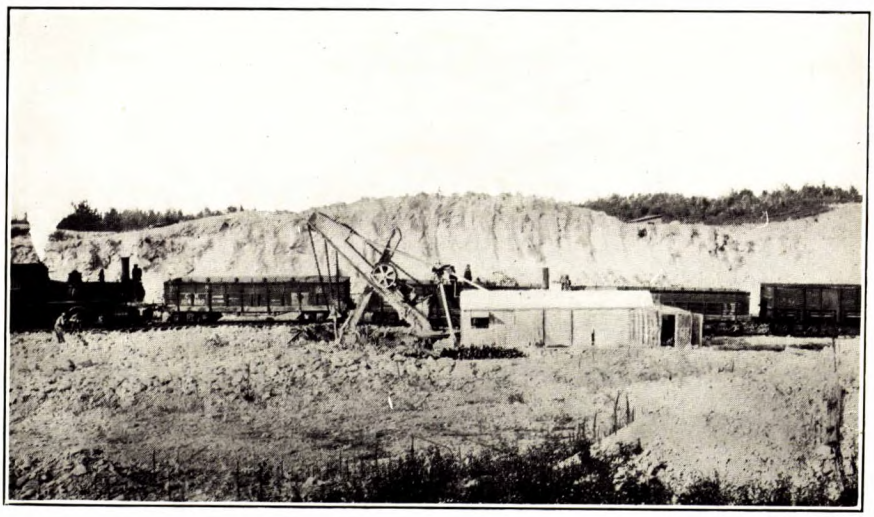


Figure 14. Gypsum occurrences in Manitoba.

In the autumn of 1904, the Manitoba Union Mining Company was purchased by the Manitoba Gypsum Company, and under this new company operations were greatly extended. In the spring of 1906 the mill and all the company's buildings at the head of Portage bay were burned to the ground. Plans for a new mill were immediately prepared, and by autumn operations were resumed with the new mill located in Winnipeg. The

Face of quarry, Gypsum, Lime and Alabastine, Canada, Ltd., Gypsumville, Manitoba, showing anticlinal fracture of beds probably due to the alteration of anhydrite into gypsum.

A. General view, looking west, in the quarry of the Gypsum, Lime and Alabastine, Canada, Ltd., Gypsumville, Manitoba.



B. Steam shovel at work loading railway cars in the quarry of the Gypsum, Lime and Alabastine, Canada, Ltd., Gypsumville, Manitoba.

crude rock was shipped by steamer from the head of Portage bay and landed at the south end of lake Manitoba at Totogan, from whence it was hauled by the Canadian Northern railway to the mill at Winnipeg.

Unfortunately, in 1909, the new mill was destroyed by fire, causing a serious setback to the company at a time when the industry in western Canada was beginning to show great promise. A new mill was built of reinforced concrete in 1910 in Winnipeg, and now forms the central unit of the present plant.

During the winter of 1910 a branch line of the Canadian Northern railway reached Gypsumville quarries, and shipments by an all-rail route were commenced.

In 1911 a new company, called the Dominion Gypsum Company, which had obtained control of several stretches in this northern district of valuable gypsum properties erected a 200-ton mill.

The Dominion Gypsum Company operated its mill for several years on rock purchased from the Manitoba Gypsum Company but in 1918 its holdings were purchased by the latter company and the mill dismantled.

In 1921, the Manitoba Gypsum Company added a modern plaster board plant to its existing equipment and since that time several additional improvements to the processes and equipment have been made.

In 1926, the Manitoba Gypsum Company acquired the British Columbia Gypsum Company at Falkland, B.C., and erected a plant at Port Mann, B.C., both deposit and plant being in operation by the end of the same year.

During the first part of 1928 the Manitoba Gypsum Company, together with its subsidiary company, the British Columbia Gypsum Company, were purchased by the Canada Gypsum and Alabastine, Ltd., Paris, Ont., since which time both concerns have been actively operated by the new management.

GYPSUM IN NORTHERN MANITOBA

At present the only company operating gypsum deposits in Manitoba is the Gypsum, Lime and Alabastine, Canada, Ltd. Operations are carried on at two points in the vicinity of Gypsumville, 170 miles north from Winnipeg, the present terminal of one of the Canadian National Railway northern branch lines.

The main quarry of this company is on sec. 26, tp. 32, range 9, west of the Principal Meridian. The workings are in the low-lying ridges immediately to the north of the village. The openings are in the form of an "L," the old north-south area being approximately 150 feet wide by 800 to 1,000 feet long, and the new east-west quarry approximately the same size. This new quarry was opened up in July 1921, and operations have been confined to this quarry ever since. The average depth of the face in this quarry is 15 feet. A drainage ditch from the east end of the quarry was dug in 1926 and has materially helped to lower the water table so that work is at present being carried on in the quarry floor.

Holes are drilled in the rock by hand augers and 3 to 5 sticks of 40 to 60 per cent dynamite are used per 5-foot depth. Firing is done by battery, 12 to 15 holes being set off at one blast. On account of the friable

nature of the rock these blasts tend to shatter the gypsum into small pieces that can readily be handled by the steam shovel.

Standard gauge tracks are run along the floor of the quarry and the cars are loaded by a Bucyrus steam shovel with a dipper of 1½ yards capacity. A 30-ton car can be filled to capacity in from 8 to 10 minutes.

From 15 to 20 cars per day are being shipped for 10 months of the year, the quarry being generally closed during January and February. A general sample of the rock from this quarry was taken from the cars at the mill in Winnipeg for testing. This sample, No. 65, weighed 198 pounds.

On sec. 3, tp. 33, range 8, west of the Principal Meridian, another quarry has been opened in the past few years, in a deposit known locally as the "White Elephant." This quarry (*see* Plate XVI) has a face of 15 feet in a very white, massive gypsum with only from 3 to 5 feet of overburden. Occasional masses of anhydrite as well as selenite are encountered. The gypsum from this deposit is hauled by teams in winter to Gypsumville, a distance of 6 miles, for shipment to Winnipeg where, on account of its whiteness, it is used in the manufacture of plaster of Paris. A large-scale sample, No. 64, was taken for testing.

Gypsum has been encountered at other localities in this northern area, namely at Fairford, 15 miles south of Gypsumville, where gypsum was found in a well at a depth of 75 feet; at Ashern, where a 2-foot bed occurs at a depth of 40 feet; and on the Vermilion river, 75 miles to the southwest of Gypsumville where a drill hole is reported to have struck a 15-foot gypsum bed at a depth of 550 feet. None of these deposits has been developed.

OTHER DEPOSITS IN MANITOBA

During the summer of 1911 a discovery of gypsum was made in the southern part of the province.

A syndicate of Winnipeg men, while drilling in the valley of a stream about 18 miles to the east of Dominion City, a small town on the south branch of the Canadian Pacific railway, encountered at a depth of 325 feet a deposit of very pure, massive white gypsum. The deposit consists of a series of beds of varying thickness, totalling in all 115 feet. One bed has a solid thickness of 50 feet, free from clay and other impurities. Alternating with these beds of gypsum are beds of fine-grained, compact, reddish, slightly calcareous clay. Five drill holes have been put down in this district at distances of more than one-quarter of a mile apart, and in all of these the gypsum and clay beds have been found in similar sequence, so that it is probable that the gypsum beds are continuous over a large area.

Analyses of pieces taken from the core showed a very pure gypsum, suitable for the manufacture of the finer grades of plaster of Paris. Small samples which were crushed, produced a very quick-setting, strong plaster.

An analysis of part of one of the cores gave the following results:—

Insoluble	2·00 per cent.
CaO	31·72 "
SO_3	45·32 "
H_2O	20·45 "
	99·49 "

F. G. Wait, Analyst.

Face of the White Elephant quarry of the Gypsum, Lime and Alabastine, Canada, Ltd., 6 miles northeast of Gypsumville, Manitoba.

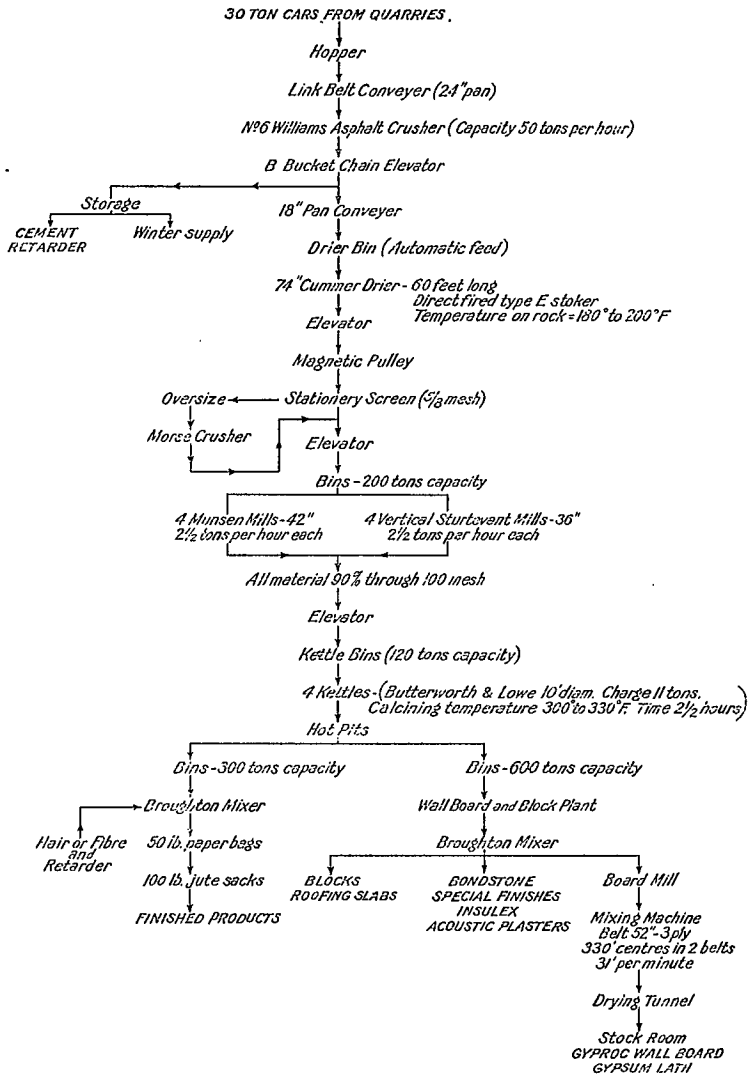


Figure 15. Flow-sheet of Winnipeg mill of Gypsum, Lime and Alabastine, Canada, Ltd., Winnipeg, Man.

Wallace[1] tabulates this occurrence as well as several other localities at which gypsum has been noted in the province as follows:—

Locality	Gypsum encountered at depth	Thickness of gypsum	Remarks
	Feet	Feet	
17 miles east of Dominion City....	260	45	Five drill holes were sunk. Gypsum wall also encountered at irregular intervals from 325 to 450 feet. Very pure and white.
Amand.....	175	25	Encountered in a well.
St. Elizabeth.....	153	27	"
St. Charles, near Winnipeg.....	40	.....	"
Charleswood.....	25	5	"
Leifur.....	10	10	Found by exploratory drilling to extend over several sections of land.
Rathwell.....	960	62	Sixty-two feet of gypsum and red clay. Some anhydrite.
Neepawa.....	1,100	.....	Data of thickness not available.
Gladstone.....	201	50	Fifty feet of limestone and gypsum; probably Devonian.

At present the only gypsum mill in operation is the mill of the Gypsum, Lime and Alabastine Canada, Ltd., situated in the western outskirts of Winnipeg.

The rock from the company's two quarries in the northern area is shipped in 30-ton gondola cars to the mill at Winnipeg where it is prepared into a complete line of gypsum products such as plaster of Paris, hardwall plasters, plaster board, partition blocks, roofing slabs, special insulating and acoustic plasters, etc. A flow-sheet of the mill is given in Figure 15.

The sales territory for material from this plant covers the three Prairie Provinces and Ontario as far east as Port Arthur.

This industry has been an important factor in the upbuilding of the non-metallic production of the province, and with ever-increasing building activity in the west there is every reason to look forward to the future with the greatest confidence.[2]

[1] "The Non-Metallic Mineral Resources of Manitoba"—Industrial Development Board of Manitoba—1927, p. 41

[2] Since this report was written, in the summer of 1929, a new company, The Western Gypsum Products, Ltd., has erected a modern and up-to-date mill in Winnipeg, in which they purpose manufacturing a full line of gypsum products. They intend operating a gypsum deposit in the vicinity of Amaranth, Man., on the Oakland branch of the Canadian National railway, 54 miles northwest of Portage la Prairie. Operations are expected to be commenced early in 1930.

CHAPTER VI

GYPSUM OCCURRENCES IN SASKATCHEWAN, ALBERTA, AND THE NORTH WEST TERRITORIES

In the provinces of Saskatchewan and Alberta as well as the North West Territories deposits of gypsum have been noted from time to time, but so far none have been developed. The distance of these deposits from markets has been the chief factor, so far, in preventing their being operated, but it is possible that with the increasing demand for gypsum products in the west the possibilities of one or more of these deposits will, in the near future, be carefully considered.

OCCURRENCES IN SASKATCHEWAN

No massive deposits of gypsum have, so far, been found in Saskatchewan. Selenite crystals up to 4 inches in length have been found in a number of localities. These occur as crystals in surface deposits which cover most of the province and are probably the result of the action of sulphuric acid derived from the decomposition of pyrite on limestone in the drift. It is not probable, therefore, that such deposits will be found of any great extent.

OCCURRENCES IN ALBERTA

In Alberta, gypsum has been found at a number of localities, outcropping both on the surface and in drill holes.

McMurray Deposits

Two wells were drilled by the Alberta Government in the vicinity of McMurray in 1919 and 1923, in both of which gypsum and anhydrite were encountered. Well No. 1 was located in the townsite of McMurray and was drilled to a depth of 685 feet, and at a depth of 500 feet the gypsum-anhydrite series was encountered. This series persisted in alternating beds of varying thickness down to a depth of 631 feet when the first salt horizon was penetrated. Well No. 2 was located by Dr. Allan, Professor of Geology, University of Alberta, 100 yards from the Alberta and Great Waterways railway at the junction of Deep creek and Clearwater river, in sec. 32, tp. 88, range 4, west of the 4th meridian. This hole was drilled to a depth of 789 feet and penetrated to granite. Beds of gypsum and anhydrite of varying thickness were first encountered at a depth of 415 feet and recurred at intervals down to the contact of the Precambrian granite at a depth of 785 feet.[1] Series of analyses were made

[1]Complete logs of these two wells are given by J. A. Allan, Can. Inst. of Min. and Met., Bull. No. 206, June, 1929 p. 777.

by J. A. Kelso, Director, Alberta Provincial Industrial Laboratories, from different beds of gypsum and anhydrite from Well No. 1 with the following results.[1]

Analyses of Gypsum and Anhydrite from Salt Well

—	No. 1	No. 2	No. 3	No. 4
Depth in feet	534	546	564	662
Residue	1·02	.....	2·02	4·22
Lime	32·81	17·36	33·88	37·42
Magnesia	5·14	6·66	0·98	1·25
Sulphuric anhydrite	58·11	0·63	48·62	54·05
Ignition loss	2·72	25·62	14·01	0·72
Silica	.....	34·20	.....	.....
Iron oxide	.....	2·00	.....	.....
Alumina	.....	9·20	.....	.....
Alkalis, etc	.....	4·33	.....	.....
Sodium chloride	.....	.....	.....	1·99

—	No. 5	No. 6	No. 7	No. 8	No. 9
Depth in feet	664½	665	666	671	676
Residue	5·62	5·20	1·02	4·72	2·01
Oxide of iron and alumina	5·98	.....	4·02	.....	.....
Lime	34·58	35·27	29·46	35·84	35·56
Magnesia	0·00	0·24	0·00	0·46	6·66
Sulphuric anhydrite	49·07	49·16	41·88	52·46	50·67
Sodium chloride	0·38	0·58	20·90	5·02	0·32
Ignition loss	4·01	9·02	2·78	1·24	4·52

—	No. 10	No. 11	No. 12	No. 13
Depth in feet	681	684	670–673	685½
Residue	4·02	.....	7·72	1·38
Lime	37·04	40·78	33·00	40·00
Magnesia	0·12	0·37	0·09	0·09
Sulphuric anhydrite	54·62	58·34	47·09	57·44
Sodium chloride	1·02	.....	4·72	.....
Ignition loss	3·01	0·42	7·30	1·07

From these analyses it can be seen that the greater part of the calcium sulphate penetrated occurs in the form of anhydrite.

La Saline Deposits

At La Saline, on the east bank of the Athabaska river, and 28 miles north of McMurray, a series of mineral springs occurs, and the deposits from these contain small quantities of gypsum, besides salt, native sulphur, etc.[2]

[1] Second Annual Report on the Mineral Resources of Alberta, 1920, p. 110.
[2] Geol. Surv., Canada, Ann. Rept., vol. V, pt. D, p. 35.

Peace River Deposits

Along the Peace river, between Bonille rapids and Peace point, beds of gypsum are to be seen from 10 to 15 feet in thickness. Blocks of gypsum, several feet in diameter, which are found on the Peace river above its confluence with Loon river, and on the Red river a few miles above its mouth, are supposed to have been carried by the ice during the Glacial period from this deposit.[1]

Camsell has given the best description of these deposits as follows:—[2]

At almost all the outcrops of the Palæozoic rocks in the area an important deposit of gypsum occurs. In other places where no outcrops occur, the presence of gypsum was suspected by the pitted and broken nature of the surface, which is so characteristic of a region underlain by gypsum. How much of the region is actually underlain by gypsum, it is difficult to say, but the area must be very great and can probably be measured in hundreds of square miles.

The thickness of the beds is variable and it is very likely in certain portions of the region they may be absent altogether. Nowhere is a complete section of the beds exposed, and, although in most outcrops the top is visible, the base is never seen. A maximum thickness of 50 feet is exposed at two points, namely, Peace river at Little rapids, and in the escarpment at the brine springs of Salt river. In other localities thicknesses of 10 or 20 feet are exposed.

No attempts have been made to work any of the gypsum deposits because of their remoteness from settled districts where gypsum products could be used, and indeed no claims have as yet been taken up on them. Some of the outcrops could not be worked economically because of the depth of overlying material, but others have not this disadvantage. The exposures on Peace river are the most favourably situated in this respect, while those in the escarpment at the brine springs could also be easily developed.

On Peace river, gypsum is exposed on both banks of the river almost continuously for a distance of 15 miles or from Little rapids to a point 5 miles below Peace point. The exposed thickness varies from a few feet up to a maximum of 50 feet, the latter occurring on the south side of the river at the foot of the rapids. The gypsum is usually white and massive. In places it is earthy and thin bedded or holds narrow bands of dolomitic limestone. Selenite is rare, but thin veins and beds of satin spar are common. Anhydrite is occasionally present in rounded nodules or in thin beds. Overlying the gypsum is a fractured and broken bed of limestone, but since the structure of the beds is undulatory the gypsum is frequently brought up to the top of the cliffs and has no cover except the drift, the limestone having been removed by erosion. The drift varies in thickness from 5 to 15 feet and when the gypsum is covered only by the drift the conditions are most favourable for the economical mining of the beds. Such conditions occur in a number of localities in the section, particularly on the north side of the river.

Judging by the character of the surface back from the face of the cliff, gypsum must extend back from the river for a considerable distance. Taking an exposed length of 15 miles along the river and an average thickness of 15 feet of gypsum and assuming that the beds extend back from the river for at least a distance of a quarter of a mile on either side of the river, the quantity of gypsum in the Peace River section is at least 217,000,000 tons. A considerable proportion of this is very favourably situated for mining on account both of its location and the thin overburden of drift.

Salt River and Little Buffalo River Deposits

A cliff of impure gypsum is to be seen on the banks of Little Buffalo river about a mile or two south of the mouth of Lobstick creek. The gypsum here is found at the base of an escarpment consisting of bedded lime-

[1]Geol. Surv., Canada, Ann. Rept., vol. V, pt. D, p. 64.
[2]Geol. Surv., Canada, Sum. Rept. 1916, pp. 139-140.

stone, the general trend of which seems to be northwest and southeast. Another exposure of gypsum, 20 to 25 feet thick, is to be found near the base of this same series of limestones, and situated about 4 miles to the south of the forks on Salt river.[1] Camsell in describing the occurrence on Salt river says:[2]—

About 4 miles south of the brine springs at the forks of Salt river, cliffs of gypsum are exposed in the face of the escarpment. The escarpment here forms a deep bay and is 150 to 200 feet in height. It is heavily wooded and as a rule rises out of Salt plain with an easy slope to the upper plain. Several streams cut through the face of the escarpment and a number of springs rise from its base. These springs are not briny though they are milky white in colour from suspended calcium sulphate. This soon settles and the water becomes pale bluish in colour. At the locality mentioned cliffs of gypsum half a mile in length appear and are visible by their whiteness from some distance out in Salt plain. The cliffs are in a ruinous state and are deeply fissured and broken down, and the base strewn with freshly detached masses of gypsum and a tangle of fallen trees. The top of the escarpment also shows many recent cracks and deep sink-holes. The cliffs show 40 to 50 feet of thin-bedded gypsum with occasional narrow layers of anhydrite or beds of dolomite. The gypsum is white or greyish and is disposed in horizontal beds. On the surface it crumbles to the powder gypsite and this is carried away by the streams and secondarily deposited farther down.

North of this locality the gypsum appears to decrease in thickness and is there seen to be overlaid by beds of grey crystalline dolomite. Gypsum was again observed in the face of the same escarpment at a point about 8 miles southwest of Fitzgerald where Salt river flows along its base. The section here shows about 20 feet of thin-bedded white gypsum overlaid by about 10 feet of dolomitic limestone.

The escarpment is known to extend more or less continuously from the last-mentioned locality in a sinuous line northwestward for about 40 miles or beyond Little Buffalo river. Since the escarpment is probably caused by erosion where hard resistant beds overlie softer and more soluble strata, it is reasonable to suspect that, as the strata of the escarpment are horizontal, gypsum will be found to occupy the base of the escarpment throughout the greater part of its length. This suspicion is borne out by the character of the surface on the top of the escarpment, which is broken and pitted with sink-holes in a way characteristic of a gypsum region.

Other Occurrences

According to Allan three new occurrences of gypsum have been discovered recently in Alberta. In referring to these he says:—[3]

These are in Jasper park, in Morely reserve, and at Burdett, east of Lethbridge. At the first mentioned locality, gypsum beds outcrop, and at the other two gypsum was encountered in drilling. At the east side of Jasper park, northwest of Brulé lake, a bed of pure gypsum of undetermined thickness outcrops for a distance reported to be nearly a mile. Samples of granular white gypsum have been received, and analyses show that this rock is pure hydrous calcium sulphate. In the drilling of the Wabash well, in section 24, township 24, range 8, west of the 5th meridian, south of Seebe, a bed of gypsum was encountered at depths of 1,904 and 1,910 feet. The third occurrence is the Burdett well, in the Bow Island gas field, in section 8, township 11, range 11, west of 4th meridian. At a depth of 3,812 feet, a bed of bluish gypsum was penetrated.

Individual crystals of selenite and clusters of crystals occur in the marine Bearpaw shales outcropping in the valley of Red Deer river. Spherical clusters of selenite crystals occur in unconsolidated clays at Barons, north of Lethbridge.

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[1]Geol. Surv., Canada, Ann. Rept. vol. XV, pt. A, pp. 159 and 167.
[2]Geol. Surv., Canada, Sum. Rept., 1916, p. 140.
[3]Bull. Can. Inst. Min. and Met., No. 206, June, 1929, pp. 781-2.

OCCURRENCES IN THE NORTH WEST TERRITORIES

Gypsum has been noted at several localities in the drainage basin of the Mackenzie river.

Gypsum Point

On the north shore of the Great Slave lake, Cameron describes a small occurrence:—[1]

At Gypsum point and along the southwest shore of the north arm, red-coloured thin-bedded calcareous sandstones and arenaceous limestones, ripple-marked and cross bedded, outcrops in various places and hold, between the bedding planes, thin seams of flesh-coloured gypsum. Some of the gypsum is well crystallized into long satin-spar crystals and shows distinct evidence of deposition from solution.

Bear Rock

Gypsum occurs at Bear Rock mountain situated about a couple of miles to the west of Fort Norman and at the junction of the Bear river with the Mackenzie river. McConnell[2] describes this deposit as follows:—

Bear rock is separated from the main range and is built of limestones, quartzites and shales, bent into the form of an anticlinal. A small stream cuts deeply into the heart of the mountain and exposes a very good section. The lowest beds seen, consist of reddish and greenish shales, alternating with layers of pink-coloured gypsum, and cut by numerous veins and seams of a white fibrous variety of the same mineral. The gypsum in part of the section replaces the shales almost altogether, and the layers are separated by mere films of greenish and reddish argillaceous material. The base of the gypsiferous shale was not seen, but they are at least several hundred feet in thickness. They are overlain by a series of dolomites, quartzites, and limestones, six to seven hundred feet thick, and then by the bluish coral-bearing limestones of the Devonian.

Other Occurrences

Gypsum also occurs on the banks of the Great Bear river in several places where it is associated with limestone, as well as on the east bank of the Mackenzie river, about halfway between the mouths of the Liard and Bear Lake rivers. At Bell rock, 7 miles below Fort Smith, gypsum is said to occur beneath brecciated limestone. At La Butte, on the Slave river, 40 miles above Smith Landing, there is another outcrop of gypsum and limestone, and still another on the Slave river immediately below point Ennuyeux, where 4 feet of thin-bedded gypsum is exposed at water level.

[1]Geol. Surv., Canada, Sum. Rept. 1916, p. 74.
[2]Geol. Surv., Canada, Ann. Rept., vol. IV, pt. D, p. 101.

CHAPTER VII

GYPSUM OCCURRENCES IN BRITISH COLUMBIA

Deposits of gypsum have been known in British Columbia for many years and intermittent attempts have been made to operate several of them, but it is only within the last few years that any real progress has been made, and the industry put on a sound basis.

The first claims for gypsum were staked as early as 1894 when several areas were filed on in the Salmon River district, about 40 miles southeast of Kamloops. These deposits are now known as the Falkland deposits. Two years later, the first staking of the Spatsum deposits occurred, but the claims were allowed to lapse and were not restaked until 1906. The Merritt deposits of gypsite were discovered around 1910 and similar deposits at Canford a few years later. The deposits in the vicinity of Mayook, Wardner, and Bull river were discovered only within the last few years.

Production of gypsum in British Columbia commenced in 1911, when 780 tons were shipped to Vancouver for use in the manufacture of cement. Since that time, production has been spasmodic, and the tonnages produced have been small until the year 1926 when they increased enormously due to the extensive operations at Falkland and Mayook. The Falkland deposits are the only ones at present in operation but extensive prospecting and development work was carried out during 1928 on some of the Mayook claims, and considerable interest is being taken in the general search for new gypsum deposits throughout the whole province.

OCCURRENCES OF GYPSUM

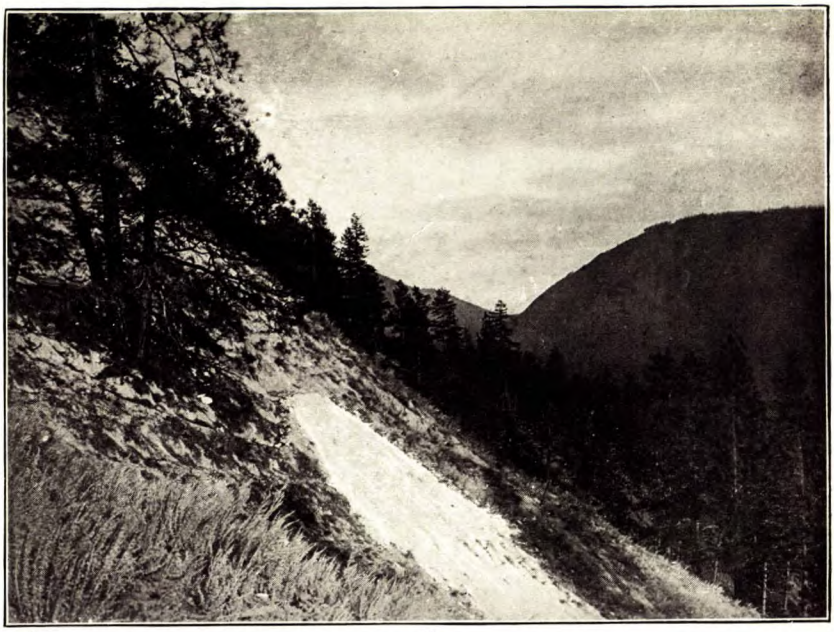
Kamloops Mining Division

Falkland Deposits

The Falkland deposits, formerly known as the Salmon River deposits, are located in township 18, range 12, west of the 6th meridian. They are owned and operated by the Gypsum, Lime and Alabastine, Canada, Ltd., this company having purchased these deposits together with the calcining and board mill at Port Mann, B.C., from the British Columbia Gypsum Company in 1927.[1] The distance from Kamloops is approximately 40 miles in a southeasterly direction and the branch line of the Canadian National railway from Kamloops to Vernon furnishes transportation to the property.

The quarry is on the side of a hill facing south and has been opened up at an elevation approximately 500 feet above the level of the railway. The rock is a massive, white to translucent gypsum with occasional bands of grey gypsum, and in places a few minute crystals of pyrite. Anhydrite is present in small amounts.

[1]A full description of these deposits before they were taken over by the B. C. Gypsum Company, is given in Report No. 245, "Gypsum in Canada", Mines Branch, Dept. of Mines, Ottawa, Canada, 1913, pp. 91-95.



A. Salmon River deposit, B.C., now known as the Falkland deposits. The white material is gypsum taken from tunnel behind tree to left of picture. This photograph was taken in 1911; the present quarry is on the slope of the hill in the trees to the right foreground.

B. Face of exposure, Spatsum deposit, Spatsum, B.C.

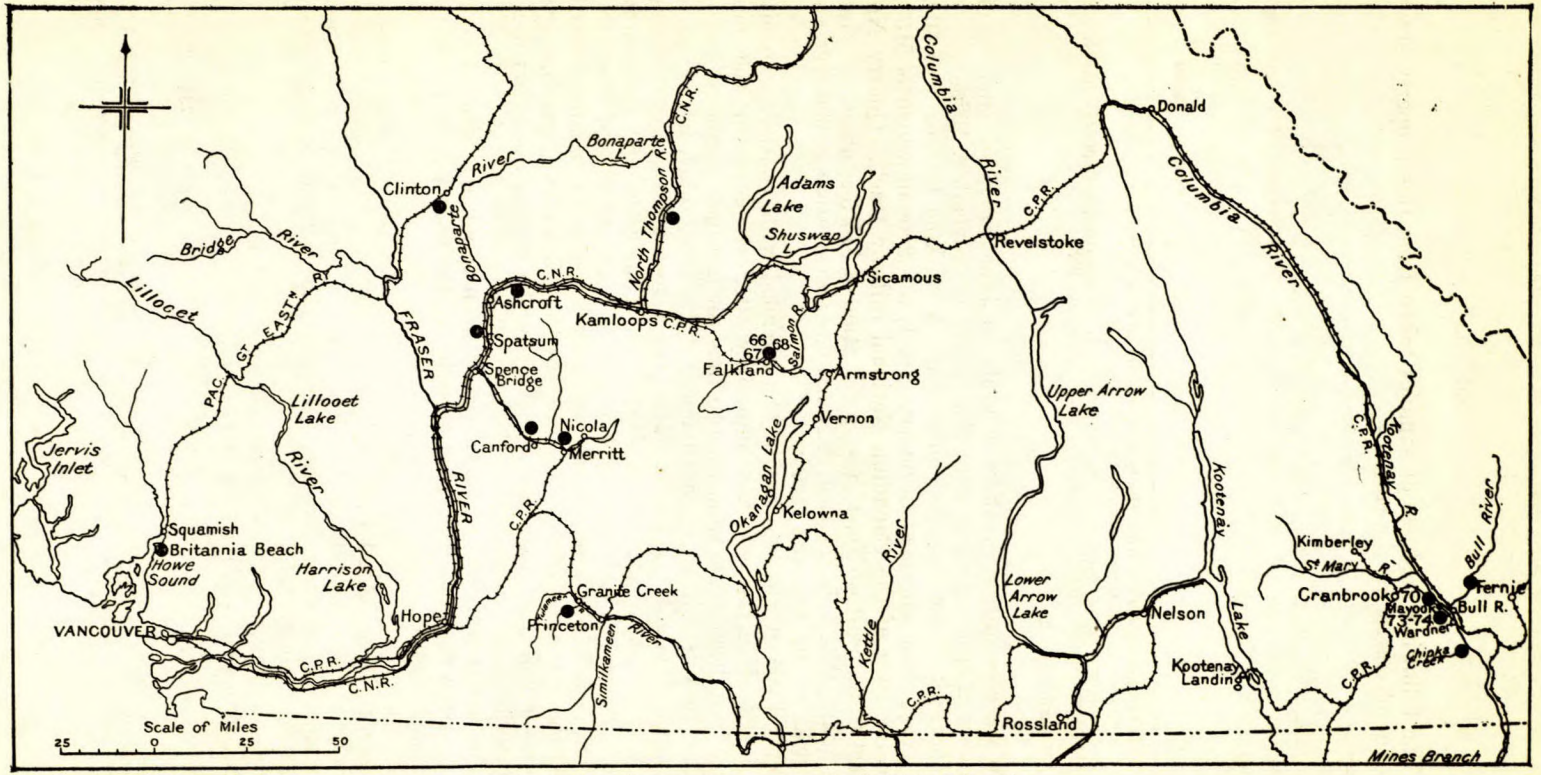


Figure 16. Gypsum occurrences in British Columbia.

The following analyses of samples taken from this property serve to show the character of the rock:—

—	1	2	3
	Per cent	Per cent	Per cent
Insoluble	0·06	0·04	3·74
CaO	32·60	32·60	31·77
SO_3	46·87	46·67	46·14
H_2O	20·80	20·40	16·79

1. This sample was taken from the face of the tunnel driven 40 feet into the face of the hill to the west of the present quarries. Mines Branch Rept. 245, p. 104.
2. Taken from sides of same tunnel as Sample No. 1. Mines Branch Rept. 245, p. 104.
3. Quartered sample (500 lb.) of run-of-quarry. January, 1927[1].

H. A. Leverin, Analyst.

Work was started on these deposits on June 10, 1925, and the first shipments of crude gypsum were made early in November, 1926.

The rock is won by open quarrying. A working face of over 60 feet has already been obtained in quarry No. 1, the floor of which is 515 feet above the level of the Canadian National railway track. Quarry No. 2, 450 feet to the west of No. 1, has an elevation of 575 feet above the tracks, while quarry No. 3, to the east of No. 1, has an elevation of 950 feet above the tracks at the shipping terminal.

Very little overburden has to be contended with, consisting chiefly of 2 to 3 feet of surface soil and impure gypsite. Shipments of the impure gypsite have been made from time to time for fertilizer purposes.

The rock is drilled by jackhammer drills and broken by 50, 55, and 60 per cent dynamite (Forcite). The broken rock is hauled in dump carts from quarries Nos. 1 and 2 to the 50-ton bin at the upper end of the gravity aerial tramway. The broken rock from No. 3 quarry is sent down to the same bin on a 700-foot inclined railway in ½-ton skips by balanced hoisting.

At the upper terminal of the tramway there is a 20 h.p. gasoline driven compressor which supplies the necessary air to the jackhammers used in the quarries.

The aerial tramway is 3,500 feet between terminals, with 14 buckets each of ½-ton capacity, the rated capacity of the tramway being 200 tons per 10-hour day.

At the railway terminal of the tramway there is a 200-ton storage bin as shown in Plate XVIII B.

Shipments at the rate of 2 carloads per working day have been maintained since the deposits were first opened. The rock goes to the company's mill at Port Mann, B.C.

Samples taken from this deposit were as follows:—

No. 66	General sample	No. 2	quarry	190	pounds
No. 67	" "	No. 3	"	169	"
No. 68	" "	No. 1	"	173½	"

[1]When this sample was taken trouble was being encountered by the company on account of small black or rusty spots developing in the finished products due to the presence of minute particles of pyrite in the rock. By a rearrangement in the mill these particles were removed by a Raymond beater and further development of the quarries has opened up new faces free from pyrite.

A. Aerial tramway of the Gypsum, Lime and Alabastine, Canada, Ltd., at Falkland, B.C. Quarry on side hill in distance.

B. Storage bins and shipping terminal of the Gypsum, Lime and Alabastine, Canada, Ltd., at Falkland, B.C.

When received at the mill the rock is first crushed through jaw crushers to 2 inches after which it goes to bins either for further treatment in the mill or else for shipment to the cement plants. The part for the mill is

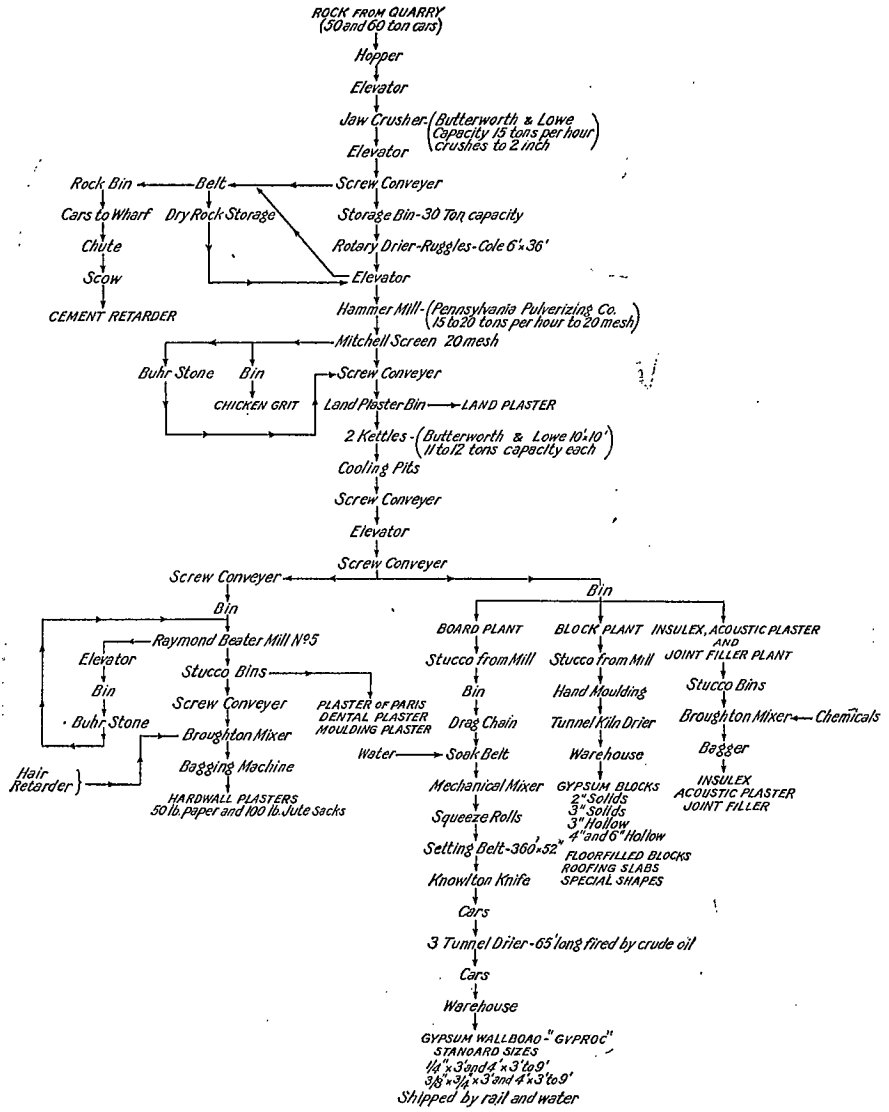
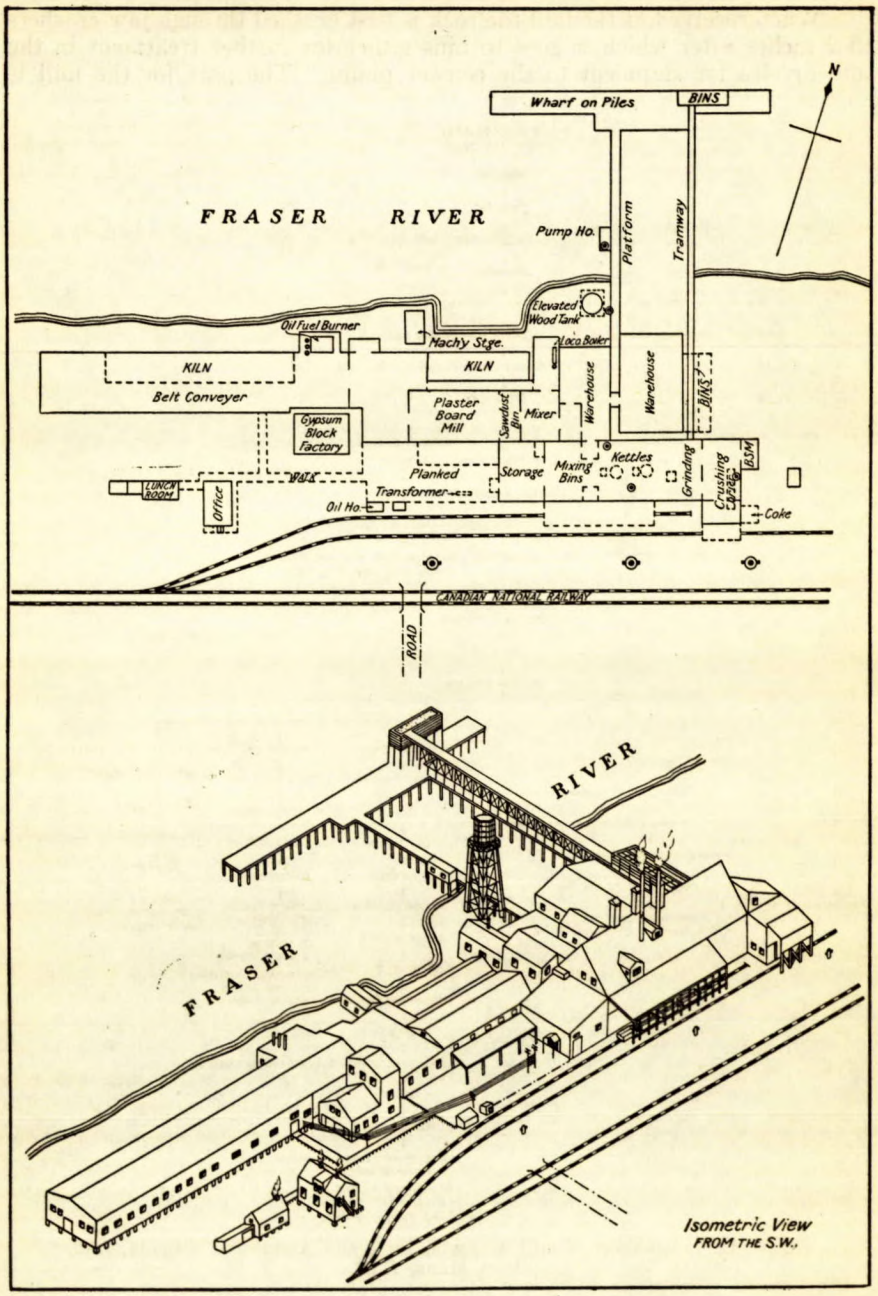


Figure 17. Flow-sheet of mill, Gypsum, Lime and Alabastine, Canada, Ltd., Port Mann, B.C.

dried in a rotary dryer, then passed through a hammer mill to pass 20 mesh, after which it is calcined in stationary-type, circular calcining kettles. From the calcining kettles it is prepared into several grades of wall plaster,



Courtesy of Gypsum, Lime and Alabastine, Canada, Ltd.

Figure 18. Plan showing layout of plant, Gypsum, Lime and Alabastine, Canada, Ltd., Port Mann, B.C.

high-grade plaster of Paris, or else it is employed in the plaster board and block mills, where standard grades of plaster wallboard and blocks are made. Flow-sheets for the plaster mill, board mill, block mill, and special products mill are given in Figures 17 and 18.

The products from this plant find a ready market in the province, and an export trade with New Zealand, Australia, Japan, etc., is rapidly developing.

Ashcroft Mining Division

Spatsum Deposits

Two exposures of gypsum-bearing rock occur on the hills forming the west bank of the Thompson river, immediately opposite Spatsum, a station on the main line of the Canadian Pacific railway, 189 miles northeast of Vancouver. The Canadian National railway main line from Kamloops to Vancouver runs along the west bank of the Thompson river at the base of the hill in which the deposits occur. The property extends from the NE. ¼ sec. 25, tp. 18, range 25, to S. ½ of the SE. ¼ sec. 36, tp. 18, range 25, and fractions of the S. ½ of the SW. ¼ sec. 31, tp. 18, range 24, and of the NW. ½ sec. 30, tp. 18, range 24, totalling in all 450 acres. The property has a frontage on the river of about 3,300 feet.

The deposits are located about 600 feet above the level of the river, which has an elevation here of about 750 feet above sea-level. Two outcrops are plainly seen, about 2,000 feet apart. These occur on prominent bluffs, with a wide, shallow gully between them. The ground rises abruptly from the water's edge for about 200 feet vertical, and then continues in a 30-degree slope to the foot of the outcrop, which rises very steeply at a slope of about 50 degrees or more. The whole mass is badly disintegrated and highly altered. Plate XVII B shows a view of the more southerly outcrop.

The rocks of the district are mostly argillaceous schists, greywackes, hydro-mica schists, and some limestones.

The appearance of these two outcrops is very remarkable. Practically no vegetation or trees of any sort appear over the whole surface of the outcrops, which stand out prominently as large, white masses against the brownish green colour of the hills around. The material is mostly a dull white or grey, badly stained in places with iron oxides to a rusty yellow colour.

The larger and more southerly outcrop has a vertical height of about 300 feet, and a length along the strike of the beds of about 200 feet. Near the base of this exposure, and about its centre, a prospect tunnel has been driven into the hill for a distance of 25 to 30 feet, and from the end of this tunnel a winze has been sunk to a depth of 30 feet. The surface material consists of a badly disintegrated mass of mica schists, limestones, and shales, with frequent nodular lumps of white gypsum of varying size. After passing through this altered material, which has been lightly recemented,

the tunnel cuts through a band of very pure, massive white gypsum, which on analysis gave the following results:—

Insoluble	0·04 per cent.
CaO	32·70 "
SO_3	46·72 "
H_2O	20·60 "
	100·06 "

This band, however, was only 5 feet wide, with a very light grey or white, highly altered hydro-mica schist together with some altered limestone for the hanging wall and the rest of the length of the tunnel. This latter material showed on analysis a small amount of gypsum mixed with it. The winze is also wholly in this altered limestone. The band of pure gypsum has a strike about north 25 degrees east and a dip to the northwest of about 40 degrees. The tunnel is the only place where this band is to be seen, as no stripping has been done on the surface to enable one to determine whether it has any great extent. Nothing in the way of prospecting has been carried on between the two outcrops, so that no definite statement can be made as to whether they belong to the same deposit or not; systematic development work and stripping will alone determine this. Before any estimate as to the value of the property can be given, the depth to which the gypsum extends will have to be determined as well as whether any other bands of pure material exist farther up the hillside. This latter is quite probable, and a series of trenches might reveal the presence of several more of these bands of workable material.

The property was first staked about the year 1896 by a prospector named Munro, who did a small amount of development work, but allowed the lease to lapse. It was then taken up about 1906 by Messrs. Sinclair and Spencer, who staked four mineral claims called the Mart, Flora, Mary, and Belle, and these cover both outcrops. The claims were surveyed in 1907.

The situation of the property for opening up as a mine is ideal. A tunnel would open up whatever gypsum is present, and an aerial cableway would convey the material to the main line of the Canadian National railway, along the base of the hill.

No work has been done on these deposits in recent years so that its commercial value yet remains to be proved.

Fort Steele Mining Division

Mayook Deposits

Within the past few years gypsum deposits of considerable extent have been discovered in the district 10 to 15 miles to the southeast of Cranbrook, the more important claims being in the Mayook, Wardner (Chipka creek), and Bull River areas. Up to the present time only one of these has been operated, namely the Sunrise claim at Mayook.

The deposits in the vicinity of Mayook consist of two groups of claims. One group consists of two claims situated to the north of the Canadian Pacific railway, three-quarters of a mile to the west of Mayook station,

Face of quarry of the Canada Cement Company, at Mayook, B.C.

and the second group composed of 7 claims lies to the south of the track just to the east of Mayook station. Whether these two deposits are the same could not be determined, since the intervening ground is heavily drift covered.

The two claims to the north of the track, namely the Cave and Sunrise claims, are owned by the Canada Cement Company, and shipments from this deposit have been made to the company's plant at Exshaw, Alberta, for cement retarder.

The deposit which is found on almost the whole of the Sunrise claim and the eastern half of the Cave claim occurs in steeply dipping beds between limestone, and is, in all probability, formed from the limestone by the action of sulphate waters coming from below. The strike of the gypsum beds is approximately south to a few degrees to the west of south, and they dip steeply from 60 to 70 degrees to the east.

A quarry has been opened up on the Sunrise claim about 100 yards to the north of the highway from Cranbrook to Mayook, and pits have been dug exposing gypsum 90 feet above the level of the quarry on the top of the ridge. The lateral extent of the gypsum has not yet been fully proven but test pits have shown it to extend for 600 yards at least.

The rock varies from a dark grey to a creamy white, some of it being soft and granular. Fragments of limestone, only slightly altered, are occasionally found in gypsum, and in places small flakes of native sulphur are to be noticed.

A quarry (Plate XIX) has been opened up for a length of 100 feet with a face of 15 feet. The rock is drilled by hand augers and the broken gypsum loaded into wagons and hauled to the railway. When this property was visited in August 1926, shipments at the rate of 2 to 3 carloads a week were being made; but on a second visit in September 1928, operations had been suspended.

Four samples were taken from this deposit in August 1926, for analysis, representing the different grades of rock occurring in the quarry, and the results obtained are as follows:—

—	1	2	3	4
	Per cent	Per cent	Per cent	Per cent
Insoluble	21·07	2·08	4·13	3·24
CaO	24·03	31·36	31·00	31·32
MgO	7·04	1·15	4·18	1·35
Fe_2O_3 & Al_2O_3	2·70	0·20	0·52	0·40
SO_3	23·95	43·40	35·72	42·32
Loss on ignition (water)	13·38	19·56	16·47	19·04
Total	92·17	98·25	92·02	97·67

1. Sunrise claim, Canada Cement Co., Mayook, B.C., dark band.
2. " " " " general sample, soft.
3. " " " " banded gypsum.
4. " " " " general sample, hard.

H. A. Leverin, Analyst.

In September 1928 a general sample, No. 70, weighing 183 pounds, from this quarry was taken for testing.

The group of claims to the south of Mayook station consists of the Badger, directly to the south of the station, with the Sheeny adjoining it on the south, and the Mayook adjoining the Sheeny on the east. To the south of the Sheeny is the Renfrew while to the south of the Mayook is the Primrose, the four latter claims making a solid block 3,000 feet square. The Roughneck adjoins the Primrose on the south, its eastern boundary being 300 feet to the east of the eastern boundary of the Primrose. To the south of the Roughneck is the Jean claim, its eastern boundary also being 300 feet east of the eastern boundary of the Roughneck.

The best exposures of gypsum found on this group occur on the west side of the Mayook, the northwest end of the Primrose, and the east side of the Sheeny claims, but potholes indicate that the deposit extends southwards through the Roughneck and Jean claims. A number of test pits and shallow shafts have been made on both sides of the deep valley face on the west side of the Mayook claim, exposing gypsum in all of them. On the east side of the Mayook, Primrose, and Roughneck claims limestone is encountered dipping 70 degrees to the east.

The rock is very similar to that found on the Sunrise claim to the north of the track, varying from a dark grey to a creamy white and in all cases is very soft, some of the surface material being disintegrated into a gypsite.

Only a superficial stripping had been done on this group when visited in August 1926 and again in September 1928.

Two samples taken in August 1926 for analysis gave the following results:—

—	1	2
	Per cent	Per cent
Insoluble	7·85	3·08
CaO	28·54	30·40
MgO	5·00	5·78
Fe_2O_3 & Al_2O_3	1·40	0·57
SO_3	33·03	33·50
Loss on ignition (water)	16·25	17·23
	92·07	90·56

1. Mayook claim—Mayook, B.C. Average sample from trenches on west half of claim.
2. Mayook claim—Mayook, B.C. From pit 10 feet deep in gully on west half of claim.

H. A. Leverin, Analyst.

The claims are controlled by a group of men from Cranbrook and Mayook and arrangements were made with them to get a large-sized sample for further testing. A series of ten samples was thus obtained in October 1928, from the following localities:—

Mayook claim, samples..... 1–5 inclusive.
Primrose claim, samples..... 6–9 "
Sheeny claim, sample 10

For the purpose of testing, in order to obtain a large enough sample, the samples obtained from the Primrose claim were all grouped together as sample No. 73 (weight 76 pounds). Likewise samples Nos. 1 to 5 from the Mayook claim and No. 10 from the northeast corner of the Sheeny claim were grouped as sample No. 74 (weight 103 pounds).

Wardner Deposits

Chipka creek, along which the gypsum deposit occurs, flows northeasterly to the Kootenay river, which it enters one mile south of the Canadian Pacific railway crossing at Wardner. Six claims form this group, the Majestic, Prince, and Sir John on the north side of the creek, with the Helen, Betty, and Lilian on the south. The claims on the south are staked directly beside and immediately to the south of the flume line running down the centre of the valley. The general trend of the gypsum is along the line of Chipka creek and the beds dip steeply to the north at dips varying from 60 to 80 degrees. The creek has evidently cut through the strata along the strike of the soft gypsum beds. The south bank of the creek rises abruptly exposing gypsum to the top and there is a valley running southeast from the creek through the Helen claim in which gypsum is indicated by potholes for 100 feet south from the edge of the escarpment. The elevation of the escarpment on the Betty claim above the level of the creek is 140 feet.

On the claims to the south of the creek the overburden is thin but on the claims to the north the gypsum dips under beds of limestone.

The best exposures are to be found on the Helen, Betty, and Lilian claims to the south of the creek, the gypsum on the northern claims being exposed only in a few places.

The rock in the southern exposures varies from bed to bed and there is a large proportion of the dark variety. Some of the beds contain sufficient limestone and cherty inclusions to make them unworkable.

Transportation from this deposit to the railway would be difficult. A spur line along the base of the escarpment from the mouth of the creek to Wardner station would entail considerable expense, and the cost of constructing a wagon road up the creek valley for team haulage would also be excessive. Probably the most feasible method would be to transport the rock by an aerial tramway across the Kootenay river to the railway on the east bank of the river opposite the mouth of Chipka creek.

Two samples were taken for analysis from this group in August 1926, the results being as follows:—

—	1	2
	Per cent	Per cent
Insoluble	2·06	1·10
CaO	31·32	32·74
MgO	1·34	0·68
Fe_2O_3 & Al_2O_3	0·28	0·32
SO_3	43·26	44·46
Loss on ignition (water)	19·42	20·68
	97·68	99·98

1. Chipka creek, B.C., Lilian claim, general sample across beds.
2. Chipka creek, B.C., Sir John claim, general sample across beds.

H. A. Leverin, Analyst.

Bull River Deposits

A deposit of gypsum occurs on both banks of the Bull river about 2½ miles from its mouth. The rocks dip steeply at 70 degrees to the north and the approximate strike of the gypsum beds at this point is east and west. The branch road leading up to the north side of the Bull river from the Kootenay valley traverses a flat bench in the vicinity of the deposit. Numerous large potholes are to be seen in this bench directly above where the gypsum outcrops at the river's edge. The height of this bench is approximately 300 feet above the river, leaving a steep bank with no rock exposures.

A tunnel, 21 feet in length, has been driven in this bank 20 feet above the water level of the river and is in gypsum all its length.

The rock is massive, dark grey in colour, and the bedding is indistinct.

A general sample taken from this tunnel for analysis gave the following results:

	Per cent
Insoluble	4·90
CaO	30·72
MgO	2·52
Fe_2O_3 & Al_2O_3	0·80
SO_3	39·36
Loss on ignition (water)	19·38
	97·68

H. A. Leverin, Analyst.

Britannia Mine Deposits

Gypsum lenses have been encountered in the Fairview claim of the Britannia mine at Howe Sound, B.C. In places these lenses are of sufficient width and extent to warrant further examination with a view to their exploitation. A brief description of the occurrence at this locality is given by Schofield[1] as follows:—

> The non-metallic minerals occurring in the schist belt are worthy of notice on account of their scientific interest and in the case of the gypsum of its future economic value.
>
> The gypsum occurs in the quartz mica schists on the Fairview claim in lenses from 10 feet to 30 feet in width. It is greyish white in colour. The contact with the schist is quite sharp. Long, thin flakes of the schist are found in the gypsum and these flakes hold the original orientation of the schist.

Since the Britannia mine, situated on the east side of Howe Sound, is only 20 miles from Vancouver, and Britannia Beach is a regular call for steamers from Vancouver to Squamish, the commercial aspect of these gypsum lenses is of extreme interest. Mr. J. I. Moore, Jr., the Mine Superintendent of the Britannia mine has therefore kindly furnished the Department with a large-scale sample, No. 44, for testing.

[1]Geol. Surv., Canada, Sum. Rept. 1918, part B, p. 59.

OCCURRENCES OF GYPSITE

A number of deposits of gypsite or gypsum earth of varying extent are to be found within the province. Some of these, in past years, have yielded small tonnages for cement retarder and fertilizer purposes. In most cases the deposits are shallow and of small tonnage so that their operation on a large scale has not been attempted. However, a number of these could be operated cheaply on a small scale for the purposes above mentioned.

Nicola Mining Division

Merritt Deposit[1]

A deposit of gypsite was staked about 1910, on the slope of a hill at a distance of about one-half mile north of Merritt on the Nicola branch of the Canadian Pacific railway.

The gypsite occurs in a very finely divided state, and the fact that the crystals are not cemented together facilitates handling and eliminates crushing. While the crude material contains considerable vegetable matter, this fact does not appear to affect its tensile strength when made into a plaster. Its colour is a light creamy brown. Two samples taken from this deposit in 1911 analysed as follows:

—	1	2
	Per cent	Per cent
Insoluble	1·10	0·50
CaO	31·90	33·80
SO_3	40·96	43·00
H_2O	19·60	20·60
	93·56	97·90
Gypsum content	88·20	92·30

1. This sample was taken from a test pit about the centre of the deposit. The area sampled was about 10 feet square at a depth of 4 feet below the surface.
2. This sample was from another pit about 150 yards to the southeast of No. 1.

A number of shipments of crude material for use as fertilizer in the Fraser valley have been made.

Canford Deposit

A similar deposit is reported to occur near Canford, a station on the Nicola branch of the Canadian Pacific railway, from which shipments of several hundred tons have been made for cement and fertilizer purposes.

Ashcroft Mining Division

The deposit is situated on the south side of the tracks of the main line of the Canadian Pacific railway, Thompson subdivision, between mile posts 41 and 42, some 6 miles east of Ashcroft.

[1]See Mines Branch Report No. 245, pp. 97 and 98, for further description.

The deposit occurs on a steep hill rising at a slope of 25 to 30 degrees from the railway right of way on the south side. The railway is bordered on the north side by the Thompson river which flows at a level of about 100 feet below the railway.

Four or five gulches cut the slope running towards the railway, and the whole area is covered by an outwash of gypsite of varying depth. A number of test pits have been made on this deposit, but until further work is done no definite statement can be made as to whether a bedded deposit of gypsum is present. The occurrence has an appearance very similar to that at Spatsum, so that beds of gypsum of good grade may be found on further development.

The property is controlled by W. S. Clark, C.P.R. agent at Spences Bridge, B.C., who has complete title to the area.

Basque Deposit

Another deposit of gypsite occurs on the Basque ranch owned by Mr. W. H. Hammond who claims there is over 100,000 tons of material available. The distance from the railway is 2 miles by a good road.

Louis Creek Deposit

According to A. W. Davis[1] another gypsite deposit occurs on the east side of the North Thompson river near Louis Creek, about 40 miles north of Kamloops, and practically adjoining the Canadian National railway. The area of the deposit is not very large, and the average depth of the pure material is only about 3 or 4 feet. A typical analysis of the gypsite (taken by Davis) is as follows:—

	Per cent
Gypsum ($CaSO_4 + 2H_2O$)	89·7
Insoluble	0·9
Organic matter	0·2
Carbonate of lime	9·1
Magnesia	trace

Clinton Mining Division

Kelly Lake Deposit

Another deposit of gypsite is said to occur on the shore of Kelly lake, close to the Pacific and Great Eastern railway, near Clinton. It is supposed to be quite extensive, and several carloads of materials are reported to have been shipped from this deposit.

Similkameen Mining Division

Granite Creek Deposit

This deposit was examined and described in 1923, by Philip B. Freeland,[2] Resident Mining Engineer for B.C. Mineral Survey District No. 4, who says in part:—

[1]Annual Report of the Minister of Mines for B.C., 1922, pp. K153-4.
[2]Annual Report of the Minister of Mines for B.C., 1923, p. A188.

Gypsum Group. This group of claims is owned by A. S. Black of Princeton, and Holmes & Son, of Coalmont. There are five claims in the group—the Gypsum, Nancy, Johnny Walker, Mary Ann, and Julia—located on each side of the wagon-road, a mile down the Tulameen river from Granite creek. Development work consists of numerous open-cuts, shallow pits, trenches, and short tunnels distributed over the entire group. A few tons of disintegrated gypsum were shipped some time ago to the cement plant at Princeton, but since that time nothing has been done on the claims. The depth or area of the deposit has never been proved. In some of the cuts the depth appears to be about 4 feet; in others about 10 feet.

On every claim there are indications of gypsiferous material, sometimes powdered and sometimes solid. The most promising outcrop occurs on the Nancy claim, below the road and close to the Kettle Valley railway. The gypsum exposed measures about 6 feet in depth and appears to cover an area of 100 feet wide and 400 feet long. These are estimated figures as the development done is not sufficient to actually prove the amount.

With the continued development of this province in the years to come, the discovery of other deposits of gypsum is quite probable, since there are large areas favourable to the occurrence of gypsum which have only been casually prospected, and even in the areas where gypsum has already been found, more detailed prospecting may yield other gypsum bodies.

CHAPTER VIII

THE TESTING OF GYPSUM AND GYPSUM PLASTERS[1]

INTRODUCTORY

The value of gypsum as a commercial commodity has been known from the time of the ancient Egyptians.

The term "plaster of Paris," i.e., calcined gypsum, was applied to it mainly because gypsum is mined in large quantities in the Tertiary deposits at Montmarte in the Paris basin, France. Under this name it was known in England as early as the thirteenth century.

In some countries the calcined gypsum is called stucco; in others calcined plaster, or plaster.

To-day gypsum products are revolutionizing the industrial arts. It is one of the best fire-resisting materials for building purposes, and its varied uses are being constantly increased.

The mineral gypsum, when pure, is a hydrous calcium sulphate, having the chemical formula $CaSO_4 \cdot 2H_2O$. This formula corresponds to the following when reduced to its final components:—

Gypsum ($CaSO_4 \cdot 2H_2O$) =
- Calcium sulphate ($CaSO_4$) ..... 79·1%
  - Lime (CaO) ..... 32·5%
  - Sulphur trioxide (SO_3) ..... 46·6%
- Water (H_2O) ..... 20·9%

It is very seldom that gypsum as pure as this is found in nature; for impurities such as clay, limestone, dolomite, iron compounds, silica, etc., are generally present in varying quantities.

Pure gypsum is white, and when in the crystalline form is transparent or translucent. The commercial material as mined is in many cases grey, yellow, or flesh red, while in others it is a very pale shade of blue. Impurities affect the translucency, and where these are present to any great extent the colour may be brown, reddish brown, or black. In the crystalline form some of the faces have a pearly, others a sub-vitreous lustre. The massive varieties are sometimes glistening, varying to a dull earthy appearance.

Gypsum is very soft, and this is one of the easiest means of distinguishing it from other minerals such as calcite, limestone, etc. It occupies the position No. 2 on Moh's scale of hardness, and can be readily scratched with the finger nail.

The special property of gypsum which gives it its chief value is the fact that when heated at a low temperature it gives up a part of its water of crystallization, and when water is added it again takes up an amount equal to that driven off, hardening or "setting" into a solid mass.

[1]This chapter has been written jointly with R. A. Rogers, Mining Engineer, Ore Dressing Division, Mines Branch, Ottawa, who supervised the crushing and preparation of the samples, calcined the ground material and made all of the several tests on the calcined products.

In the testing of gypsums for their suitability for making plaster, a chemical analysis alone was not deemed sufficient to determine the possibilities of the material from any deposit. It has been found that two different samples, having almost identical chemical analyses, would give widely different results when made into plaster, nothing being indicated by the chemical analyses to account for such a difference. In order, therefore, to determine the plaster-making qualities of Canadian gypsums, all the deposits being worked and a number of the more promising outcrops throughout Canada were sampled, samples being collected during the summers of 1927 and 1928.

SAMPLING OF DEPOSITS

The sampling, where possible, was done personally by the writer. Six sacks of rock were taken for each sample, the sacks holding approximately 35 pounds each. In the case of deposits where no work had been done or which were idle at the time of visiting, channel samples were taken, each sackful being taken from a different part so as to obtain representative material from that locality. Where quarries were in operation similar methods were employed to obtain a proper sample or else the six sacks were filled from six different cars or carts as they were being taken from the quarry. In three or four cases where it was impossible to obtain the samples personally, the samples were taken by the owners who were requested to furnish samples taken in the above manner. The samples of prepared plaster were obtained by taking small amounts from different parts of the plaster bins until the six sacks were filled. All samples were shipped to the Ore Dressing Laboratories of the Mines Branch, Booth Street, Ottawa, for testing.

PREPARATION OF SAMPLES

The samples of crude gypsum as received averaged about 185 pounds each. This gypsum was in lump form, the lumps running 4-inches in diameter and smaller. A representative specimen was retained without crushing from each sample.

Washing and Drying. As many of the samples were taken from surface outcrops, some dirt and foreign material was unavoidably included. The samples were, therefore, first washed with water, being thoroughly scrubbed to remove any adhering mud. After washing, the samples were bagged and placed on steam radiators to dry at a low temperature sufficient only to drive off the mechanically held water and not high enough to affect the water of crystallization.

In some cases a part of the sample was very fine. This part of the sample was washed on a 20-mesh screen, the dirty water decanted from the –20 mesh, and this fine material dried. The –20-mesh portion thus obtained was added to the remainder of the sample when it was fed to the burr mill.

METHOD OF GRINDING SAMPLES

Coarse Crushing. The dried gypsum lumps were fed to a No. 103 Austin gyratory crusher which reduced them to 1 inch. The product from this crusher was further reduced to $\frac{1}{4}$ inch in a No. 00 Sturtevant swing-sledge mill. At this stage, any –20-mesh material obtained in the washing of the sample was added to the product from the hammer mill.

Fine Grinding. Each sample was then ground in a 24-inch Munson burr mill until 95 per cent passed through 100 mesh. The cleanup from the burr mill after the grinding of each sample was rejected. This reject averaged 3 pounds.

Sampling. The fine-ground gypsum was then cut with a Jones riffle sampler until a 2-pound sample was obtained. One-half of this was retained by the Ore Dressing Division and the other half given to the Chemical Division for chemical analysis.

CHEMICAL ANALYSIS

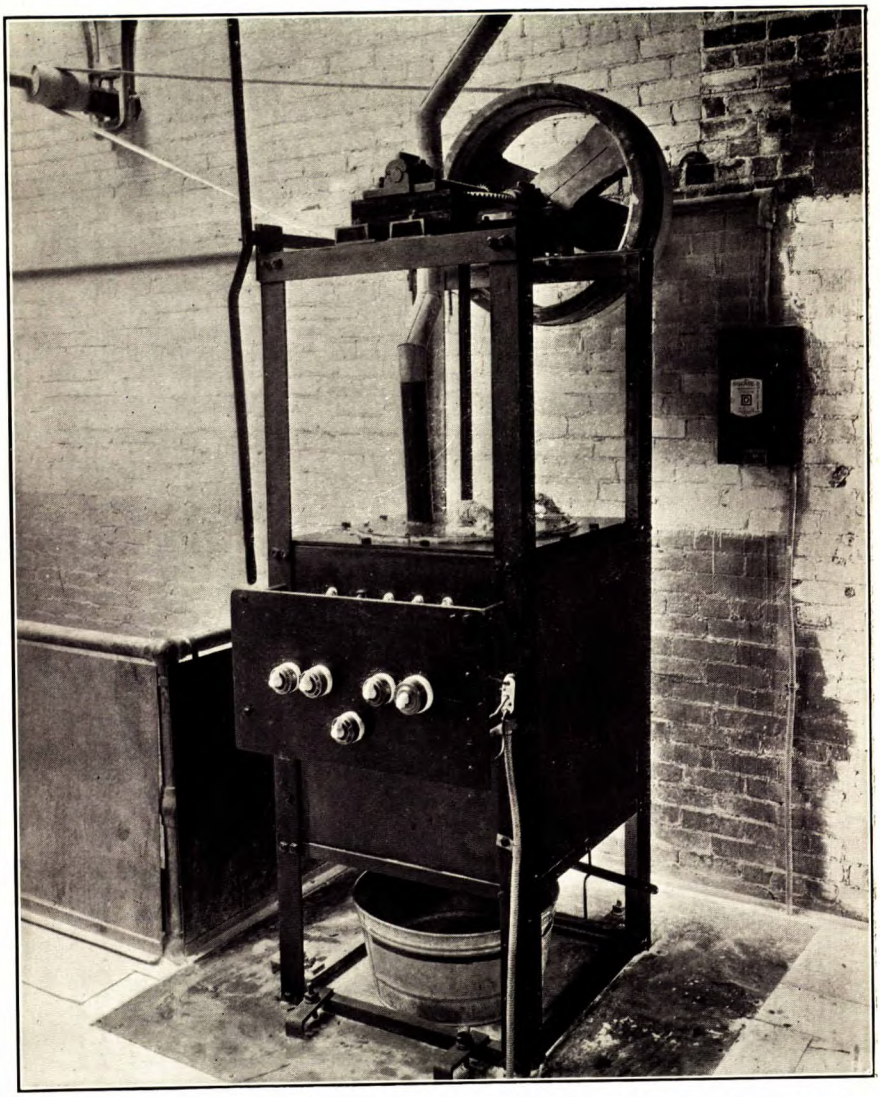
The methods adopted for the chemical analysis of the samples were those as laid down by the A.S.T.M. in Serial Designation C26-27, modifications being made in only one or two minor details. On account of the small percentage of CO_2 present in most of the samples, the amounts of CO_2 reported in the table were not made by direct determination but calculated from the excess of CaO after the SO_3 had been satisfied. The MgO was in most cases considered as carbonates and the CO_2 required to satisfy it was added to the amount reported. While the CO_2 given in the average analysis of all the samples tested is 0·82 per cent, in 50 per cent of the samples CO_2 was entirely absent. The results of the chemical analysis are given in Table I, page 92.

CALCINING SAMPLES

Kettle Employed

For the purpose of calcining small batches up to 75 pounds in the laboratory it was necessary to design some type of apparatus in which the gypsum could be constantly agitated and at the same time heated uniformly to the required temperature. A small, electrically heated kettle was therefore designed by the writer and built in the machine shop of the Mines Branch, Booth St., Ottawa, and in this kettle all the gypsum samples collected were calcined. Batches of 50 pounds were calcined at a time and the operation of the kettle was in every way satisfactory.

The kettle was designed on the plan of the circular batch kettles in common use in the industry. It consists of a cylindrical chamber 18 inches in diameter and 2 feet high with a concave bottom. This chamber is made of $\frac{1}{4}$-inch boiler plate with all joints electrically welded and afterwards machined to give a smooth interior surface. The calcining chamber or kettle is placed in a square heating box, also of $\frac{1}{4}$-inch boiler plate, having a full 2-inch clearance on all four points nearest the circular kettle. The



Electrically heated gypsum calcining kettle, capacity up to 70 pounds raw gypsum. (For description of this furnace *see* p. 74.) Designed by L. H. Cole and built in the mechanical shops of the Fuel Testing Division, Mines Branch, Booth St., Ottawa. This kettle was employed to make all the calcining tests for this report.

kettle is placed on iron supports which lift it 2 inches above the bottom of the box. The inside height of the box is 2 inches greater than the height of the kettle so that the top of both the box and the kettle are flush. Surrounding the heating box is another square box, made of $\frac{3}{16}$-inch boiler plate, having 5-inch clearance on all sides and bottom between it and the heating chamber. The space is completely filled with diatomite for purposes of thorough insulation and conservation of heat. The top of the outer box is also made flush with the others. A square top plate of $\frac{1}{4}$-inch boiler plate, the size of the outer box, and with a hole the exact size of the calcining chamber is bolted to suitable fastenings on the top, a sheet of asbestos the same size being placed underneath it. This firmly seals both

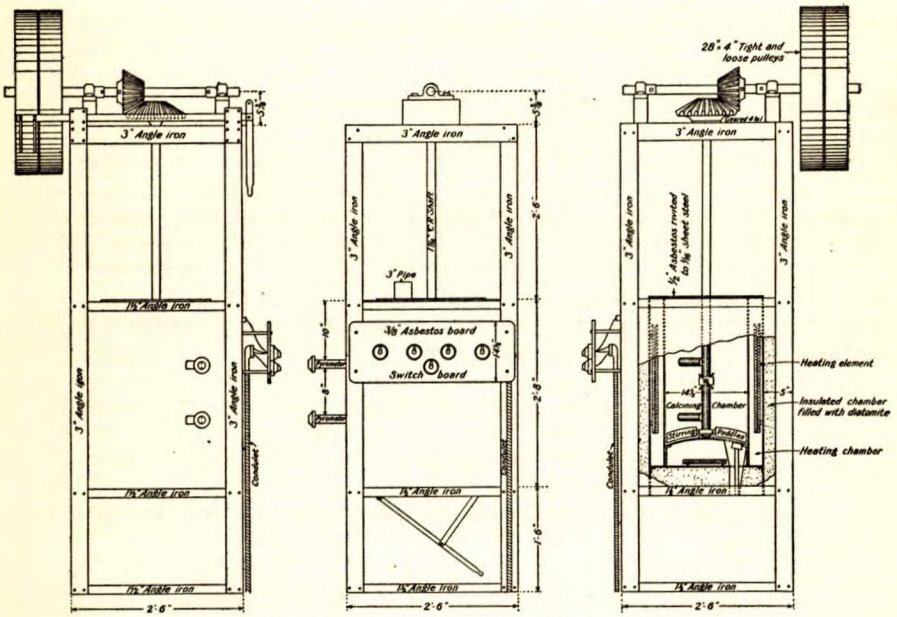


Figure 19. Electric calcining kettle.

the insulated portion and the heating chamber but leaves the top of the calcining chamber open for charging. A sectional cover, lined on the underside with asbestos sheeting, covers the top of the calcining chamber when in operation. One section of this top has a pipe leading to a dust collector in order to allow the escape of the steam driven off from the sample and to collect any fine material carried away with the moisture. The other section has two asbestos covered handles to facilitate removing it for charging.

Stirring Mechanism. In order to properly agitate the sample during calcination a steel shaft, $1\frac{1}{4}$ inches diameter, is placed down the centre of the calcining chamber. This rests on a ball-bearing in the bottom of the kettle and is driven by gears from above, operating from a belt drive. Two sets of paddles, at right angles to each other, are firmly bolted

to this shaft, the bottom set being placed so as just to clear the bottom and the second set half way up the kettle. The gears are so designed that the paddles revolve at 15 r.p.m.

Emptying Device. A 2-inch hole in the bottom of the kettle to which a pipe is attached extending through both heating box and insulating box, and suitably closed when in operation by a plug attached to a lever, enables the kettle to be immediately emptied of its charge the instant calcination is complete. A galvanized iron tub placed under the kettle catches the hot, finished stucco when the charge is dumped.

Heating Element. Four, standard size, oven elements are bolted on the inside of each side of the heating box and an 8-inch circular element placed on the inside of the bottom of the same chamber. Five switches placed on a switchboard on the outside of the insulating chamber and connected, one with each of the elements, in such a manner that each element can be operated independently. Three heats can be obtained on each element, thus enabling the temperature in the kettle to be closely controlled.

Temperature Control. For determining the temperature of calcination in the kettle two tubes are run through the insulating box, the heating chamber, and into the kettle to within $\frac{1}{8}$ inch of the stirring shaft. These tubes are sealed at the inner end and that part of them passing through the insulating and heating chambers are insulated on the inside. The hole left through this insulation is just of sufficient size to allow the sheathing for a thermocouple to fit snugly. A thermocouple placed in this tube is insulated from the heat of the heating chamber but records the temperature in the kettle. The temperature record is obtained from a standard Tycos pyrometer. The two tubes are used so that temperatures could be determined at different parts of the kettle. It was found, however, in practice that on account of the smallness of the batch and the excellent insulation provided that there was practically no difference in readings taken from either tubes. Records were therefore taken in the tests from the lower tube.

Operation of Kettle. When a sample was to be calcined, the heating elements of the kettle were turned on. A batch of 50 pounds of the ground gypsum was used for each test. By means of a thermocouple inserted in the lower iron tube which passes through the side of the kettle, the temperature was registered on a standard Tycos pyrometer. This was read every 5 minutes and the temperature recorded. When the temperature of the kettle had reached about 150° F. the stirring paddles were set in motion, and the sample placed in the kettle.

Time of Calcination

As the temperature increases the gypsum begins to "boil" and rises several inches in the kettle. The calcination is continued until the sample shows a distinct settling in the kettle. There is generally a distinct change in the temperature curve at this time. At this point the current is turned off and the kettle emptied into a metal tub through the discharging hole in the bottom. The batch is allowed to cool slowly in the tub, any inequal-

ity in the calcination thus being equalized. The small amount of calcines remaining on the bottom of the kettle is discarded. After each test the steam pipe was taken down and brushed out. The kettle was also brushed out and finally blown out with compressed air.

For the purpose of uniformity in the tests each sample was taken to the first settle only. The fact that different temperatures were required to reach this stage in the several samples can be accounted for by the different percentages of gypsum in the several samples. It is quite probable that harder and stronger plasters could be obtained with a number of the samples tested, by calcining to higher temperatures, but it was impossible to thus extend the investigation indefinitely.

The time required for calcining averaged about one hour and 20 minutes and the average temperature of the samples tested when calcination was finished was 307° F.

THE TESTING OF CALCINED PLASTERS

Standard Methods

The standard methods of testing gypsum and gypsum products of the American Society for Testing Materials, Serial Designation C26-27, were followed wherever practicable.

After the calcined gypsum had cooled, it was thoroughly mixed. A small sample was taken and placed in a glass stoppered bottle. From this sample the amount of water which remained was determined by placing one gramme of it in a platinum crucible and drying in an oven at 215° to 230° C. to constant weight.

The average percentage of water after calcination for 63 tests was 5·45 per cent.

The ratio, $\frac{\text{Water after calcination}}{\text{Combined water}}$, was found to be 0·286 for 61 samples.

Before further testing a calcined plaster it was placed in a tub and again thoroughly mixed.

It has been found that the properties of calcined gypsum are greatly affected by even such small amounts of impurities as may be introduced by careless laboratory manipulation. In order, therefore, to obtain dependable results, the following precautions were strictly observed in all the tests:—

(*a*) All apparatus were kept thoroughly clean. Especially all traces of set plaster were removed after each test.

(*b*) Distilled water, free from chlorides and sulphates was used throughout the tests.

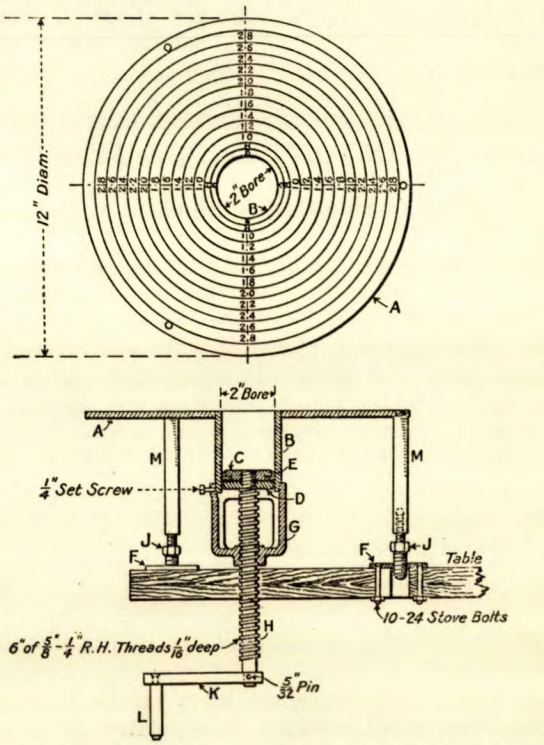
(*c*) The temperature of the distilled water was kept at 20° C.

Testing Consistency of Calcined Gypsum

The method employed for the determination of the testing consistency is that as laid down by the American Society for Testing Materials in their standard methods Serial Designation C26-27 as follows:—

In order that the results of testing samples of different plaster shall be directly comparable, it is necessary that all calcined gypsum be first brought to the same consistency, by the addition of the proper amount of water. An accurate method for determining this consistency is the most important step in the standardizing of physical methods for testing cementing materials.

For a description of the apparatus to be used for measuring consistency, reference is made to the accompanying illustration (Figure 20) of the Southard viscosimeter which has been used with satisfactory results.



A - 3/16" Hard Brass Plate Scale Disk
B - 2" Ex. H. Seamless Brass Tube Cylinder
C - Brass Piston Top
D - " " Bottom
E - Leather " Packing
F - 3/16" × 1" Flat Bar Steel Support Plate
G - Brass Cage (Open on two Sides)
H - 5/8" Hard Brass Piston Screw
J - 1/2" Hex. Brass Support Stud
K - 3/8" × 3/4" C.R.S. Screw Lever
L - 3/8" Diam. C.R.S. Lever Handle
M - 1/2" Diam. C.R.S. Support Rod

Figure 20. Southard viscosimeter.

The apparatus consists of a brass cylinder of 2 in. (5·08 cm.) bore with a circular disk flange flush with its upper end. The screw actuating the piston is 5/8 in. (1·59 cm.) in outside diameter, 1/4 in. (0·635 cm.) pitch, right-hand square threads 1/16 in. (0·159 cm.) deep. The top of the brass disk flange is etched wth concentric circles which vary in diameter from 6 cm. up to 28 cm. by increments of 2 cm.

When in position for use the brass flange is to be maintained in a true horizontal position.

To prepare this viscosimeter for use see that the piston, cylinder walls and top of plate are clean. Then by turning the crank, bring the top of the piston exactly flush with the top of the plate. Then by reverse cranking make ten complete turns, which will lower the piston to a point 2½ in. (6·35 cm.) below the top of the plate. Make a mixture of at least 300 grms. total of dry calcined gypsum and water. Shake the calcined gypsum into the water through a No. 8 (2380-micron) sieve allowing it to soak two minutes. Stir to an even fluidity for not to exceed 30 seconds. Pour this mixture immediately into the well in the centre of the plate of the viscosimeter, filling the well just flush with the top of the plate. Then immediately turn the crank at the bottom of the viscosimeter ten turns at the rate of one turn per second. The upward motion of the piston will cause the mixture to overflow into a circular pat, it being understood that the top face of the circular disk of the instrument is to be adjusted and maintained in a true horizontal plane. Next take the average of the quadrant readings on the concentric lines on the top of the plate.

A neat mortar mixture is of testing consistency, if with this operation, it gives a circular pat averaging 9·7 cm. in diameter, and shall be expressed as the number of cubic centimeters of water required to be added to 100 grms. of the plaster.

The average testing consistency of 63 samples was 66.

Determination of Time of Setting

The method for determining the time of setting as laid down by the A.S.T.M. is by use of the Vicat needle, similar to that used in the setting time of cement.

Difficulty was experienced in obtaining concordant results with the Vicat needle. For this reason, a method employed by a number of Canadian plaster companies was adopted for the determination of the time of setting.

A piece of common window glass about 8 inches square and $\frac{3}{32}$ inch thick is used. One hundred grammes of the sample are mixed with enough water to make a paste of testing consistency, previously determined. The mixing is done according to the directions for mixing given under testing consistency. The paste is spread on the glass plate and flattened into a pat about $\frac{7}{16}$ inch thick. The set of the plaster is considered complete when it separates from the glass of its own accord when the latter is flexed by pressure from the hands on the opposite edges of the plate. Upward pressure is applied by the index finger of one hand and downward pressure by the base of the thumb. The thumb of the other hand exerts downward pressure while the heel of the same hand presses upwards. The plate is inverted while it is being flexed, and the time of setting is taken as the elapsed time from adding the water to the sample to when the pat leaves the glass plate.

It was found that average time of setting of 65 samples was 16 minutes.

Determination of Tensile Strength

The method laid down for the determining of tensile strength by the A.S.T.M. was followed, the specimens being broken in a Riehle shot machine. The procedure was as follows:—[1]

Mix 500 grammes of the sample to testing consistency. Cast into a five-gang briquet mould, of the shape and size used for testing Portland cement (see the Standard Specifications and Tests for Portland Cement, Serial Designation: C 9 of

[1]A S.T.M. Serial Designation C26-27, p. 9.

the American Society for Testing Materials. Do not cast each briquet successively, but move the containing vessel back and forth over the moulds while pouring continuously. Work the briquet slightly with the point of the trowel to remove air bubbles, and level off the briquets. When sufficiently hard, remove and store in the room at a temperature of not less than 15·6° C. (60° F.) nor more than 37·8° C. (100° F.) for at least seven days. Weigh once a day. When the weight has become constant to within 0·1 per cent, proceed to test the specimens in a standard machine used for the determination of tensile strength.

The average tensile strength shall be reported as the tensile strength of the material, except that if one or two briquets vary more than 15 per cent from the average of the five, they shall be discarded and the tensile strength shall be reported as the average of the remaining specimens. In case three or more briquets vary more than 15 per cent from the average of the five, tests shall be continued upon three batches of five briquets and the average of the fifteen briquets shall be reported. The tensile strength of all briquets shall be reported.

It was found that the average tensile strength of 63 samples was 390 pounds per square inch.

Determination of Compressive Strength

The A.S.T.M. method for this test was followed, the cylinders being broken on a Tinius Olsen 200,000-pound machine, using an adapter for recording small loads. The procedure was as follows:—[1]

Mix 2,000 grammes of the sample to testing consistency. Cast into five 2 by 4-in. split cylinders set plumb upon a metal or glass plate. Do not cast each cylinder successively, but move the containing vessel back and forth over the cylinders while pouring continuously. Work the cylinders slightly with the point of the trowel to remove air bubbles, and level off the top of the cylinders. When sufficiently hard, remove and store in the room at a temperature of not less than 15·6° C. (60° F.) nor more than 37·8° C. (100° F.) for at least seven days, and by weighing once a day, when the weight has become constant to within 0·1 per cent, proceed to test the specimens in a standard machine used for the determination of compressive strength.

The average compressive strength shall be reported as the compressive strength of the material, except that if one or two of the cylinder specimens vary more than 15 per cent from the average, the compressive strength shall be reported as the average of the remaining specimens.

The average of compressive strength to tensile strength was found to vary, the average for 92 tests being 5·2.

DESCRIPTION OF SAMPLES TESTED AND LOCALITIES FROM WHICH THEY WERE OBTAINED

Each sample as collected was given a number and all tests on the samples were carried out under that number. Notes on each sample and the locality from which each was obtained are herewith given:—

Sample No. 1

Locality. -Plaster Rock, Victoria county, New Brunswick. Sample taken from gypsum beds exposed on south side of Tobique river, half a mile above the town of Plaster Rock.

Texture. -Massive to granular with minute crystals of selenite.

Colour. Crude rock: Reddish mottled with white. Calcined product after set: Pink.

[1] A.S.T.M. Serial Designation C26-27, pp. 9 and 10.

Sample No. 2

Locality. Hammond river, Kings county, New Brunswick. Sample taken from outcrop of gypsum on northwest side of river, 1 mile above railway bridge.

Texture. Massive, compact.

Colour. Crude rock: Mottled grey to white. Calcined product after set: Very slight cream tint.

Remarks. The strength of this plaster increased considerably from September 1928 to April 1929.

Sample No. 3

Locality. Apohaqui, Kings county, New Brunswick. Sample taken from outcrops exposed in a ravine on the farm formerly owned by Robert White, situated 2 miles northeast of Apohaqui station on the Canadian National railway.

Texture. Massive, compact.

Colour. Crude rock: Mottled grey to white. Calcined product after set: Slight cream tint.

Sample No. 4

Locality. Mount Pisgah, Kings county, New Brunswick. Sample taken from exposures on the farm of G. Norden, 2 miles north of Plumweseep station on the Canadian National railway.

Texture. Massive, compact.

Colour. Crude rock: Creamy white to pink with occasional grey patches. Calcined product after set: Very slight cream tint.

Sample No. 5

Locality. Petitcodiac, Westmorland county, New Brunswick. Sample was taken from an outcrop at the southern end of the deposit near a schoolhouse $1\frac{1}{2}$ miles from Petitcodiac station on the Canadian National railway.

Texture. Massive, compact with occasional selenite crystals.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight cream tint.

Remarks. The strength of this plaster increased greatly from August 1928 to April 1929.

Sample No. 7

Locality. Curryville, Albert county, New Brunswick. Sample was taken from the face of quarry of the Albert Manufacturing Company at Demoiselle creek.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Paper white. Calcined product after set: White.

Sample No. 8

Locality. Curryville, Albert county, New Brunswick. Sample was taken from the stock-pile at the mouth of the tunnel on the property of the Hillsborough Plaster Quarrying and Manufacturing Company, Demoiselle creek.

Texture. Crude rock: Massive, compact alabaster structure.

Colour. Crude rock: Watery white, grinding paper white. Calcined product after set: White.

Remarks. This plaster increased in strength in five weeks.

Sample No. 9

Locality. Hopewell Hill, Albert county, New Brunswick. Sample taken from a number of outcrops in this area to give an average representative sample of the district.

Texture. Crude rock: Massive, crystalline.

Colour. Crude rock: Greyish white. Calcined product after set: White.

Sample No. 10

Locality. New Horton, Albert county, New Brunswick. Sample taken from a number of outcrops in this area to give an average representative sample of the district.

Texture. Crude rock: Massive, crystalline.

Colour. Crude rock: Greyish white. Calcined product after set: Very slight cream tint.

Remarks. The strength of this plaster increased considerably in six weeks.

Sample No. 11

Locality. Edgett Landing, Albert county, New Brunswick. Sample taken from the face of the quarry of the Hillsborough Plaster Quarrying and Manufacturing Company.

Texture. Crude rock: Massive, compact, occasional selenite crystals.

Colour. Crude rock: Mottled grey and cream. Calcined product after set: Very slight cream tint.

Sample No. 12

Locality. Cape Maringouin, Westmorland county, New Brunswick. Sample taken from the outcrops exposed along the shore to the west of the wharf.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Creamy white. Calcined product after set: Slight cream tint.

Remarks. The strength of this plaster increased considerably in six weeks.

Sample No. 13

Locality. Jamesville West, Victoria county, Nova Scotia. Sample taken from gypsum bluffs to the north of the Canadian National tracks, on the farm of Neil Campbell. Owner, Newark Plaster Company.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Grey. Calcined product after set: White.

Sample No. 14

Locality. Grass Cove, Victoria county, Nova Scotia. Sample was taken from the quarry of the Iona Gypsum Company[1], Deposit No. 2, 2 miles north of Iona station on the Canadian National railway. Average sample of material used for hardwall plaster.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled greyish white. Calcined product after set: Very slight cream tint.

Sample No. 15

Locality. Grass Cove, Victoria county, Nova Scotia. Sample was taken from the quarry of the Iona Gypsum Company, Deposit No. 2, 2 miles north of Iona station on the Canadian National railway. Average sample of material used for the manufacture of plaster of Paris.

Texture. Crude rock: Massive, compact, slightly crystalline.

Colour. Crude rock: White. Calcined product after set: White.

Remarks. The strength of this plaster increased very greatly with age from May 1928 to April 1929.

Sample No. 17

Locality. Plaster Cove, Victoria county, Nova Scotia. Sample taken from the face of the quarry of Cape Breton Gypsum Company, one mile north of Iona station on the Canadian National railway.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: White.

Sample No. 18

Locality. Jamesville, Victoria county, Nova Scotia. Sample taken from the property of J. R. McNeil, on the north side of the Canadian National railway, 2 miles west of Iona station.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Greyish white. Calcined product after set: Very slight cream tint.

Sample No. 19

Locality. McKinnon Harbour, Victoria county, Nova Scotia. Sample taken from the farm of H. M. Gillis, $\frac{1}{4}$ mile north of the highway and $\frac{3}{4}$ mile west of McKinnon Harbour station on the Canadian National railway.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Greyish white. Calcined product after set: White.

Sample No. 20

Locality. Ottawa Brook, Victoria county, Nova Scotia. General sample taken from the quarries of the Newark Plaster Company, one-half mile north of the railway.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Creamy white. Calcined product after set: Slight cream tint.

[1]Now Iona Consolidated Gypsum Corporation.

Sample No. 21

Locality. Mouth of river Denys, Inverness county, Nova Scotia. Sample taken from gypsum cliffs on the east bank at the mouth of the river Denys.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Slight cream tint.

Remarks. The strength of this plaster increased considerably from August 1928 to February 1929.

Sample No. 22

Locality. Little Narrows, Victoria county, Nova Scotia. Sample taken on the east side of the highway running from Little Narrows to McKinnon Harbour and 2 miles south of Hazeldale.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Creamy white. Calcined product after set: White.

Sample No. 23

Locality. Madame island, Richmond county, Nova Scotia. Sample taken from exposures on the south side of the road, one mile east of highway bridge over Lennox passage.

Texture. Crude rock: Massive, granular.

Colour. Crude rock: Grey. Calcined product after set: Slight grey tint.

Remarks. The strength of this plaster increased considerably from August 1928 to April 1929.

Sample No. 24

Locality. Alba, Inverness county, Nova Scotia. Sample taken from the farm of John N. Matheson, 2 miles northwest of Alba station on the Canadian National railway.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Cream. Calcined product after set: White.

Remarks. The strength of this plaster increased greatly from September 1928 to April 1929.

Sample No. 25

Locality. Little Narrows, Victoria county, Nova Scotia. Sample taken on the McAskill property, 2 miles east of Little Narrows and $\frac{3}{4}$ mile south of St. Patrick channel.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: White.

Remarks. The strength of this plaster increased greatly with age from September 1928 to April 1929.

Sample No. 26

Locality. Baddeck bay, Victoria county, Nova Scotia. Sample taken from the Morrison quarry (Quarry No. 1) of the North American Gypsum Company, 1 mile east of the head of Baddeck bay.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: White with slight grey mottling. Calcined product after set: White.

Remarks. The strength of this plaster increased slightly from October 1928 to August 1929.

Sample No. 27

Locality. Baddeck bay, Victoria county, Nova Scotia. Sample taken from Quarry No. 2 of the North American Gypsum Company, 1½ miles east of the head of Baddeck bay.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight cream tint.

Remarks. The compressive strength of this plaster increased slightly from September 1928 to August 1929.

Sample No. 28

Locality. Island Point, Boularderie island, Victoria county, Nova Scotia. Sample taken from gypsum outcrops on the west end of the property owned by the Big Harbour Gypsum Syndicate.

Texture. Crude rock. Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Slight cream tint.

Remarks. The strength of this plaster increased greatly with age from May 1928 to April 1929.

Sample No. 29

Locality. Goose Cove, St. Ann harbour, Victoria county, Nova Scotia. General sample taken from the face of quarries of the Victoria Gypsum Company.

Texture. Crude rock: Massive compact.

Colour. Crude rock: Mottled grey and cream. Calcined product after set: Very slight cream tint.

Remarks. The strength of this plaster increased considerably from August 1928 to April 1929.

Sample No. 29a

Locality. Askilton, Inverness county, Nova Scotia. Sample taken from the Macdonald farm, 1 mile west of River Inhabitants road, 3½ miles from the Canadian National railway.

Texture. Crude: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight grey tint.

Remarks. The strength of this plaster increased greatly from August 1928 to April 1929.

Sample No. 30

Locality. Cheticamp, Inverness county, Nova Scotia. General sample taken from the stock-pile on the wharf of the Atlantic Gypsum Products Company, Cheticamp, Nova Scotia.

Texture. Crude rock: Massive, compact to slightly crystalline.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight grey tint.

Sample No. 31

Locality. Mabou harbour, Inverness county, Nova Scotia. General sample taken from the storage bins of the Nova Scotia Coal and Gypsum Company, at the mouth of Mabou harbour.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight cream tint.

Sample No. 32

Locality. Antigonish harbour, Antigonish county, Nova Scotia. General sample of soft material occurring on the property of the Nova Scotia Gypsum Company (Canada Cement Company).

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled cream and white. Calcined product after set: Very slight cream tint.

Sample No. 33

Locality. Antigonish harbour, Antigonish county, Nova Scotia. General sample of hard material occurring on the property of the Nova Scotia Gypsum Company (Canada Cement Company).

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Greyish white. Calcined product after set: Very slight cream tint.

Remarks. The strength of this plaster increased considerably with age from July 1928 to April 1929.

Sample No. 34

Locality. Walton, Hants county, Nova Scotia. General sample taken from the shipping bins of the Atlantic Gypsum Products Company at Walton.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Slight grey tint.

Sample No. 35

Locality. Windsor, Hants county, Nova Scotia. General sample of product of the Windsor Plaster Company's quarry, 1½ miles southeast of Windsor. Sample taken from bins at mill.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight grey tint.

Sample No. 36

Locality. Clarksville, Hants county, Nova Scotia.

Sample taken from the product of the quarry of the Windsor Plaster Company at Clarksville, Nova Scotia. Material sampled at mill.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey-white. Calcined product after set: Very slight grey tint.

Sample No. 37

Locality. Windsor, Hants county, Nova Scotia. General sample taken from the Meadows quarry of the Canadian Gypsum Company (U.S. Gypsum Company) 3 miles east of Windsor, Nova Scotia.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Grey with white mottling. Calcined product after set. Very slight grey tint.

Remarks. The strength of this plaster increased greatly with age from August 1928 to April 1929.

Sample No. 38

Locality. Windsor, Hants county, Nova Scotia. General sample taken from the Cables quarry of the Canadian Gypsum Company (U.S. Gypsum Company) 3½ miles east of Windsor, Nova Scotia.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Slight grey tint.

Remarks. The strength of this plaster increased greatly with age from July 1928 to April 1929.

Sample No. 39

Locality. Windsor, Hants county, Nova Scotia. General sample of hard rock, Windsor Gypsum Company, 3 miles southeast of Windsor, Nova Scotia.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight grey tint.

Sample No. 40

Locality. Windsor, Hants county, Nova Scotia. General sample of soft rock, Windsor Gypsum Company, 3 miles southeast of Windsor, Nova Scotia.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Cream to white. Calcined product after set: White.

Sample No. 42

Locality. Aspy bay, Victoria county, Nova Scotia. General sample from exposures at Aspy bay. Sample collected by Joseph W. McFarlane at request of writer.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled cream and white. Calcined product after set: Very slight cream tint.

Remarks. The strength of this plaster increased considerably with age from October 1928 to April 1929.

Sample No. 44

Locality. Britannia mine, Howe sound, British Columbia. Sample of gypsum from the underground workings of the Britannia mine. Furnished at the request of the writer by J. I. Moore, Jr., Mine Superintendent.

Texture. Massive, compact.

Colour. Crude rock: Mottled blue and white with greenish tinge. Calcined product after set. Very slight grey tint.

Sample No. 50

Locality. Lythmore, Oneida township, Haldimand county, Ontario. General sample of crude rock from the Lythmore mine of the Gypsum, Lime and Alabastine, Canada, Ltd.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set. Very slight grey tint.

Sample No. 51

Locality. Lythmore, Oneida township, Haldimand county, Ontario. General sample of stucco prepared in Lythmore mill, Gypsum, Lime and Alabastine, Canada, Ltd.

Colour. Calcined product after set: Very slight grey tint.

Sample No. 54

Locality. Caledonia, Seneca township, Haldimand county, Ontario. Calcined Raymond product fines, Trade No. 6, Caledonia mill, Gypsum, Lime and Alabastine, Canada, Ltd.

Colour. Calcined product after set: Light grey.

Remarks. This plaster increased greatly in strength from July 1928 to April 1929.

Sample No. 55

Locality. Caledonia, Seneca township, Haldimand county, Ontario. Sanded hardwall, Caledonia mill, Gypsum, Lime and Alabastine, Canada, Ltd.

Colour. Calcined product after set: Light grey.

Remarks. Raymond coarse product, ground to 40 per cent through 60 mesh.

Sample No. 56

Locality. Canfield creek, Cumberland county, Nova Scotia. Sample taken from gypsum outcrops on each side of mouth of Canfield creek, 4 miles south of Pugwash and 2 miles west of Pugwash Junction on the Oxford branch of the Canadian National railway.

Texture. Crude rock: Massive, granular.

Colour. Crude rock: Banded brown and white. Calcined product after set: Slight ivory tint.

Sample No. 57

Locality. Cheverie, Hants county, Nova Scotia. Sample taken from Foul Meadow Quarries, Connecticut Adamant Plaster Company, 1½ miles south of shipping wharf.

Texture. Crude rock: Massive, compact to slightly crystalline.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight grey tint.

Sample No. 59

Locality. Hansford, Cumberland county, Nova Scotia. Sample taken from quarry on west side of road at Hansford, 4 miles east of Oxford, Nova Scotia.

Texture. Crude rock: Massive, compact to slightly crystalline.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight cream tint.

Sample No. 60

Locality. Nyanza, Victoria county, Nova Scotia. Sample from gypsum deposits on the north side of highway on the McRae property, ½ mile east of Nyanza, Nova Scotia.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and cream. Calcined product after set: Very slight cream tint.

Sample No. 61

Locality. Ingonish, Victoria county, Nova Scotia. General sample from stock-pile at wharf of the Ingonish Gypsum Company (Canada Cement Company.)

Texture. Crude rock: Massive, compact.

Colour. Crude rock. Mottled grey and white. Calcined product after set: Very slight grey tint.

Sample No. 62

Locality. Nappan, Cumberland county, Nova Scotia. General sample from the quarries of the property formerly operated by the Maritime Gypsum Company, 4 miles south of Amherst, Nova Scotia.

Texture. Crude rock: Massive, compact to slightly crystalline.

Colour. Crude rock: Mottled brown and white. Calcined product after set: Very slight cream tint.

Sample No. 63

Locality. Moose river, northern Ontario. General sample from the Curran claims on the west bank of the Moose river, 37 miles south of Moose Factory. Sample collected by W. Tees Curran.

Texture. Crude rock: Massive, compact to slightly crystalline.

Colour. Crude rock: White. Calcined product after set: White.

Sample No. 64

Locality. Gypsumville, Manitoba. Sample taken from the "White Elephant" quarry, Gypsum, Lime and Alabastine, Canada, Ltd., situated on sections 2, 3, 10, and 11, township 33, range 8, west of the Principal Meridian.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Grey to white. Calcined product after set: White.

Sample No. 65

Locality. Gypsumville, Manitoba. General sample of material from the quarries of the Gypsum, Lime and Alabastine, Canada, Ltd., Gypsumville, Manitoba. Sample obtained from cars on arrival at mill in Winnipeg.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Grey. Calcined product after set: Very slight grey tint.

Sample No. 66

Locality. Falkland, British Columbia. General sample, Quarry No. 2, Gypsum, Lime and Alabastine, Canada, Ltd.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: White. Calcined product after set: White.

Sample No. 67

Locality. Falkland, British Columbia. General sample from Quarry No. 3, Gypsum, Lime and Alabastine, Canada, Ltd.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight grey tint.

Sample No. 70

Locality. Mayook, British Columbia. General sample from quarry on the Sunrise claim, Canada Cement Company property, on the north side of the Canadian Pacific railway, ¾ mile west of Mayook station.

Texture. Crude rock. Massive, compact.

Colour. Crude rock: Dark grey. Calcined product after set: Light grey.

Sample No. 71

Locality. Hillsborough, Albert county, New Brunswick. General sample of material from quarries of the Albert Manufacturing Company. Sample taken from cars at mill and furnished by the company.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Banded grey and white, grinding white. Calcined product after set: White.

Sample No. 72

Locality. Hillsborough, Albert county, New Brunswick. Sample of "Hammer Brand," neat plaster furnished by the Albert Manufacturing Company.

Colour. Calcined product after set: White.

Sample No. 73

Locality. Mayook, British Columbia. General sample from the Primrose claim of the Mayook Syndicate situated south of Mayook station on the Canadian Pacific railway. Sample furnished by owners of property.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Dark grey. Calcined product after set: Light grey.

Sample No. 74

Locality. Mayook, British Columbia. General sample from the Mayook and Sheeny claims of the Mayook Syndicate, situated south of Mayook station on the Canadian Pacific railway. Sample furnished by owner of property.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Dark grey. Calcined product after set: Light grey.

Sample No. 75

Locality. St. Croix, Hants county, Nova Scotia. General sample from the quarry of the St. Croix Mining and Manufacturing Company. This property lies on the north side of St. Croix river, 2½ miles from Newport station on the Dominion Atlantic railway and ½ mile from the main road leading from Windsor to Brooklyn. Sample furnished by J. W. Smillie, Manager.

Texture. Crude rock: Massive, compact.

Colour. Crude rock: Mottled grey and white. Calcined product after set: Very slight cream tint.

Sample No. 79

Locality. Taken from deposits ½ mile from Government landing wharf on Amherst island, Magdalen islands, Quebec.

Texture. Crude rock: Fibrous, banded.

Colour. Crude rock: Faint pink. Calcined product after set: Very faint pink.

Sample No. 80

Locality. Taken from deposit 2 miles from Government wharf, Grindstone island, Magdalen islands, Quebec.

Texture. Crude rock: Fibrous with thin lenses of reddish clay.

Colour. Crude rock: Faint pink. Calcined product after set: Very faint pink.

Sample No. 81

Locality. Taken from deposit ¾ mile from Government wharf, Alright island, Magdalen islands, Quebec.

Texture. Crude rock: Massive.

Colour. Crude rock: Mottled grey and white. Calcined product after set: White.

TABLE I

Results of Tests on Canadian Gypsums and Plasters

	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	29A	30	31	32	33	34	35	36	37	38	39	40	42	44
06	0·16	0·50	0·92	0·64	0·30	0·68	0·14	0·47	0·28	0·30	0·79	1·41	0·10	0·54	0·25	0·10	0·10	0·30	0·60	0·69	0·29	0·14	0·40	0·25	0·20	4·55	1·70	0·35	0·54	0·73	0·25	0·15	0·54	3·00
04	0·08	0·12	0·08	0·14	0·05	0·08	0·08	0·05	0·03	0·05	0·10	0·14	0·04	0·08	0·07	0·16	0·04	0·08	0·24	0·12	0·12	0·04	0·04	0·04	0·16	0·31	0·08	0·04	0·08	0·08	0·06	0·04	0·04	0·24
ne	0·04	none	0·06	none	0·11	none	0·08	0·03	0·05	0·03	0·08	0·08	0·02	none	0·03	0·04	0·06	0·02	0·02	none	none	0·02	0·02	0·02	none	0·19	0·06	0·06	0·01	none	trace	trace	0·02	0·80
00	33·18	32·72	33·17	33·85	34·30	32·77	32·80	33·11	32·67	32·56	32·56	32·15	33·17	34·78	33·23	32·86	32·72	32·90	33·78	33·06	33·35	32·90	33·23	32·38	33·81	31·34	31·92	32·38	32·78	32·95	34·25	32·49	32·77	31·24
04	0·03	0·15	0·06	0·21	0·06	0·03	0·16	0·08	0·06	0·08	0·69	0·66	0·06	0·20	0·03	0·12	0·07	0·04	0·10	0·22	0·06	0·21	0·05	0·05	0·14	0·26	0·20	0·40	0·40	0·16	0·24	0·15	0·15	0·68
98	47·60	46·00	44·18	47·78	49·20	45·82	46·88	46·58	46·68	45·90	45·90	42·56	45·84	45·50	46·58	46·94	46·72	45·90	47·17	47·20	46·14	46·24	45·90	46·20	45·28	44·60	46·14	46·62	46·28	46·20	48·74	46·60	45·48	45·38
00	18·85	19·34	19·17	16·63	15·93	19·07	20·15	18·66	19·90	20·20	18·22	19·27	19·60	16·30	18·84	20·10	20·56	19·80	17·67	18·37	19·44	19·52	18·55	19·94	19·50	19·00	19·90	19·91	19·50	19·90	15·45	20·30	20·30	18·55
...	.....	0·41	1·76	.....	.....	0·55	.....	0·40	.....	0·33	1·08	2·48	0·82	2·30	0·48	.....	.....	0·60	0·57	.....	0·82	0·41	0·77	.....	1·57	.....	.....	.....	0·31	.....	.....	.....	0·70	.....
12	99·94	99·24	99·40	99·25	99·95	99·00	100·29	99·38	99·67	99·45	99·42	98·75	99·65	99·70	99·51	100·32	100·27	99·64	100·15	99·66	100·22	99·48	98·96	98·88	100·66	100·25	100·00	99·76	99·90	100·02	98·99	99·73	100·00	99·89
18	0·342	0·312	0·304	0·298	0·257	0·281	0·283	0·309	0·271	0·298	0·297	0·296	0·296	0·256	0·306	0·285	0·312	0·277	0·285	0·297	0·282	0·296	0·298	0·271	0·274	0·302	0·285	0·289	0·263	0·258	0·272	0·297	0·212	0·243
5°	280°	287°	298°	280°	330°	295°	290°	323°	347°	330°	300°	310°	322°	280°	315°	305°	320°	325°	320°	315°	260°	342°	328°	340°	320°	300°	320°	327°	300°	320°	290°	335°	338°	300°
36	6·44	6·03	5·83	4·95	4·10	5·35	5·70	5·77	5·40	6·01	5·42	5·71	5·81	4·18	5·77	5·73	6·41	5·49	5·03	5·45	5·49	5·78	5·52	5·41	5·35	5·73	5·67	5·59	5·13	5·13	4·20	6·05	4·31	4·50
37	66	63	66	59·5	56	68·5	57	65·5	76·5	73	63·5	65	68·5	59	57	61	68	66·5	60	76	59	64	67	69	56·5	69·5	70	69	59	58	58·5	71	73·5	72
16	14	16	13	14	13	15	13	17	10	17	14	14	18	21	16	28	16	18	27	9	27	15	18	16	15	20	16	17	16	13	16	16	10	10
66	344	446	339	340	314	296	476	410	344	333	415	397	383	435	463	496	392	357	449	305	461	427	324	374	442	372	370	374	462	444	370	355	344	313
36	1,784	2,291	1,876	1,599	1,752	1,588	2,845	1,878	1,698	1,495	1,827	2,298	1,630	2,383	2,658	2,794	1,807	1,894	2,665	1,675	3,034	2,104	1,666	1,789	2,693	1,834	1,618	1,708	2,512	2,456	1,668	1,598	1,945	1,567

	60	61	62	63	64	65	66	67	70	71	72	73	74	75	79	80	81	Average
78	0·33	0·52	0·26	0·25	0·19	0·51	0·19	2·42	1·80	0·30	0·25	1·70	3·21	0·75	0·68	1·06	0·48	**1·03**
10	0·06	0·08	0·06	0·06	0·08	0·17	0·08	0·47	0·28	0·08	0·11	0·46	0·34	0·08	0·10	0·07	0·11	**0·14**
e	0·08	trace	trace	trace	0·01	0·13	trace	trace	0·12	0·06	trace	trace	0·44	0·10	0·08	0·13	0·11	**0·10**
39	32·86	33·00	33·18	33·00	33·00	32·20	32·95	32·43	31·73	32·54	33·26	31·90	31·18	32·90	32·51	32·51	33·09	**32·67**
05	0·12	0·08	0·06	0·21	0·07	0·77	0·07	0·08	2·40	0·08	0·07	1·30	2·50	0·06	0·04	0·04	0·17	**0·39**
02	46·74	46·07	46·75	46·90	47·23	45·34	47·10	44·49	40·75	46·87	54·58	43·52	40·13	47·14	46·31	46·94	46·40	**45·65**
35	19·72	19·41	19·62	19·41	19·78	19·61	19·42	19·47	17·65	20·20	6·14	18·70	17·15	18·58	20·07	19·43	18·19	**19·01**
00	.....	0·58	.....	.....	.....	1·18	.....	1·00	5·21	.....	.....	2·53	5·14	.....	0·10	0·04	0·65	**0·82**
99	99·91	99·74	99·93	99·83	100·36	99·91	99·81	100·36	99·94	100·13	99·41	100·11	100·09	99·61	99·89	100·22	99·20	**99·81**
70	0·263	0·251	0·308	0·283	0·265	0·306	0·313	0·277	0·304	0·270	.....	0·288	0·308	0·318	0·283	0·302	0·328	**0·286**
0°	332°	320°	320°	338°	312°	298°	325°	318°	295°	308°	320°	320°	282°	295°	298°	310°	290°	**307°**
23	5·18	4·88	6·05	5·50	5·24	6·01	6·08	5·40	5·36	5·46	6·14	5·39	5·28	5·90	5·68	5·88	5·98	**5·45**
5	68	69	70	71	64·5	71	72·5	75	68	72	65	69	70	71·5	69	70	74	**66**
13	14	22	12	17	19	17	16	19	16	17	11	17	11	15	13	17	14	**16**
74	385	418	387	385	452	396	407	376	360	425	427	396	359	396	343	383	253	**390**
76	2,116	1,961	2,048	1,872	2,462	2,048	2,223	1,858	1,723	2,097	2,596	2,029	1,660	2,155	1,647	1,563	1,149	**2,021**

NOTE

In interpreting the results given in this table there are several important points that should be distinctly understood.

1. The calcining was done in a laboratory size kettle using a batch of 50 pounds of crude rock. Calcined in a full size commercial kettle, the plaster produced might be slightly different.

2. Calcination was carried in each case to the first settle. This was done for purpose of uniformity in the tests, although it is probable that a stronger plaster might have been obtained from some of the samples by carrying the calcination slightly further. To determine the best calcination temperature for each sample would require a long series of calcination tests on different batches of the same sample, and to do this for all the samples was obviously impossible in the time available. The results obtained show the possibilities of Canadian gypsums, however, and all are well above the strengths required in the specifications. Caution should, therefore, be used in comparing one sample against another, since one sample which may have a high tensile or compressive strength as shown in this table may have reached its maximum strength on the first settle while another with slightly lower results may require a higher temperature of calcination to produce its best product.

3. Ageing of the plaster is an important point. In the tests it was found that tests made on calcined plaster within a week after calcination invariably gave lower results than those on the same plaster kept for several months. The tests as given are those obtained as far as possible in a uniform time after calcination for each sample. Some samples showed a greatly increased strength on ageing while others increased only slightly.

CHAPTER IX

TECHNOLOGY AND USES OF GYPSUM AND GYPSUM PLASTERS

The technology of gypsum and gypsum plasters and the manner in which the materials are prepared for different uses is so extensive, that to cover the subject adequately would require a great deal more space than is available in this report. It is proposed, however, to deal with this phase of the subject later at greater length in a separate report, and to embody in this chapter only a brief outline dealing principally with methods employed in the Canadian quarries and mills.

EXPLOITATION OF GYPSUM DEPOSITS

The methods employed in the exploitation of gypsum deposits are generally of the simplest. The operations consist of stripping, quarrying or mining, and transportation.

However, several important points have to be taken into consideration when opening up a quarry, which, if not considered, would be likely to handicap an operator seriously. A deposit of gypsum may be everything that is desired in the way of quality and extent, but still may not be capable of being worked economically on account of its distance from transportation, ready market, and also its heavy overburden. Its location also with respect to the drainage of the surrounding country may necessitate a heavy expense in keeping a quarry free from water, so that this factor has in some cases to be taken into account. Another factor that sometimes influences the operation of a quarry is the labour market. In some of the rural districts it has been found that many of the farmers are willing to work in the quarries a part of their time, and, although in that case the cost of labour is a little lower, considerable time is always lost as the farmers will not work regularly; they naturally have to spend a considerable time attending to their farms at some seasons of the year. Consequently the availability of a steady supply of labour is an item that should be taken into account. When steady labour is obtainable, better work can naturally be accomplished, and new and improved methods can more readily be taught the quarrymen when they are working continuously instead of intermittently.

Stripping

Methods

The amount of overburden resting on the gypsum beds has a great bearing on both the method of operating the quarry and its successful development. When there is a rock covering over the gypsum and also a deposit of drift material, the stripping of the deposit is out of the ques-

tion, and mining methods are employed; but where the overburden consists of only soft material it is generally more economical to remove this overburden and to extract the gypsum by open quarrying. The removal of this material entails great expense; at present it costs from 20 cents to 25 cents per cubic yard to remove such material. When operations are undertaken on a sufficiently large scale to warrant the use of a power shovel, the cost of stripping is between 15 and 20 cents; but where only a small quarry is to be opened, and stripping has to be done by hand, the operator must consider very carefully what depth of an overburden he can reasonably afford to remove.

The methods of stripping usually employed in gypsum practice come under the four following heads:—

Stripping by:

(1) Hand.
(2) Horse scrapers.
(3) Power shovel, steam, electric, or gasoline.
(4) Hydraulic.

Hand. It is only in very small quarries, or where the overburden is very light, that the work is done by hand. The work has naturally to be carried on during the summer months, as the frost would make the price during the winter months prohibitive. When the dirt is removed by hand it is shovelled into carts and hauled to the nearest dumping ground, or else it is allowed to cave into the quarry and then sorted from the gypsum and carted away. This latter practice is greatly to be condemned, as the loose waste cannot help getting mixed with some of the white rock, impairing its value for plaster manufacture. It is a practice that not only impairs the value of the rock but causes extra expense and delay in having to sort and remove the waste from the quarry face, and the amount of good rock which is unavoidably taken to the dump with the waste is no small item. This rock would be saved by proper stripping beforehand. The practice in some of the quarries is to strip an area clean and then to shovel out the potholes as far down as possible and in some cases to hydraulic the surface to remove as much loose material as possible, the whole of the rock broken can then be handled directly with the least possible delay. The cost of such procedure per ton of rock mined is remarkably low, running only a few cents per ton.

Horse Scrapers. In northern Manitoba the overburden is removed by horse scrapers similar to those used by contractors in railway construction work. The surface covering consists of about 3 feet of clay and loam, loosely cemented together by gypsum. This material readily breaks up before the scraper, and can then be hauled away.

Power Shovel. In the larger quarries, the power shovel has come into general use for the removal of overburden. Where the overburden is of any great thickness, it is removed in benches by the shovel working on the top of the deposit. In that case a track is generally laid alongside the shovel, and the shovel loads directly into cars, which can then be hauled to the best dumping ground available. This method proves satisfactory to a certain extent, but considerable material falls into the

quarry, and must be removed either by hand, or by a second shovel. A second method, sometimes employed, is to remove the overburden over a bench of gypsum, to operate the shovel on top of this bench, and then clean off this bench by hand and carts. This method leaves most of the gypsum free from danger of being mixed with the waste material.

Hydraulic Stripping.[1] The removal of overburden in the gypsum quarries by hydraulic means has not been resorted to, to any great extent, it being employed only occasionally in a modified form to wash off the surface after the greater part has been removed by other means.

Quarrying or Mining of Gypsum

In the Maritime Provinces, and also in the west, the larger deposits of gypsum are all comparatively near the surface, with only a covering of loose material which can easily be removed, but which would not hold up if undermined. Consequently the only method in most cases is to remove the gypsum by open quarrying. This method has a number of advantages over underground mining, which have been greatly to the benefit of the gypsum operators. These advantages may be briefly stated as follows:

(1) Easier supervision. A better idea can be obtained of the class of material that is being quarried.
(2) Better ventilation, as the men are always working in the open air.
(3) Easier handling of the gypsum.
(4) No timbering is necessary, and all the material can be extracted as no pillars have to be left.

Its disadvantages are few, the principal being the exposure to all the different kinds of weather, thus hindering the work, and the danger of exposure of the men to heavy rain, snow, or extreme cold.

Quarrying

As a rule, in the past, most of the quarries operating in gypsum had no regular shape, and nowhere did any systematic method seem to have been employed. It was generally a case of taking the gypsum from wherever it occurred, without any regard to future economy in working. In consequence many of the quarries were just a series of potholes, with no two parts of the quarries alike. Thus, much time was lost by the repeated handling of the gypsum, when in many cases one handling would have been sufficient. While these methods still exist in a few of the older quarries, many new faces and deposits have been opened up in recent years under the most modern and efficient quarrying practice with the result that great economies have been made.

The present practice in the smaller quarries is to obtain as high a face as possible of clean gypsum, and to break it down by caving. This is accomplished by drilling the lower part of the face with auger and hand-power drills, and then blasting the holes with a low strength dynamite,

[1] A detailed description of hydraulic stripping is given in "Gypsum in Canada" Mines Branch, Dept. of Mines, Canada, Rept. No. 245, pp. 113–116.

generally about 40 per cent strength. This brings down a large tonnage of gypsum, which is then broken up by sledge hammers to a convenient size for handling. The broken material is hand-picked, so as to remove any pieces of anhydrite or foreign matter, and is loaded into small cars or dump carts and hauled either to the mill or wharf direct, or where there is a railway line, to the nearest siding where it is dumped into the railway cars.

In the larger quarries the procedure is somewhat different. After the surface is stripped clean of overburden, well drills are employed to put down a series of deep holes at a regular distance back from the face. These are then fired by a battery and a large tonnage broken down at one blast. Any large blocks are "bulldozed" by jackhammers.

Power shovels are used extensively to load the broken rock into the cars.

In the gypsum deposits of northern Manitoba, a steam shovel is being employed successfully to handle the gypsum. After the surface is stripped the gypsum, which is of a soft variety, is drilled by a series of vertical holes placed regularly at 8-foot intervals across the working face of the deposit. These holes, when blasted, shatter the gypsum sufficiently so that it can be handled by the steam shovel directly into the standard railway cars standing on a siding beside the shovel. This method is found to be cheap and economical, and enables a large tonnage to be got out in a very short time.

Drilling is done both by hand and power drills, auger drills similar to those employed in coal-mining being used. They are found to work very successfully as the gypsum is soft and drills easily.

Mining

Where the overburden is heavy, and consists of a rock capping over the gypsum beds, the deposits are usually worked by underground methods. On account of the small price obtainable for the gypsum the simplest and cheapest methods have to be employed. In the earliest gypsum operations in Canada, the deposits were opened up by an incline tunnel, generally at a slope of 15 to 20 degrees, and present practice seems to follow the example of these first attempts. One mine in Ontario is being operated by a vertical shaft.

When the bed of gypsum has been reached, main haulage ways are laid out, and the gypsum is recovered by a system of rooms and pillars similar to that employed in coal mines. Tracks are laid to the face in these chambers, and the broken gypsum is loaded directly into cars, which are then taken by hand, or horses, to the main haulage way, where they are made up into trains preparatory to being hauled up the incline by a small hoist. Considerable loss as compared with quarrying is caused by the fact that the pillars in most cases are composed of good gypsum which would otherwise be recovered.

Drainage

Gypsum quarries, as a rule, are seldom troubled with water, but in some places, especially where the level of the floor of the quarry is near the level of the water table of the surrounding country, the problem of

handling the water has to be taken into consideration. In this case a sump is located in the lowest part of the quarry, into which all the water collects, and a small duplex pump, generally stationed somewhere well protected from the blasting, is sufficient, being operated only a few hours each day, to handle all the drainage from the whole quarry. In cases where the quarry is below the drainage level of the surrounding country a larger pumping plant has to be installed.

Transportation

Transportation facilities in the quarries are of the simplest nature. The rock is placed in small cars or else hauled in single dump carts to the loading platform from which they are dumped into railway cars. Where a power shovel is used the rock is loaded directly into the railway cars.

The method of transporting the loaded material from the quarry to the mill or shipping pier is, in most cases, by narrow gauge railways, and this affords easy and cheap handling.

Where the crude rock has to be shipped by boat, the most recent practice in Canada has been to install crushing plants either at the quarry or shipping pier, in which the rock is cracked to 3-inch size and smaller. It can then be handled mechanically by conveyer belts and loaded into the vessels in the minimum amount of time. This also facilitates the unloading of the vessels at its destination since grab buckets can be employed to great advantage.

MANUFACTURE OF CALCINED GYPSUM

It has long been known that gypsum ($CaSO_4 \cdot 2H_2O$), when heated so as to drive off $1\frac{1}{2}$ parts of its water of crystallization, has the power of again taking up this water which it lost, and forming a hard, durable substance suitable for all kinds of plaster work. This property of gypsum was known to the ancients centuries ago, and evidences of cements and plasters made in this way from gypsum are still to be seen on many of the old structures found in the recent extensive excavations of the ruins of ancient Egypt.

Much work has been done to determine the actual temperature at which gypsum loses part of its water of crystallization and forms the hemi-hydrate, $CaSO_4 \cdot \frac{1}{2}H_2O$, and it is fairly well agreed among investigators that this takes place at 107°C. (224·6°F.) in saturated air under a pressure of one atmosphere.

The hemi-hydrate, $CaSO_4 \cdot \frac{1}{2}H_2O$, is also known as "first settle stucco" as well as "calcined gypsum." In commercial practice, however, it is customary to employ much higher temperatures than that above given and it is probable that the commercial product obtained, while consisting mainly of calcined gypsum, contains also appreciable quantities of what is commonly called "soluble anhydrite" or "second settle stucco," a product formed between 130° and 525° C., as well as "flooring plaster" formed at a temperature slightly above 525° C., and "dead burned" formed at 600° C. and above.

The soluble anhydrite will not normally set by itself but has a great avidity for water, forming the hemi-hydrate; the "flooring plaster" takes up water extremely slowly but finally sets to a hard substance, while the "dead burned" material has no capacity for setting within a commercially reasonable time.

In Canadian practice the calcining temperatures range from 280° to 350° F. and therefore it is reasonable to expect that at least a small proportion of the batch may be converted into the soluble anhydrite, and that there also may be some amount of raw or unburnt gypsum still uncalcined. The remaining heat in the batch after dumping into the hot pits will gradually calcine the part uncalcined in the kettle and the seasoning of the plaster afterwards allows any of the "soluble anhydrite" formed to take up moisture from the air to form the hemi-hydrate. The final product therefore is probably uniform in composition.

In actual practice, preparing the gypsum for the market consists of three and sometimes four operations:—

(1) Crushing and grinding.
(2) Calcining.
(3) Mixing.
(4) Manufacture of gypsum products.

Crushing and Grinding

Opinions differ in different countries as to the advisability of carrying on crushing operations before or after calcining. The general practice on this continent is to reduce the gypsum to a flour before calcining, and, after, to sieve and repulverize all material that will not pass through a 100-mesh sieve. This method has the advantage of allowing the whole material to become uniformly calcined, but greater power is required to crush the gypsum before calcining. In European practice, where crushing is carried on after calcination, the crude material becomes greatly shattered by the calcination, and is thus easier to crush, but the product is not so evenly calcined. Then again, in European practice calcining methods are employed which adapt themselves more readily to lump gypsum than to the powdered material, while on this continent the kettle system is the most universally employed, and this system requires a finely powdered material. A modification of both these methods has been adopted in a few of the Canadian mills, where the gypsum is crushed in the ordinary way to about 20 mesh and then calcined, after which the final grinding is done by one or other of the standard methods.

In crushing the gypsum three stages are generally required, namely, heavy crushing in large Blake jaw crushers, or "nippers" as they are known to the gypsum trade, then through rotary or gyratory crushers (colloquially "crackers"), and finally through pulverizers which reduce the material to a flour. In cases where gypsum earth is the material to be treated, the heavy and sometimes the intermediate stages of crushing can be dispensed with.

The gypsum rock as it is brought from the mine or quarry is dumped on a rock slide which leads directly into a large jaw crusher with corrugated jaws, in order to prevent clogging.

In some cases, where the material to be crushed varies in size, it is well to have the rock slide composed of a series of grizzlies, or iron bars, so as to sort out roughly the material less than 3 inches in size, and feed it directly to the rotary crusher. This, it will be found, will save a considerable quantity of power required to operate the large nipper.

From the jaw crusher the broken rock is allowed to drop automatically into the rotary crusher. These machines are quickly adjustable for fine or coarse products. The spindle type is the most frequently employed. From the cracker the material, which has been reduced to about $\frac{3}{4}$-inch size, is taken by an elevator to the top of the building and generally placed in a bin, from which it descends by gravity into the dryers and then to the pulverizers, or, where dryers are not employed, into some type of pulverizer. Further reduction and pulverizing of the rock is done in hammer mills and emery or burr mills. Separation of the fines is accomplished by air where hammer mills are employed.

Preheating. In several of the Canadian mills preheaters or dryers have been installed and the temperature carried in these dryers is such that in some cases partial calcination of the rock takes place, thus materially shortening the calcining time in the kettle. These are both of the rotary type and the vertical French type.

Screening. Screening may be done before or after calcination; and vibratory screens are almost universally used, unless grading is done in an air separator.

Calcining

When pure gypsum is heated under atmospheric pressure in saturated air it loses part of its water of crystallization. The whole mass violently "boils", and finally settles, producing "first settle gypsum". On further heating the remainder of the combined water is driven off, a second violent boiling takes place as well as a second settle and soluble anhydrite is formed.

In Canadian mills it is customary to carry the batch only to the end of the first settle, and only in rare cases is the second settle reached.

Many methods have been tried to calcine gypsum, with more or less success, but, so far, in Canada, the kettle system is the only one in use.

Ancient Methods. In the early part of the nineteenth century, when the gypsum industry was in its infancy on this continent, the gypsum was boiled in cauldrons which held anywhere from two to fifteen barrels each. The fuel used was wood placed under these pots. After the first boil was accomplished, the material was shovelled out on platforms beside the cauldrons, and allowed to cool. The boiling mass was constantly stirred by hand. This method was found both slow and expensive, and has been entirely replaced by either kettles or rotary calciners.

Foreign Methods. In Europe the cauldron method was also employed as well as calcining in ovens. This latter system is still used where the product required is to be of very uniform grade and high quality. It is adapted only to small quantities of very best grade of white gypsum, such as is required in the porcelain industry. The Mannheim system, although not yet adopted in American practice, is being employed to a considerable extent in Europe.

The Kettle Method. Although the kettle method of calcining gypsum is slow and wasteful of heat, it, nevertheless, still is the commonest way employed in both the Canadian and American mills. It has the advantage of being easily watched by the operator, and produces a very even and well calcined plaster.

Several styles of kettles are employed, but they vary only in minor details. The first kettles made were of about 5 tons capacity, but lately the tendency has been to increase this, and kettles of 15 tons capacity are quite common.

The kettles consist essentially of a stationary, vertical cylinder, 8 to 12 feet in diameter and 8 to 10 feet deep. This cylinder is fired from beneath and flues pass back and forth, thus heating the mass of gypsum in the cylinder. A rotating shaft, in the centre of the kettle, to which are attached two sets of paddle arms, keeps the mass in constant agitation. A lever beside the top of the kettle opens a trapdoor at the bottom which connects with a chute leading to the cooling-bin.

In charging the kettle, the material is allowed to run in very slowly, and is constantly agitated by the paddles. The kettle is kept at the start of a run at about 200° F. (93° C.) to 212° F. (100° C.). It takes from 1 to 1½ hours to fill the kettle. When the kettle is full the temperature is increased, and at the end of 2½ to 3 hours the charge is withdrawn, and allowed to cool in the fireproof, brick cooling-chambers beneath the kettles.

Rotary Calcination. Continuous calcination by some type of rotary calciner has not yet been adopted in any of the mills in Canada, although several are in actual operation in the United States. These calciners are really only modified types of the rotary cement kiln adapted to the burning of gypsum.[1]

The Mixing of Gypsum

Mixing Plasters

When the gypsum has been sufficiently calcined it is run into cooling-pits which are generally made with a concrete or brick lining. In these it is left for a sufficient length of time to cool properly. An advantage is also gained by leaving the material in these pits, as the excess heat acts on any part of the mass that has not been sufficiently calcined and brings it all to a uniform grade of calcination. It is probable also that the small part of the batch which may have been overburned into the soluble anhydrite form, has time to absorb moisture from the air to form the hemi-hydrate. From these pits it is elevated and placed in bins in the mixing part of the mill. When in this state it is called stucco, plaster, or calcined plaster. Where grinding has not been carried on before calcination the stucco is again fed through grinding mills and then put through screens, or else through some type of hammer mill followed by air separation. Where complete grinding has been completed before calcination the stucco is fed to the screens direct. The types of screen most generally employed are some kind of vibratory screen. The oversize from these screens is reground in small burr mills.

[1]For a description of rotary calciners see "Gypsum in Canada" Mines Branch, Dept. of Mines, Canada, Rept. No. 245, pp. 130-137.

Stucco or calcined plaster has a setting time of from five to twenty minutes. This is altogether too fast for commercial work, so in order to increase the time for the initial set some material known to the trade as retarder has to be added. Wood fibre or hair is also added to the material as fillers, and these materials are added together with the retarder in what is known as a mixing machine. This machine consists essentially of a hopper-shaped feeding bin into which the weighed materials are dumped, and a cylindrical chamber with a revolving paddle. When all the materials which go to make up a hardwall plaster are weighed out, a lever dumps the mixture into the main body of the mixer. This consists of a horizontal cylindrical box with a revolving screw paddle which keeps the mixture constantly stirred, thus ensuring a perfect mixing of all the materials. From the bottom of the mixer a number of chutes over which bags can be placed are so arranged that when the mixing operation is completed, the plaster can be dumped directly into the bags or barrels placed to receive it.

Retarders. In nearly all the Canadian gypsum mills the material used as a retarder for the setting of gypsum is a patent retarder made from the refuse from the stock yards and packing houses. Many materials may be employed for this purpose, such as glue, glycerine, sugars of different sorts, cereal grains ground to a sufficient degree of fineness, sawdust, wood pulp, etc., and mineral materials such as lime, slags, alkalis, acids, etc., are frequently employed. The action of these retarders seems to be along mechanical lines, by hindering the crystallization of the plaster and the absorption for the time being of the water which is necessary for the complete hydration of the product. There does not seem to be any appreciable effect on the tensile strength of the plasters by the addition of a small amount of retarder.

Accelerators. Occasionally, as in the case of a stucco made from a poor grade of gypsum earth, some material has to be added to hasten the setting of the plaster. For this purpose certain salts are employed. In the better grades of fine white plaster, such as are used for dental purposes, in order that a very quick set may be obtained, either alum or borax is added and thoroughly mixed. The set in this latter case is then only about three to five minutes.

THE USES OF GYPSUM AND GYPSUM PLASTERS

Uncalcined Gypsum

Gypsum rock, as it comes from the mine or when treated only by crushing and grinding, is used in many industries.

As a Retarder for Portland Cement

Since the cement industry has grown to such a large extent, the demand for ground, crude gypsum for use as a retarder has steadily increased.

When a small amount of gypsum is added to Portland cement the set of the cement is retarded, but apparently the tensile strength is not injured. The percentage which is allowed, according to specifications,

varies in different countries, England and Germany allow only 2 per cent, while in other countries a maximum of 3 per cent is permitted.

Although larger amounts of gypsum still act as a retarder to the cement and also increase its strength, the concrete so treated, will, after a time, check and crack so as to become useless.

At one time plaster of Paris was employed entirely to retard the setting of cement, but later it was found that crude gypsum acted in a similar way, so this is the form in which it is generally used, as the cost is less than the calcined gypsum. In purchasing gypsum the cement manufacturer purchases the rock on the basis of its sulphur trioxide content (SO_3), generally specifying 36 per cent or over, as this appears to be the main requisite in the reaction which takes place

Recent investigation and research has shown that gypsum-anhydrite mixtures are also suitable for retarding cement.[1]

Many attempts have been made to substitute gypsum for limestone in the manufacture of Portland cement, and to save the sulphur content from the gypsum as a by-product. Although several patents have been issued in the United States covering processes which use gypsum in this way, none seem to have been exploited to any extent.

Manufacture of Sulphuric Acid

The enormous quantities of sulphuric acid which are to be found in nature in gypsum and anhydrite have led many to experiment and take out patents on processes for its recovery, but so far no methods have been commercially operated on this continent.

The first proposal was to pass steam over red hot gypsum, which was supposed to liberate SO_2, O, and SO_3, leaving the CaO behind.

Another method was to pass HCl gas through a red hot mixture of gypsum and coal, forming $CaCl_2$, CO, H_2S, and S.

Still another process covered by patent was to subject gypsum to an electric current within a furnace in which the gypsum was in a molten condition. By supplying an excess of free oxygen, sulphur dioxide was formed, which was conveyed into lead chambers and converted into sulphuric acid in the usual manner.

Fertilizers

The use of ground gypsum as a fertilizer was one of the first uses made of this material. The material, commonly known as land plaster when used in this manner, is considered to have a very beneficial effect on many crops, especially those coming under the head of leguminous, such as clover, etc.

When first used, very little was known concerning its reactions in benefiting these crops, but of late years it is generally conceded that it proves beneficial in only a small number of soils and then it acts only as an indirect fertilizer. It is supposed to act on the double silicate of magnesia and potash, liberating potash so that it is free to act as plant food.

[1]For a detailed study of this subject the reader is referred to "Rock Products", Chicago, Ill. Nov. 24 and Dec. 8, 1928, issues.

Another use of land plaster is as a retainer of ammonia in barnyard compost. If applied freely around the stables on the floor and compost piles it acts as a disinfectant, and also retains the ammonia, so that this valuable product is saved to the farmer when he puts the fertilizer on the land.

Land plaster, it is claimed, tends to make heavy non-porous clay soils more open so that they do not remain too wet, and when applied to sandy soils, on account of the affinity of powdered gypsum for water, it will retain moisture or draw water from the atmosphere. The application of land plaster in a dry season to the light sandy soils of western Canada might possibly ensure a satisfactory crop, where under present conditions a complete failure would be the natural result. In the southern states at the present time ground gypsum or anhydrite is freely used as a fertilizer by the peanut cultivators and some 8,000 to 10,000 tons of anhydrite is annually shipped from Nova Scotia for this purpose.

It is well to remember that acid phosphate fertilizer as ordinarily manufactured by the reaction of sulphuric acid on raw phosphate contains a large proportion of gypsum, and this amount in many cases is sufficient for some soils and crops. If new processes for the manufacture of acid phosphate without the use of sulphuric acid develop sufficiently to ultimately replace that manufactured with sulphuric acid, it is probable that the demand for land plaster would again increase.

Land plaster has also been found of use in areas where the soil carries appreciable quantities of carbonate of soda or " black alkali ". This salt has been noticed to appear in the irrigated areas in southern Alberta, being brought to the surface by capillary action, and since this salt has an exceedingly injurious effect on crops, the addition of gypsum would be beneficial, changing the carbonate to sodium sulphate, which has no deleterious effect.

Flux

In connexion with the smelting of certain nickel ores mined in New Caledonia, crude gypsum is used as a flux. Thus, in smelting this ore, coke and gypsum are added to the charge, the latter furnishing the sulphur necessary for collecting the metal into a matte. It also acts as a base to counteract and slag the siliceous gangue.

In Germany it has been used as a flux for many years in the concentration of lead-copper matte in the reverberatory furnace.

In the Carmichael-Bradford blast-roasting process dehydrated gypsum is added as flux to galena concentrate.

Paints, Crayons, etc.

The uncalcined, finely ground gypsum is used in considerable quantities as a body for several grades of paint; it is also used in a semi-calcined condition.

White and coloured crayons used in blackboard and other work are now extensively made from gypsum. The uncalcined gypsum rock is very finely ground in a disk pulverizer and combined with several other ingredients, principally as a binder, and the mixture is then pressed into required shapes and dried before packing.

Terra Alba

Under the name of *terra alba* uncalcined gypsum is ground to a flour and sieved, after which it is sold in bags and sacks for many purposes. Its principal use in this form is as a paper filler and a filler for cotton goods. It has also been used as an adulterant in flour, sugar, baking powders, etc. The analyses made of these several articles in connexion with the operation of the pure food laws have been the means of detecting a wide range of such illegitimate use.

Terra alba or gypsum flour when mixed with a pure grade of wheat flour is called Corine flour, and is used in dusting moulds for metal casting in foundries.

To the water used for brewing purposes gypsum flour is sometimes added, as it enables the water so treated to dissolve the albuminous matter in the malt more effectually. The water from some wells in England is especially prized for brewing, on account of its having passed through the gypseous deposits through which the wells are bored.

Many other uses are found for ground, uncalcined gypsum, such as a base for mixing with Paris green or other insecticide, and as a drug, etc.

Sculpture Work

When large blocks of clear gypsum can be obtained in the form known as alabaster it is highly prized by sculptors and artists for statuary and other forms of art decoration.

Calcined Gypsum

Plaster of Paris

Plaster of Paris is the name given to all gypsum which has been only partly dehydrated and to which no impurities have been added either before or after calcination. Its use is very varied and extensive, and it is constantly being employed in new industries as its applications become known. Several of the more important uses will be described.

Dental Plaster. Plaster of Paris enters to a large extent into dental work, in the forming of plaster casts for plate work. For this work the gypsum has to be ground exceedingly fine, and special care is taken in calcining, in order to obtain a uniform product. Only the whitest and purest of gypsum can be employed for dental plaster.

Modelling. In artists' modelling, plaster of Paris is used to take casts from the original piece of work, in order to reproduce it either in bronze or other suitable material.

Moulds. For moulds of every description plaster of Paris is extensively employed. The uses to which this material is put in the line of moulds, etc., are practically limitless, but only a few of the more prominent will be mentioned.

Plate Glass Moulds for Polishing. The calcined gypsum, of which so much is employed in the plate glass industry, needs to be very finely pulverized and especially free from grit, in order not to scratch the polished

surface of the glass embedded in it. The process is briefly as follows: the rough plates of heavy glass, after coming from the kilns, are placed on large, heavy, circular tables, up to 24½ feet in diameter, which have been covered with a coat of plaster of Paris. As the plaster sets, the plate of glass becomes firmly embedded in it, thus holding it rigid for polishing, and also relieving it from any strain it may be put to while being polished. When the first side is polished, the plaster is broken away around the edges and the plate removed. The table is then thoroughly cleaned, and a fresh coating of plaster spread over its surface, and the plate again placed on it, with the polished side down.

At many of the glass factories the old, set plaster, as it is scraped off the tables, is taken and recalcined in small kettles. The product thus obtained is mixed with new plaster and used only when polishing the first side, as it is considered too likely to contain grit, which would scratch the polished side.

A ton of 2,000 pounds of plaster is sufficient to embed about 910 square feet of glass.

Pottery Moulds. Large quantities of plaster of Paris are employed in the manufacture of moulds for various pottery designs. It is especially adapted to this use on account of the porous nature of the gypsum moulds, which permits the ready evaporation of the moisture from the clay, while the surface of the ware is not exposed to dangerous draughts.

Hat Moulds. In the manufacture of most of the hats used, the blocks on which they are shaped are made of calcined gypsum.

Foundry Work. For special castings and for casting of Babbitt in many foundry shops plaster of Paris is used extensively on account of its porosity.

Moulds for Rubber Stamps. In mouldings for rubber stamps of all descriptions calcined plaster is made use of, on account of its readily taking sharp imprints.

Interior Decorations. One of the larger industries to which calcined gypsum is adapted is the decoration of public buildings, principally interior work. Although it is sometimes used in outside decoration, where buildings are erected which are only for temporary use, as were the buildings at the World's Fair at Chicago, it will not withstand the exposure of air and rain. A few years will cause it to crumble and go to pieces if not protected by a glazed, waterproof coating.

For interior decoration or relief its use is extending each year. The mouldings, cornices, etc., to be seen in public buildings, are now made from this material. The interior of the Union Station at Ottawa, Canada, gives a good idea of the extent to which it can be employed.

Surgical Casts. The medical profession employs plaster of Paris in considerable quantities for casts around broken limbs, etc. On account of its ready setting qualities, firmness when set, and the fact that it is not affected by moisture, heat, or cold, it is especially adapted for this purpose.

Plaster Ornaments and Casts. In the finer art work, plaster of Paris plays a considerable part. Statuettes and all kinds of ornaments for home decoration are made of this material, as well as many of the casts and busts seen in public buildings.

Manufacture of Match Heads. Calcined gypsum is employed by the match companies in the form of a good grade of plaster of Paris. It enters into the composition of match heads.

Safe Construction. A considerable quantity of plaster of Paris is used each year in Canada by the manufacturers of steel safes. The use to which it is put is to fill in between the hollow walls of the safe.

It is claimed that a mixture of plaster of Paris and alum forms the best known filling for safes, as an external application of heat is certain to liberate a large quantity of water, which is transformed into steam, thus ensuring safety to the contents of the safe.

Jewellery Manufacture. Jewellery manufacturers use considerable quantities of the finer grade of calcined gypsum, in which they set gold, silver, and precious stones to engrave or polish them.

Cement Plasters

When gypsum (which either contains certain impurities before calcining or to which special materials have been added after calcining) is partly dehydrated at a temperature not exceeding 400°F., the resultant product is known to the trade as cement plaster. This material is now being used extensively in building construction in preference to lime plaster, more especially for the first and second coats. Although slightly more expensive at present than lime plasters, its greatly superior heat resistance, such as is required in all modern fireproof buildings, and its lasting qualities are quickly overcoming the prejudice against its price, and as cheaper methods are being constantly employed in its manufacture, its use for this purpose is bound to increase. The fire-resisting qualities of plaster of Paris were discovered early in the history of its use, and many of the wooden beams in the houses in Paris which had been covered with a thin coating of plaster were found, after the great Paris fire, to have entirely escaped destruction. In several large, recent fires in modern buildings where this cement plaster had been employed on the interior walls, it has been noticed that the exterior walls had been ruined by the flames from the window openings, while the interior of these same walls had escaped due to their protecting coating of plaster.

In certain climates and in certain countries this plaster has a phenomenal lasting and preserving quality, notably in the moderate climate of southern Europe and Egypt, and portions of ancient buildings which had been coated with plaster are in a far better state of preservation than the rocks and masonry which were unprotected in this way.

In ordinary plaster of Paris the setting time is very rapid—from 5 to 20 minutes. In order to enable easier manipulation and to give time for the plaster to be moulded and handled properly on the walls, certain

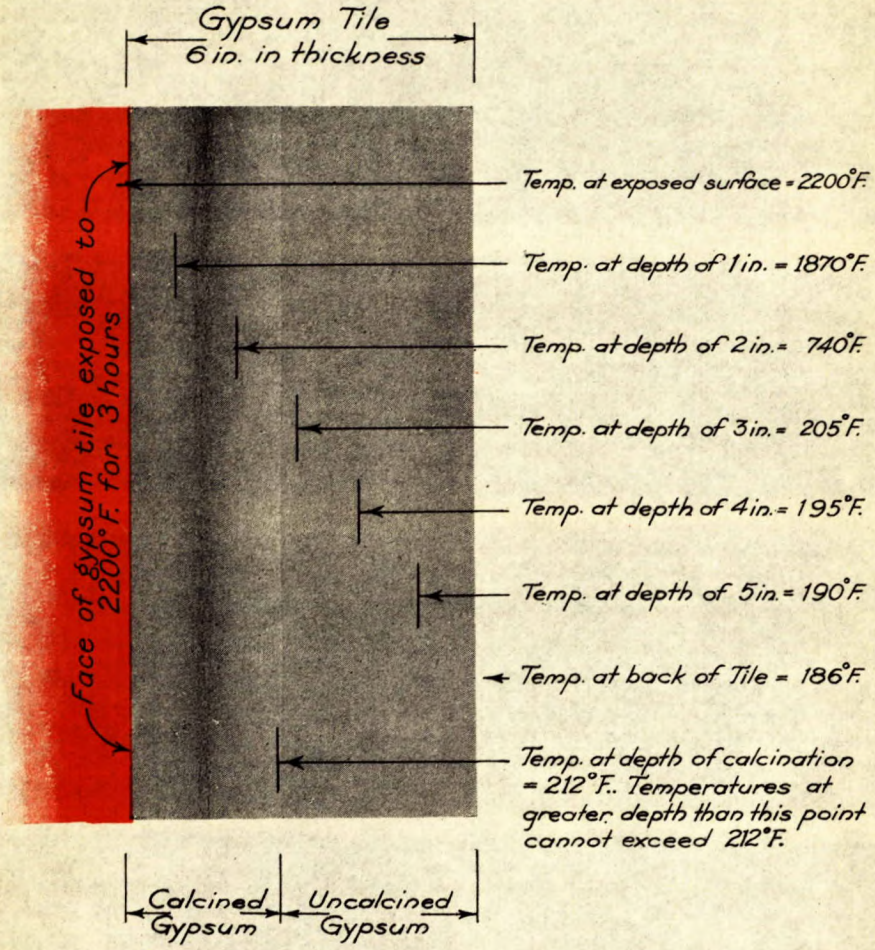


Fig. 21, Graphical Representation of Fire Test
Conducted by the Underwriter's Laboratories Inc.

materials known as retarders are added. Their composition and action have been described elsewhere.

To form a binder and strengthener to the cement plasters several materials, such as wood fibre, hair, etc., are employed, the material so used generally giving to the product the name by which it is commonly known to the trade. For the preparation of the wood fibre, cottonwood or common poplar has been found to be very serviceable, and is employed in most of the Canadian mills. The logs are cut into lengths of about 24 inches and have an average diameter of 12 inches. These are placed horizontally in a fibre machine, which is very similar to a lathe in its action, the poplar block being revolved and a series of toothed, circular plates being revolved and pressed against the block. These circular plates are keyed on a shaft lying parallel to the length of the block. One fibre machine will cut enough fibre in a shift of 10 hours to make 50 tons of wood fibre plaster.

The hair-picking machine generally consists of a toothed drum revolving at a fairly high speed of 600 to 700 revolutions per minute. Into this machine the baled hair is fed by hand. One of these machines will usually pick from 5 to 8 bales per hour.

When wood fibre plaster is manufactured, the following proportions are generally used. These vary considerably, according to the quality of the plaster, and also to the practice in different mills.

Calcined plaster	1,000 pounds.
Retarder	3 to 5 pounds
Lime (CaO)	10 to 12 pounds
Wood fibre	30 to 70 pounds

A plaster such as described above will require from 2 to 24 hours to set.

When hair is used as a binding material, the same proportions are employed as for wood fibre plaster, with the exception that picked hair is substituted for wood fibre. The quantity of hair added is generally from $1\frac{1}{2}$ to $4\frac{1}{2}$ pounds for every 1,000 pounds of plaster. Unlike lime plaster the plaster manufactured from gypsum does not act on the hair and eat it away. Other materials are sometimes substituted in place of the wood fibre or hair, such as asbestos fibre or manila fibre, but although they form a very good binding material their use has not become very extensive.

Flooring Plaster

A type of plaster which, so far, has had little attention in this country, but which will be sure to gain favour, is already extensively used in Germany and on the continent under the name of flooring plaster. This plaster is produced by the complete dehydration of pure gypsum at a temperature over 400°F., but the material is not dead burned. The German name for this material is "Estrickgyps", or "Estrick gypsum". Its manufacture differs a little from ordinary cement plaster in that a special vertical kiln is employed, and the material is calcined in small lumps at a temperature of about 500°F.

The special use that is made of this material in Germany is, as its name implies, for flooring plaster. It sets very slowly, but becomes exceedingly hard and forms a strong, durable, cheap flooring for ordinary purposes.

Hard Finish (Wall) Plasters

When gypsum is calcined at a red heat, or over, and certain substances (usually borax or alum) added, and then heated again, the resultant plaster is known as hard finish plaster. It is slower in setting than ordinary plaster, but attains a greater degree of hardness. This increased hardness is supposed by Landrin to be due to the reaction of sulphate of alumina and potash on the plaster rock, converting nearly all the carbonate of lime into gypsum. Several different methods have been employed to produce these plasters, and the plasters so obtained are known under such names as Keene's cement, Parian cement, Martin's cement, etc.

Keene's Cement. The best known and most prominent of these cements was first manufactured many years ago under English patents —since expired—under the name of Keene's cement. Until the last few years, all of this material employed in America was imported, but it is now being successfully manufactured on a small scale in the United States, as well as at the plants of the Gypsum, Lime and Alabastine, Canada, Ltd., at Winnipeg, Man., and Port Mann, B.C.

The calcination of the gypsum in the manufacture of this product is carried on in small, vertical kilns, somewhat similar to those used in burning lime. The gypsum, which is generally calcined in small lumps, is brought to a red heat, after which it is treated with a 10 per cent solution of alum, and allowed to dry. Calcination is carried on after this to a dull red heat, but no further. The product is finally ground to flour in emery mills.

Mack's Cement. Another hard finish plaster, known under the name of Mack's cement, is composed of flooring plaster (dehydrated gypsum), to which has been added a small quantity—0·4 per cent—either of dehydrated sodium sulphate (Na_2SO_4) or potassium sulphate (K_2SO_4). Unlike Keene's cement, this is a very quick setting material and has great adhesive qualities. On account of its surface being but slightly porous when set, it absorbs very little oil when painted.

Parian Cement. Parian cement is obtained in a similar manner to Keene's cement, with the exception that the saturating solution is composed of borax instead of alum. The time of the set can be regulated by the strength of the borax solution in which the calcined gypsum is treated; the stronger the borax the slower the set.

Many chemicals have been tried, with more or less success, as a hardener for calcined gypsum, and the products sold under such names as Martin's cement (solution, potassium carbonate, K_2CO_3), Magand's cement (solution, sulphate of zinc, sulphate of iron, or sulphate of copper), and many other varieties.

Insulating and Acoustic Plasters

Insulation. So much has been written in recent years about the need for insulation in building construction that it is almost superfluous to call attention to the preventable heat waste going on in Canada each year. To prevent such waste many solutions of the problem have been advocated, mainly along the line of the addition of some insulating material in the construction of buildings, and many such materials have been tried or are being employed with varying success.

When it is realized that it is not alone necessary to insulate a house to keep in the heat during winters in Canada but also to prevent the heat entering a building during the hot summers, the need of proper insulation is readily apparent.

On account of the increasing demand for fireproof construction it is necessary to employ such insulating materials as are non-inflammable or nearly so, and the fire-resisting qualities of gypsum at once suggested this material for such use. Gypsum plasters, however, if used in the ordinary way are too heavy and if used directly as an insulation would be uneconomical on account of the great thickness necessary to ensure the proper heat resistance. Research, however, has developed a light weight product called "Insulex", with a gypsum base, which has all the desired qualities and which has now been on the market for a number of years with good success.

In hundreds of structures of almost every conceivable type, including residences, hospitals, churches, schools, bakery and industrial ovens, cold storage rooms, business premises, apartments, hotels, factory buildings, farm buildings, storage tanks, etc., scattered all over Canada as well as the United States, the use of Insulex has proven highly satisfactory.

While covered by many patents, relating not alone to the basic principle of manufacture, but also to many specific details, the manufacture of Insulex is comparatively simple. It consists essentially of the addition of certain chemicals to the calcined gypsum at the plant, which, when water is added to the mixture on the job where it is employed, react together with the liberation of a gas, expanding the mass to many times its normal bulk. The set of the plaster is so timed that the material hardens when the greatest expansion is attained, forming a light porous mass full of minute sealed cavities which act as insulators both against heat and cold, so that thicknesses of from 4 to 6 inches of Insulex have the insulating value equivalent to many times that thickness of many other materials.

There are three varieties of Insulex in general use which are classified as follows: the weights given being the amount of Insulex material required to fill one cubic foot of space when poured and set:—

8 pounds light weight.
18 pounds medium weight.
30 pounds heavy weight.

The need for a dry insulation that could be placed in existing structures or in new buildings, and covered in quickly, independent of weather conditions, has led to the development of dry Insulex.

This material is a light, fluffy, flaky gypsum insulation. It can be placed direct from its paper bag containers into the spaces to be insulated, and it is both fireproof and verminproof.

Outdoor and indoor temperature records have been kept at Canadian buildings which show that a frame building, having the stud and 4-inch rafter spaces filled with dry Insulex, can be maintained at a temperature equal to about that of the mean day and night outdoor temperature, without either heating or cooling plant.

Under these conditions, the development of the future in such buildings will undoubtedly be the provision of heating plants only large enough to provide the amount of heat necessary to raise the indoor temperature from the mean outdoor level to the required mean indoor level.

In contrast with this, our uninsulated buildings, or buildings with only a very inadequate amount of insulation, now require heating plants large enough to take care of the temperature difference from the indoor level down to the average of the lowest dips experienced during the winter months.

The most recent development both in United States and in Europe with regard to the heating of buildings is to provide plants that will condition the air, that is to say, which will moisten it, and distribute it to all parts of a building in such volume as will meet the varying requirements of the occupants.

These demands involve the use of refrigerating plants, and it is now found that the extravagant heat transmitting qualities of ordinary building construction make the provision of such plants altogether too costly for buildings other than those of a few large financial institutions.

This condition is creating a demand for adequate insulation in districts that formerly had such climatic conditions that no insulation, or only very partial insulation, was considered necessary for ordinary heating requirements.

Acoustic Plaster. The study of the acoustics of large buildings such as auditoriums and churches has occupied the attention of scientists for many years but it is only within the last decade or so that the subject has been really properly understood. It is a well known fact that some halls or churches are so built that every word or note of a speaker or singer can be heard with the greatest ease in every part of the room, while in others it is extremely difficult. In the latter case it is hard on a speaker and irritating to the audience.

The great increase in noises concurrent with modern civilization has rendered necessary a radical change in modern construction methods to counteract such noises, and endeavours are being made to eliminate noises of factories, typewriter rows in offices, echoes and reverberations in public speaking places, as well as street noises so that it is hoped in the near future such nuisances will be materially decreased.

One of the most serious defects is due to the echo caused by the reflection of sound from the smooth hard surfaces of walls and ceilings. It has been found that about 98 per cent of sound was reflected from ordinary plastered walls and to eliminate or at least alleviate this trouble a special gypsum plaster, called "acoustic plaster", has been developed.

Such plasters consist essentially of gypsum plaster to which has been added certain chemicals which develop gas cells during the period of hydration and application of the plaster, and during the initial set, these gas cells burst at the exposed surface, resulting in open pores that persist fairly well for the depth of the plaster. Porous volcanic rock sands are added to these plasters and greatly assist the artificially formed pores in absorbing sound waves.

Sound waves enter the pores of acoustic plaster and by friction create heat. Some of the sound energy, therefore, changed to heat energy is no longer available as sound energy, and so the quieting process is brought about.

Walls plastered with "acoustic plasters" have been found to absorb as high as 30 per cent of the sound waves striking them.

Process of Manufacture of Gypsum Wallboard

Gypsum wallboard is essentially composed of a layer of gypsum plaster enclosed between two sheets of fibrous material somewhat resembling a high-grade blotting paper though not so absorbent. Such boards are used for interior walls and ceilings and may or may not be further decorated. Sometimes they are used as a backing for plaster, but for this purpose a gypsum lath has been developed which is preferable to the ordinary wallboard. The manufacture of both products is similar with the exception that the gypsum lath has a different paper on one side.

Ingredients. The ingredients used in the manufacture of gypsum wallboard consist of a calcined plaster to which has been added some material such as sawdust, starch, etc., and water, the core of plaster being enclosed between two sheets of fibrous paper material.

Manufacture of the Board. The calcined plaster coming from the bins is spread on the soak belt where it is thoroughly mixed with water and the other ingredients added. From the soak belt it travels through the mixer which ensures a complete mix. The slurry is then conveyed through spouts to the belt where it is spread out on the bottom layer of paper which is slightly wider than the top layer. The screed rolls spread the slurry over the paper evenly to the desired thickness and at the same time lays the upper layer of paper on top of the slurry. After passing through the rolls an edger on each side turns over the overlap on the bottom paper and firmly cements it to the upper paper with paste, at the same time making a square edge. The board thus prepared is carried along the belt in a continuous strip, the belt travelling at such a rate that by the time it reaches the cutting knife the slurry has set sufficiently hard to allow handling if necessary. The paper used is such that a part of the slurry is pressed into it when passing through the rolls, thus assuring a perfect bond between the paper and the gypsum core.

The strip of board on reaching the end of the continuous belt is cut into the desired lengths and then runs onto an automatic transfer machine which takes the boards to the charging end of the dryer and starts them on their way through the dryer.

In the dryer the boards are completely dried by steam and are automatically discharged at the other end. They are then examined and trucked to the store-room for shipment.

The sizes of board prepared vary in the different mills and can be made in any size to suit specifications.

The Manufacture of Gypsum Tile

In the manufacture of gypsum blocks the material used is calcined plaster and some filler material such as shavings or starch.

The mixing is carried on in a similar manner to the mixing for wallboard, namely on a soak belt and mixer, and the slurry is then poured into some type of automatic tile machine, which consists of a series of moulds of the desired shape on a revolving platform. This platform revolves slowly so that each mould is filled as it passes under the spout from the mixer. By the time a complete revolution of the platform has been made the tile is sufficiently set to enable it to be removed to a truck and the mould is closed ready for filling when it comes again under the spout.

The green tile are placed on a truck which is run directly into a tunnel dryer. From the discharge end of the dryer the trucks are run to the stock-room or storage pile.

Various sizes of both solid and hollow blocks are made as required.

The Manufacture of Gypsum Roofing Slabs

The materials used for the manufacture of gypsum roofing slabs are the same as for tiles or blocks with the addition of steel reinforcing rods.

The materials are mixed as required in a batch mixer and poured into individual moulds in which the steel reinforcing rods are placed and the surface finished by hand. When set the slabs are removed from the moulds, placed on trucks and run through the tunnel dryer and stored for shipment. Several sizes to suit demand are made.

Miscellaneous Uses

Beside the uses already mentioned calcined gypsum is employed to make a great variety of special plasters and shapes and its use in the building industry is constantly being enlarged.

CHAPTER X

THE GYPSUM INDUSTRY OF CANADA

The increasing importance of the gypsum industry is evidenced by the fact that the production has increased from 473,129 tons valued at $809,632 in 1909 to 1,205,846 tons valued at $3,622,007 in 1928, an increase of over 155 per cent in production and 347 per cent in value in the 20-year period.

Although the export trade in crude gypsum still forms a large proportion of the industry it is gratifying to see that the home consumption is steadily improving and while the percentage of the crude gypsum mined that enters into the manufacture of calcined products in the country is only 16·8 per cent, its value is 50 per cent of the total gypsum production of the whole country.

It is to be hoped that each succeeding year will see an increase in the amount manufactured in Canada and with the steady growth of the country and a serious endeavour to capture a part at least of the world market in gypsum products, the outlook for the industry is decidedly promising.

HISTORY

Gypsum deposits have been known in Nova Scotia since the time of the earliest settlers and shipments of the crude rock were made from the Windsor district to the United States a number of years before the Revolutionary War. After the war of 1812 these shipments assumed larger proportions and have been increasing ever since. The first recorded production in Ontario was in 1822 when a small amount was mined and crushed for fertilizer. Thus even in Ontario the industry is over 100 years old.

As a matter of interest it might be stated that the discovery of gypsum in Nova Scotia was the first in North America, the deposits in New York state not being discovered until 1792, Michigan in 1823, and Ohio about 1849.

During the first half of the nineteenth century the industry in Canada had a varied career, Nova Scotia and Ontario being the principal producers. Of the first discovery of gypsum in New Brunswick very little is known. Evidence of very early work having been carried on in the district adjacent to the town of Hillsborough, is shown by the signs of excavation and small deposits of waste now covered over by undergrowth of considerable size. Small shipments were made from time to time previous to the year 1847 by farmers from this district. In 1854 more active operations were commenced and in that year the foundation was laid for the operations of the present business controlled by the Albert Manufacturing Company.

In the meantime the operations in Nova Scotia were steadily enlarging so that during the years from 1860-67, twenty-five ports in Nova Scotia were shipping gypsum obtained from deposits in three counties.

The industry in Ontario had in the most part to depend on a local market so that its expansion was not so rapid as that in the Maritimes. The first calcining mill was erected about 1846 and had a daily capacity of about ten tons. At present the industry is well established and rapidly increasing.

The deposits of Manitoba were first operated in 1901 and have been in production on an increasing scale ever since. The first production of gypsum in British Columbia was made in 1911 but it was not until 1926 that the industry was put on a sound basis in this province.

At present there are 17 mines or quarries being operated in Canada as well as 7 calcining mills, with the prospect of several more properties being opened up and at least two more mills being erected during the next year.

THE MARKETING OF GYPSUM

In the early years of the industry the marketing was a simple matter. The rock found a ready market in its crude lump form, or else it was ground and sold as fertilizer, the only use it was put to for many years. With the advent, in the early years of the past century, of the calcining mill and the manufacture of gypsum plasters, the industry was at once beset with great difficulties. Coming in direct competition with lime and other plasters, its value as a plastering material had to be established, and the greatest perseverance and patience on the part of the manufacturers of gypsum plasters were required to overcome the prejudice and antagonism of the builders, who for many years had been accustomed to using other plasters and to whom a change to a new and virtually unproven product was the height of folly. The work of these pioneers in the industry, however, has been amply rewarded and the use of hardwall gypsum plasters is now well established.

The past ten years in the gypsum industry has seen wonderful changes, not alone in the grade of the product produced but also in the greatly diversified line of products manufactured. Gypsum blocks, gypsum tiles, gypsum roofing slabs, gypsum wallboards, insulating and acoustic plasters are now being manufactured on an increasing scale each year, and with the rapid advances being made in gypsum research new uses are constantly being found.

Coincident with the rapid strides made in the technology of the industry the problems of marketing the many products of the mills have become so increasingly difficult that the sales department of any gypsum company is now regarded as a department of major importance in the organization. Large appropriations have to be made each year for extensive advertising campaigns and a staff of salesmen, thoroughly conversant not only with the technology of the products manufactured but with the consuming industries maintained in the territories in which the products are to be marketed.

It can thus be seen that what in its infancy was a comparatively simple matter of quarrying and disposing of the crude product, has become a highly specialized industry requiring the services of a staff of trained specialists not only in the manufacturing end but throughout the whole organization.

Uncalcined Gypsum

According to the American Society for Testing Materials Standard Specifications for Gypsum[1], crude gypsum may be in any of the following forms and sizes:—

(a) *Run-of-mine Gypsum.* The form in which it comes from mine or quarry.

(b) *Crushed Gypsum.* Run-of-mine gypsum further reduced so that all of it will pass a 3-inch (76-mm.) ring, and not more than 25 per cent shall pass a No. 100 sieve.

(c) *Sized Gypsum.* Shall all pass a 1½-inch (38-mm.) ring, and not more than 10 per cent shall pass a ¼-inch sieve.

(d) *Ground Gypsum.* Gypsum further reduced for specific uses. Ground gypsum may be in any of the following standard forms:—

No. 1. This material shall all pass a No. 14 sieve and not less than 85 per cent of it shall pass a No. 100 sieve.

No. 2. This material shall all pass a No. 14 sieve, and not less than 60 per cent nor more than 85 per cent of it shall pass a No. 100 sieve.

No. 3. This material shall all pass a No. 8 sieve, and not less than 40 per cent nor more than 60 per cent of it shall pass a No. 100 sieve.

No. 4. This material shall all pass a No. 100 sieve.

According to these same specifications "no material may be considered as gypsum which contains less than 64·5 per cent by weight of $CaSO_4 \cdot 2H_2O$".

Gypsum in its crude form is still used in many industries and its marketing in such a form presents few difficulties. In cement manufacture it is added to the clinker before grinding, and for such a use is generally bought on the basis of its SO_3 content, 36 per cent of SO_3 being a common specification, a premium being paid or a penalty being imposed according as the percentage of SO_3 is above or below the specification. The market for gypsum for use in cement naturally is directly dependent on the status of the cement industry since definite proportions are required for each barrel of cement manufactured. At the present time the Canadian cement plants are employing Canadian gypsum for practically all their production. For this use the gypsum is required in the run-of-mine or crushed gypsum form.

The use of gypsum in recent years in Canada as a fertilizer has not been very extensive, but with the steadily increasing need for soil beneficiation the use of gypsum should increase. It has proved successful in the past for neutralizing black alkali and for such crops as alfalfa and clover it has been found to increase the yield materially. For such use the finely ground material is employed.

Relatively small amounts of the crude gypsum are also marketed for paint filler, paper filler, and metallurgical purposes, as well as for the manufacture of crayons, buttons, phonograph records, etc., but such uses are specialized and require the highest grade of white rock.

[1]A.S.T.M. Standard Specifications 1927, pt. II, pp. 75-76.

Calcined Gypsum

The marketing of calcined gypsum presents a more serious problem than the marketing of the crude material. Care has to be taken to produce an always uniform product which will fulfil all the requirements of the trade. The American Society for Testing Materials after careful study has adopted the following Standard Specifications for Calcined Gypsum.[1]

Testing. 1. The chemical and physical properties of calcined gypsum shall be determined in accordance with the Standard Methods of Testing Gypsum and Gypsum Products (Serial Designation: C26) of the American Society for Testing Materials.[2]

Definition. 2. Calcined gypsum is the product resulting from the partial dehydration of gypsum by means of heat.

Sizes. 3. Calcined gypsum may be marketed in either of the following sizes:—

No. 1. Material of this size shall all pass a No. 14 sieve, and not less than 75 per cent of it shall pass a No. 100 sieve.

No. 2. Material of this size shall all pass a No. 14 sieve, and not less than 40 nor more than 75 per cent of it shall pass a No. 100 sieve.

Note: A tolerance provision of 1 per cent on all sieve determinations is permitted. All sieve numbers refer to U.S. Standard Sieve Series.

Fineness. 4. Calcined gypsum may be marketed in any of the sizes enumerated for calcined gypsum in Section 3.

Time of Setting. 5. (a) The time of set of calcined gypsum shall be suitable for the purposes intended and shall conform to the provisions prescribed for such in the Standard Specifications for Gypsum Plasters (Serial Designation: C28) of the American Society for Testing Materials.

(b) Calcined gypsum for moulding or casting shall set in not less than 10 minutes nor more than 40 minutes.

Tensile Strength. 6. (a) Calcined gypsum shall have a tensile strength of not less than 200 lb. per sq. in. (14 kg. per sq. cm.).

(b) Calcined gypsum for moulding or casting shall have a tensile strength of not less than 200 lb. per sq. in. (14 kg. per sq. cm.).

Compressive Strength. 7. (a) Calcined gypsum shall have a compressive strength of not less than 1,000 lb. per sq. in. (70 kg. per sq. cm.).

(b) Calcined gypsum for moulding or casting shall have a compressive strength of not less than 1,000 lb. per sq. in. (70 kg. per sq. cm.).

A study of the tests made on Canadian gypsums shows that all the samples tested satisfy the requirements of the above specifications and that many of them have tensile and compressive strengths far in excess of that called for by the above standards.

The problem, therefore, of preparing products from Canadian material to fulfil these standards is merely a matter of careful manufacture and the disposal of the products becomes a straight advertising and selling proposition.

The rapid advances made in research problems on gypsum and gypsum products during the past decade, have brought to light many new uses for this mineral and it has become practically essential for all up-to-date companies to employ highly technical research engineers in order to keep their products of the highest grade and to develop new uses. With the increasing competition in the industry, the necessity of research work cannot be too strongly emphasized for any company that intends to progress.

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[1] A.S.T.M. Standard Specifications 1927, pt. II, pp. 75-76.

[2] The tests employed on Canadian gypsums are given in Chapter VIII.

The problem of marketing gypsum and gypsum products has also become a highly specialized phase of the industry. It is not alone sufficient for a salesman to be a good talker, but he must also be thoroughly conversant with the technical side of the manufacture of the products he is selling as well as their proper use. Quite frequently the salesman is confronted with problems of a technical nature arising out of the use of some of the material he has sold, and it is necessary that he be in a position to advise the purchaser as to the proper mode of procedure or make suggestions to remedy any apparent trouble that may arise. With the many new gypsum products that are constantly being discovered and placed on the market, it becomes necessary for the salesman to educate the public to their possibilities and advantages, and to do so he must be first trained himself in their manufacture as well as to their application in the several industries. It can thus be seen that the class of salesman required in this industry must be of the highest calibre and preferably with a technical training as well.

THE POSSIBILITIES OF THE INDUSTRY IN CANADA

The possibilities for the expansion of the gypsum industry in Canada are bright. The population of the country is steadily growing, with a consequent steady demand for additional housing accommodation. The increasing tendency in construction to make buildings as nearly fireproof as possible has greatly increased the demand for gypsum products on account of their fire-resisting qualities. New industries are rapidly being established throughout the whole country, and the construction of buildings required for such industries will call for additional production of gypsum products. Moreover, the Canadian climate is such that the proper insulation of structures from both heat and cold is receiving serious consideration. For this purpose special insulating plasters and other products prepared from gypsum have been developed and are finding a ready market, their use for such a purpose proving extremely satisfactory. In the field of sound-deadening products, the market for acoustic plasters prepared from gypsum, is being rapidly extended and should prove, in the years to come, one of the standard materials for construction for public halls, auditoriums, office buildings, or any place where noises are at present excessive.

The gypsum industry in Canada at present is on a sound financial basis, the companies producing products which are fully the equal of any on the continent, the plants are modern in every way and production is being maintained in a most efficient manner.

There seems to be no reason therefore why the next decade should not see an increase in the gypsum industry in Canada fully as great as that during the past 10 years.

The Building Industry

Since the manufactured products of the gypsum industry are essentially materials used in the building industry, the trend of the latter naturally has a distinct bearing on the welfare of the gypsum industry. The follow-

ing extract from the Annual Review of Building Permits issued by 63 cities in Canada in 1928[1] is of decided interest:—

According to data tabulated by the Dominion Bureau of Statistics, the value of building authorized by 63 cities during 1928 was considerably greater than in any other year since this record was commenced in 1920, aggregating $219,105,715, compared with $184,613,742 in 1927, $156,386,607 in 1926, and $125,029,367 in 1925. These totals are based on revised statistics furnished by civic officials, for whose co-operation acknowledgment is hereby made. The average index number of wholesale prices of building materials, compiled in the Bureau, stood at 149·3 in 1928, compared with 147·7 in 1927 when prices were lower than in any of the seven preceding years; the index number of wages in the building trades, prepared by the Labour Department, averaged 185·6, compared with 179·3 in 1927. The 1913 figures are the base, equal to 100, upon which both these indexes are computed.

The noteworthy increase in construction, as indicated by the authorizations of 63 co-operating cities, was also reflected in the Bureau's index number of employment in building, based upon returns from over 500 contractors employing an average payroll of 40,000 persons; this index, based upon the average employment in 1926 as 100, averaged 112·0, as compared with 108·7 in 1927. Last year's mean was the highest in the record, which goes back to 1920. Further, the activity in building during 1928 had a stimulating effect upon the industries related to construction, clay, glass and stone and structural iron and steel works, in which employment was at a considerably higher level than in previous years. According to the MacLean Building Review for January 1929, the value of the contracts awarded throughout Canada was $472,032,600 in 1928, compared with $418,951,000 in 1927, an increase of 12·6 p.c. An analysis of the value of contracts awarded according to the intended use of the buildings to be erected, shows that there was a slight falling-off in the proportion of business building in the aggregate, but an increase in factory or industrial building, while residential building and engineering projects remained in practically the same proportion as in 1927.

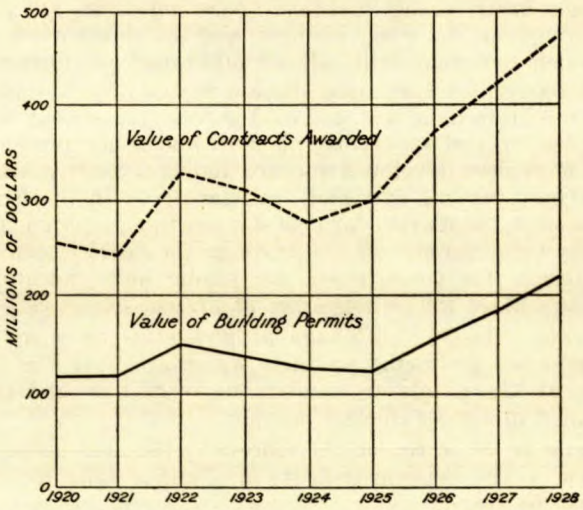

Figure 22. Value of building permits issued by 63 cities and of construction contracts awarded throughout Canada, by years, 1920-28.

Figure 22 shows graphically the value of building in Canada by years since 1920, while Figure 23 shows the value of the building authorized by 63 cities, by months, in the last 5 years.

[1]Annual Review Building Permits in Canada, 1928, Dominion Bureau of Statistics.

The pronounced and successive increases in the volume of building during the last few years is illustrated in this chart, which also shows that the value of construction during 1928 was higher than in any previous year since 1920.

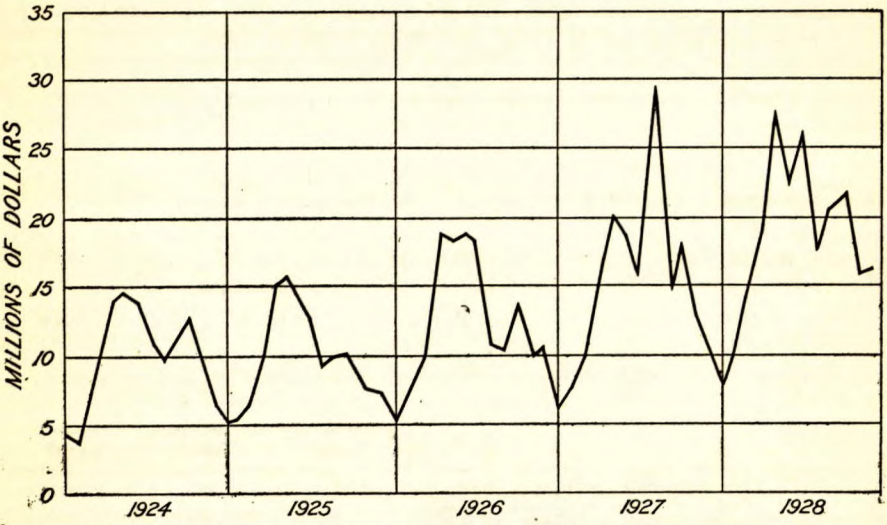

Figure 23. Total value of building permits issued by 63 cities, by months, 1924-28.

The following table gives the value of the building authorized by the 63 co-operating cities during the nine years for which data are available.

TABLE II

Value of Building Permits in Canada, 1920-28

Year	Value of building permits issued	Index Nos. of value of permits issued (1920=100)	Average Index Nos. of wholesale prices of building materials (1913=100)	Index Nos. of wages in the building trades (1913=100)
	$	Per cent	Per cent	Per cent
1920	117,019,622	100·0	214·9	180·9
1921	116,794,414	99·8	185·2	170·5
1922	148,215,407	126·7	162·2	162·5
1923	133,521,621	114·1	167·0	166·4
1924	126,583,148	108·2	159·1	169·1
1925	125,029,367	106·8	153·7	170·4
1926	156,386,607	133·6	149·2	172·1
1927	184,613,742	157·8	147·7	179·3
1928	219,105,715	187·2	149·3	185·6

According to these figures, building in 1928 was 87 per cent greater than in 1920, while the wholesale cost of building materials continued considerably lower. On the other hand, wages in nine building trades showed general advances in the 14 cities upon whose rates the indexes are based.

That building operations in Canadian cities during 1929 are continuing in undiminished volume is evidenced by the Dominion Bureau of Statistics' monthly returns, the value of building permits issued in the first five months of 1929 amounting to $95,551,123 as against $79,285,027 in the corresponding period of 1928, and $62,479,480 in 1927.

IMPORTS OF GYPSUM INTO CANADA

The imports of gypsum and gypsum products into Canada has slightly increased in the five-year period 1924-28, but the import of 43,071 tons valued at $268,103 in 1912 still remains the highest on record. The importation in 1928 of such a large proportion of the finished products with respect to the total import (*see* Table III, Chapter XI) is well worthy of serious study by the companies operating in Canada.

The rates of duty on gypsum and gypsum products entering Canada are as follows:—

Tariff Item	——	British Preferential Tariff	Intermediate Tariff	General Tariff
292	Gypsum, crude (sulphate of lime)	Free	Free	Free
293	Plaster of Paris, or gypsum, calcined, and prepared wall plaster, the weight of the package to be included in the weight for duty per 100 lb	8 cents	11 cents	12½ cents
294	Plaster of Paris, or gypsum ground, not calcined	10 per cent	12½ per cent	15 per cent

THE POSSIBILITIES OF THE EXPORT TRADE FOR CANADIAN GYPSUM

On account of the large deposits of gypsum of excellent grade in Canada which are easily accessible to transportation and cheaply quarried, the export markets for this material have always been of the greatest importance. The value of the crude rock as mined being low, it is obviously impossible to ship the material in this form any great distance. However, the location of the deposits in the Maritimes is such that water shipment is available to practically all of them, and consequently they have been able to place their product to great advantage in the Atlantic seaboard markets of the United States. Indeed, export shipments from the Maritime deposits of crude rock have assumed such proportions that in 1928 they formed over 63 per cent of the total gypsum tonnage mined. The extension of this market rests, however, with the requirements of the mills in the United States and any influence that would adversely affect this export trade of the crude rock would seriously affect the Canadian industry.

The export of calcined gypsum and gypsum products is an entirely different matter. Such products are of materially higher value and in consequence can afford to be transported greater distances. In consequence

the export market open for such products is vastly greater than that available to the crude material. A small but gradually increasing export trade in finished gypsum products has been carried on by Canadian firms for a number of years, but there should be opportunities for greatly extending this trade when conditions in other countries become better known and the value of the Canadian products is more widely recognized.

In order to obtain information as to conditions in other countries in which the Canadian products might possibly compete, a circular letter was sent to all the Canadian Trade Commissioners and the replies received are of interest. Thanks are here extended to the several Trade Commissioners for the painstaking, thorough, and wholehearted manner in which they responded to the request for information, and their replies were such that it was deemed advisable to include them as an Appendix to this report.

CHAPTER XI

STATISTICS OF GYPSUM PRODUCTION[1]

The gypsum industry is one of the oldest mineral industries in Canada, gypsum having been produced for over 150 years. The earliest workings were in Nova Scotia where gypsum is known to have been produced before the time of the American Revolution.

Since that time the industry has experienced many vicissitudes, but each year has seen production from some part of the country. Nova Scotia for a long time was the only producer, followed by New Brunswick in 1816. Then Ontario started in a small way in 1822, and Manitoba in 1901. British Columbia shipped small tonnages as early as 1911 but it was not until 1926 that the industry was firmly established in that province.

CANADIAN PRODUCTION

Up to the year 1913 the production of gypsum showed a general increase from year to year, reaching in that year a total of 636,370 tons valued at $1,447,739. During the next five years, that is the war years, there was a sharp decline, reaching the lowest in 1918 when the production was only 152,287 tons valued at $823,006.

For the past ten years, 1919-28, the production increase each year—with the exceptions of the years 1921 and 1923 when there were slight decreases—has been very rapid, so that in 1928 the production reached a record of 1,205,846 tons valued at $3,622,007, almost double the production of 1913.

WORLD PRODUCTION

Canada ranks high in the world production of gypsum, it being the third largest producer. United States is the largest, producing in 1927 over 43 per cent of the world production; France being second with about 22 per cent. Canada's production in the years 1925-26-27 was 6·1 per cent, 7·1 per cent, and 9·1 per cent respectively.

In the British Empire, Canada ranks first as a producer of gypsum, having produced 52·7 per cent in 1925, 56·0 per cent in 1926, and 58·1 per cent in 1927.

EXPORTS

The greater part of the Canadian production is being exported to the United States as crude rock but the export trade in gypsum plasters and gypsum products is gradually increasing. The percentage of the production exported for the last five years was: 1924, 74 per cent; 1925, 73 per cent; 1926, 77 per cent; 1927, 65 per cent; and 1928, 69 per cent. Of this export about 1 per cent is prepared plasters and gypsum products.

[1]The figures used to compile the tables in this chapter are taken from the official reports of the Dominion Bureau of Statistics, unless otherwise stated.

TABLE III

Summary of Statistics on Gypsum in Canada, 1924-28

—	1924					1925					1926					1927					1928 (a)				
	Tons	Per cent	Value	Per cent	Value per ton	Tons	Per cent	Value	Per cent	Value per ton	Tons	Per cent	Value	Per cent	Value per ton	Tons	Per cent	Value	Per cent	Value per ton	Tons	Per cent	Value	Per cent	Value per ton
			$		$			$		$			$		$			$		$			$		$
Crude gypsum mined	703,733	100·00				705,852	100·00				931,193	100·00				1,105,704	100·00				1,305,873	100·00			
Crude gypsum calcined	144,744	20·56				162,820	23·06				161,841	18·45				196,232	17·75				219,568	16·81			
Production by Grades—																									
Lump	139,618	21·61	253,191	11·47	1·81	131,612	17·79	198,806	8·32	1·51	151,906	17·19	225,749	8·15	1·49	225,264	21·19	371,488	11·43	1·65	24,589	2·04	52,215	1·44	2·12
Crushed	381,262	59·02	693,785	31·42	1·82	447,766	60·48	820,141	34·32	1·83	576,489	65·24	1,002,679	36·19	1·74	665,499	62·60	1,223,070	37·62	1·83	995,297	82·54	1,709,423	47·20	1·72
Fine ground	5,478	0·85	31,882	1·44	5·82	5,993	0·80	35,843	1·50	5·98	5,874	0·66	36,813	1·32	6·27	7,065	0·66	42,633	1·31	6·03	9,549	0·79	54,407	1·50	5·70
Calcined	119,658	18·52	1,229,250	55·67	10·27	154,952	20·93	1,335,101	55·86	8·62	149,459	16·91	1,505,572	54·34	10·07	165,289	15·55	1,613,824	49·64	9·76	176,411	14·63	1,805,962	49·86	10·24
Total	646,016	100·00	2,208,108	100·00	3·42	740,323	100·00	2,389,891	100·00	3·23	883,728	100·00	2,770,813	100·00	3·14	1,063,117	100·00	3,251,015	100·00	3·06	1,205,846	100·00	3,622,007	100·00	3·00
Production by Provinces—																									
Nova Scotia	441,752	68·38	915,845	41·48	2·07	551,230	74·46	1,070,408	44·79	1·94	678,107	76·73	1,187,918	42·87	1·75	829,438	78·02	1,512,015	46·51	1·82	971,736	80·59	1,764,262	48·71	1·82
New Brunswick	86,738	13·43	476,804	21·59	5·50	71,745	9·69	408,917	17·11	5·70	59,546	6·74	468,411	16·91	7·87	85,293	8·02	524,550	16·13	6·15	74,783	6·20	500,502	13·82	6·69
Ontario	88,121	13·64	467,097	21·15	5·30	82,020	11·08	491,833	20·58	6·00	89,987	10·18	496,059	17·90	5·51	83,998	7·90	500,688	15·40	5·96	85,811	7·12	553,271	15·28	6·45
Manitoba	29,375	4·54	348,212	15·77	11·85	35,088	4·74	417,868	17·48	11·91	35,172	3·98	461,461	16·60	13·12	39,895	3·75	512,008	15·75	12·83	51,285	4·25	609,039	16·81	11·88
British Columbia	30	0·01	150	0·01	5·00	240	0·03	865	0·04	3·61	20,916	2·37	156,964	5·66	7·50	24,493	2·31	201,754	6·21	8·24	22,231	1·84	194,933	5·38	8·77
Total	646,016	100·00	2,208,108	100·00	3·42	740,323	100·00	2,389,891	100·00	3·23	883,728	100·00	2,770,813	100·00	3·14	1,063,117	100·00	3,251,015	100·00	3·06	1,205,846	100·00	3,622,007	100·00	3·00
Impor s—																									
Crude	3,252	44·41	63,156	49·30	19·42	4,433	49·69	66,064	48·47	14·90	933	14·81	32,442	27·23	34·77	1,092	13·29	42,741	28·97	39·14	1,097	9·21	40,312	21·19	36·75
Ground	102	1·39	2,174	1·70	21·31	119	1·33	3,858	2·83	32·42	209	3·32	6,846	5·75	32·76	111	1·35	2,996	2·03	26·99	256	2·15	7,379	3·88	28·82
Plaster of Paris	3,969	54·20	62,770	49·00	15·82	4,369	48·98	66,386	48·70	15·19	5,156	81·87	79,853	67·02	15·49	7,016	85·36	101,823	69·00	14·51	10,563	88·64	142,550	74·93	13·50
Total	7,323	100·00	128,100	100·00	17·49	8,921	100·00	136,308	100·00	15·28	6,298	100·00	119,141	100·00	18·91	8,219	100·00	147,560	100·00	17·95	11,916	100·00	190,241	100·00	15·97
Exports—																									
Crude	472,236	96·81	747,829	89·91	1·58	533,646	98·95	861,468	90·80	1·61	668,064	98·52	1,069,123	88·58	1·60	684,178	99·05	1,101,595	90·69	1·61	824,536	99·01	1,240,987	89·80	1·51
Ground—calcined	5,226	3·19	83,927	10·09	16·06	5,643	1·05	87,242	9·20	15·46	10,062	1·48	137,785	11·42	13·69	6,556	0·95	113,049	9·31	17·24	8,232	0·99	140,946	10·20	17·12
Total	477,462	100·00	831,756	100·00	1·74	539,289	100·00	948,710	100·00	1·76	678,126	100·00	1,206,908	100·00	1·78	690,734	100·00	1,214,644	100·00	1·76	832,768	100·00	1,381,933	100·00	1·66

(a) Preliminary figures.

IMPORTS

Imports are small compared with the production in Canada, amounting in 1928 to 11,916 tons valued at $190,241. An interesting feature is the increase in the last few years of the imports of plaster of Paris, having increased from 48 per cent of the total in 1925 to 88 per cent in 1928.

CAPITAL INVESTED

The capital invested in the gypsum industry is given in Table IV for the years 1922-28 together with other miscellaneous data. From this table may be seen the great strides that have been made in the past few years.

The following tables, Nos. III, IV, and V, give in detail the general statistics of the industry for the past few years.

TABLE IV

Principal Statistics of the Gypsum Industry in Canada, 1922-28

Year	Number of firms	Capital employed	Number of employees	Salaries and wages	Cost of fuel and electricity	Miscellaneous expenses	Selling value of products
		$		$	$	$	$
1922	13	4,092,090	1,055	909,072	127,246*	436,765	2,160,898
1923	15	4,249,628	1,225	1,017,556	190,906	552,990	2,243,100
1924	14	4,423,697	1,219	1,114,468	181,003	458,268	2,208,108
1925	15	4,506,995	1,039	1,018,585	189,649	(a)	2,389,891
1926	18	6,696,077	1,368	1,255,427	241,414	(a)	2,770,813
1927	19	9,055,624	1,427	1,311,688	198,199	.....	3,251,015
1928	16	8,035,319	1,159	1,171,814	242,260	(a)	3,743,648

*Fuel only.
(a) Data not available.

TABLE V

***World Production of Gypsum, 1913 and 1923-27**

(Long tons)

Country	1913	1923	1924	1925	1926	1927
BRITISH EMPIRE						
United Kingdom	285,338	317,909	371,703	414,529	465,191	506,350
Canada	568,188	516,340	576,800	661,003	789,043	949,211
Union of South Africa	108	5,731	9,073	7,123	11,029	15,187
Cyprus (exports)	3,714	11,029	14,296	24,193	20,410	15,150
India	24,961	39,297	38,123	36,244	34,473	38,105
Australia	8,826	68,236	85,861	90,150	80,565	122,842
Total	891,135	958,542	1,095,856	1,233,242	1,400,711	1,646,845
FOREIGN COUNTRIES						
Austria	.....	35,561	32,262	24,067	21,739	24,814
Esthonia	(a)	(a)	(a)	3,821	4,751	11,979
France	1,698,633	2,319,414	2,289,443	2,293,000	(a)	(a)
Germany	.....	29,579	42,635	57,352	44,956	(a)
Greece	2,194	2,434	21,850	9,898	9,158	(a)
Italy	.....	547,364	590,298	662,707	645,012	(a)
Jugoslavia	.....	.....	.....	.....	610	1,046
Luxemburg	.....	.....	.....	24,556	33,447	7,724
Rumania	.....	37,810	20,454	52,994	43,616	76,496
Russia	(a)	(a)	(a)	166,353	286,993	278,532
Spain (exports)	6,938	2,444	4,568	2,958	3,165	(a)
Algeria	.....	48,633	53,600	71,700	64,600	(a)
United States	2,320,989	4,244,150	4,502,347	5,066,964	5,031,644	4,774,007
Argentina (exports)	171	2,106	2,179	1,833	(a)	(a)
Chile	6,038	8,147	5,600	8,310	16,065	(a)
Peru	(a)	(a)	(a)	14,413	.....	.....
China (exports)	4,970	7,159	5,042	6,984	3,721	2,431
Japan	(a)	33,724	42,400	152,736	(a)	(a)
Total	4,039,933	7,318,525	7,612,678	8,620,646	6,209,477	5,177,629
Grand total	4,931,068	8,277,067	8,708,534	9,853,888	7,610,188	6,823,874

*Source—Prior to 1925 Imperial Institute publications: Data for 1925 and 1926 obtained directly from the statistical bureau of the different countries.

(a) Data not available.

APPENDIX

THE POSSIBILITIES OF EXPORT TRADE FOR CANADIAN GYPSUM

The following letters[1] received from Canadian Trade Commissioners throughout the world give an excellent review of the possibilities of an export market for Canadian gypsum.

In case it is desired to communicate with any of the Canadian Trade Commissioners with reference to any of their reports which follow, a list of these is here given with their addresses:—

Argentina

E. L. McColl, B. Mitre 430, Buenos Aires. Cable Address, Canadian. Territory includes Chile and Uruguay.

Australia

D. H. Ross, Address for letters, Box 196C, G.P.O., Melbourne. Office, Safe Deposit Building, Melbourne. Cable Address, Canadian. Commercial Agent: B. Mullin, The Royal Exchange Building, Sydney, N.S.W.

Belgium

Jean J. Guay, 98 Boulevard Adolphe Max, Brussels. Cable Address, Canadian. (Territory includes Rumania, Bulgaria, Hungary.)

Brazil

A. S. Bleakney, Address for letters, Caixa Postal 2164 Rio de Janeiro. Office, Avenida Rio Branco, 9. Cable Address, Canadian.

British West Indies

Trinidad: R. T. Young. Address for letters, P.O. Box 125, Port of Spain. Office, Colonial Bank Building. (Territory includes Barbados, Windward and Leeward Islands, British Guiana.) Cable Address, Canadian.

Jamaica: F. W. Fraser, P.O. Box 225, Kingston. Office, Jamaica Mutual Life Insurance Building. (Territory covers Jamaica, Haiti, Bermuda, the Bahamas and British Honduras.) Cable Address, Canadian.

Mexico

C. Noel Wilde. Address for letters, Apartado Num, 126-bis, Mexico City. Office, Edificio Banco de Londres y Mexico, Num. 30. (Territory includes Central American Republics.) Cable Address, Cancoma.

Netherlands East Indies

G. R. Heasman, P.O. Box 84, Batavia, Java. (Territory includes Straits Settlements, Federated Malay States, and Siam.) Cable Address, Canadian.

New Zealand

C. M. Croft, Address for letters, P.O. Box 33, Auckland. Office, Yorkshire House, Shortland street, Auckland. Cable Address, Canadian.

[1]Customs duties quoted in these reports are those prevailing at the time the reports were prepared.

Norway

F. H. Palmer, care of British Legation, Oslo. Territory includes Scandinavian countries and Finland. Cable Address, Canadian.

Panama

J. A. Strong, P.O. Box No. 222, Panama City. (Territory includes Venezuela and Colombia.) Cable Address, Canadian.

Peru

G. R. Stevens, Lima. Casilla 1212. Office, Calle Coca 478. (Territory includes Bolivia and Ecuador.) Cable Address, Canadian.

South Africa

C. S. Bissett, P.O. Box 683, Office, Westminster House, Adderly street, Cape Town. Cable Address, Cantracom.

United Kingdom

London: Harrison Watson, Canadian Building, Trafalgar Square, S.W.1, England. Cable Address, Sleighing, London.
Liverpool: Harry A. Scott, Trade Commissioner, Century Bldgs., 31 North John street. Cable Address, Canadian.
Bristol: Douglas S. Cole, Sun Building, Clare Street. Cable Address, Canadian.
Glasgow: Gordon B. Johnson, 200 St. Vincent Street, Scotland. Cable Address, Cantracom.

United States

New York City: Frederic Hudd, 44 Whitehall Street. Cable Address, Cantracom.
Chicago: R. S. O'Meara, Willoughby Tower, 88 Michigan Avenue. Cable Address, Canadian.
San Francisco: H. R. Poussette, Suite 405, Alaska Commercial Building, 310 Sansome St. (Territory covers the Pacific seaboard and Rocky Mountain states.)

China

L. M. Cosgrave. Address for letters—P.O. Box 300. Office—North China Daily News Building, 17 The Bund, Shanghai. Cable Address, Canadian.

Cuba

James Cormack. Address for letters—Apartado 1945. Office Address, Call Obrapia 35, Havana, Cuba. (Territory includes Venezuela, Colombia, San Domingo and Porto Rico.) Cable Address, Canadian.

France

Hercule Barré, 3 rue Scribe, Paris (9). Cable Address, Cancomac. (Territory includes French Colonies in North Africa, Egypt, Palestine, Syria.)

Greece

Henri Turcot, 8 Metropole Street, Athens. (Territory includes Turkey.) Cable Address, Canadian.

Germany

L. D. Wilgress, Gutrufhaus, Neuerwall 10, Hamburg 36. Cable Address, Canadian (Territory covers Germany—except the Rhine Valley, Czechoslovakia, Austria, Poland, Esthonia, Latvia, Lithuania, and Soviet Russia.)

Holland

J. C. Macgillivray, Beursplain 26B, Rotterdam. (Territory includes the Rhine valley and Switzerland.) Cable Address, Canadian.

Hong Kong

Paul Sykes, Exchange Building, Hong Kong. Territory includes South China, the Philippines, and Indo-China. Cable Address, Canadian.

India and Ceylon

Richard Grew, Acting Trade Commissioner, P.O. Box 2003. Office, 8 Esplanade Mansions, Government Place East, Calcutta. Cable Address, Canadian.

Irish Free State

J. H. English, 66 Upper O'Connell street, Dublin. Cable Address, Canadian.

Italy

A. B. Muddiman, via Manzoni Nr. 5—Milan (102). Cable Address, Canadian. (Territory includes Spain, Portugal and Greece, Gibraltar, Canary Islands, Malta, Italian Colony in Africa, Albania, Jugoslavia, Turkey, and Cyprus.)

Japan

Tokyo: J. A. Langley, Commercial Secretary. Address for letters, P.O. Box F. 101, Tokyo Central. Office, Imperial Life Assurance Building, Marunouchi, Tokyo. Cables, Canadian.

Kobe: Acting Trade Commissioner. Address for letters, P.O. Box 230. Office, Chamber of Commerce Bldg., Kobe. Cables, Canadian.

UNITED KINGDOM

Harrison Watson

Chief Canadian Government Trade Commissioner in the United Kingdom

(February 1929)

For many years past this office has periodically investigated the possibilities, and I regret to report that the results have been uniformly discouraging.

The chief reason is that within the United Kingdom itself there are located large and extensive deposits of gypsum of high quality which have been worked for years, and up to the present at least supply practically the whole of the requirements of this country at a lower price than is procurable upon imported gypsum.

It is true that a certain quantity of gypsum is imported from France. However, the average total does not exceed 40,000 tons (including alabaster), whereas the United Kingdom production of gypsum in the calendar year 1927 was 506,350 tons. It seems necessary to emphasize the fact that the bulk of this imported gypsum is in a calcined condition, because if profitable competition from Canada became possible, it would appear essential for the Canadian gypsum to reach this country in a calcined condition. As is mentioned later on, most of the raw gypsum produced in the United Kingdom is calcined at the mines prior to shipment and reaches the building trade in the shape of plaster.

One reason for the import trade referred to is the proximity of the French deposits to this country, which means that in certain cases the cost of transportation from France to the United Kingdom would not greatly exceed the freight from the mines in the Midlands to distant points. Also, apart from the fact that it is inevitable that a certain amount of gypsum will come in from abroad, it is claimed that the quality of the French gypsum is preferred for certain purposes.

In any case, French gypsum is immune from the necessarily heavy cost of transportation over a distance of nearly 3,000 miles which is associated with the export of Canadian gypsum to Great Britain.

Indeed, it is the cost of transportation which has been the outstanding obstacle in various investigations which we have conducted from time to time. Prices both of gypsum and of transportation have fluctuated, but any rates of freight securable

have always made the laid-down cost so high that profitable competition was out of the question. It is possible that a lower freight than is procurable from existing steamship services could be obtained by chartering. However, with such abundant supplies of gypsum readily available in the United Kingdom, there has been little or no incentive to experiment, and we are unaware that any Canadian or United Kingdom firm has taken up the matter.

As regards the price of gypsum, values vary somewhat according to quality. Upon making fresh inquiries, we learn from an authoritative source that to-day's price for Nottingham and Derby gypsum of high quality ranges between 15s. and 20s. per ton of 2,240 pounds loaded on rail at the mines. Upon the other hand, gypsum is usually shipped to London and other points in the form of plaster and ready for the building trade. In this connexion calcining plants are located at central points close to the mines in the Midlands, and also elsewhere, which are controlled by the Gypsum Association, a body of which most of the leading gypsum producers are members.

According to the editor of a representative trade paper *The Builders' Merchants Journal*, whom we consulted, prices for this plaster range from rather below £3 per ton for coarse plaster to about £5 10s. to £5 15s. for fine white plaster and Parian cement—delivered on the job in London. Sacks are an extra charge, costing 1s. 6d. each, which is reimbursed, however, when the sacks are returned.

Again reverting to your questionnaire, there is at the present time no customs duty on gypsum and plaster, etc., when imported into the United Kingdom.

While you will be aware of the various uses made of gypsum in Canada, you will appreciate the probability of some variation and diversity as far as the United Kingdom, and probably other countries, are concerned. For one thing, we have never heard of gypsum being used in this country as a fertilizer in the shape of land plaster or some other form. A reason for this is the large number of other fertilizers—guano, basic slag, superphosphates, etc.—which are readily and cheaply available in this country, and which are apparently preferred, from their qualities to gypsum. While on this subject it seems interesting to reproduce a memorandum which the editor of the *Builders' Merchants Journal* also kindly supplied upon the uses of gypsum in the United Kingdom.

> Gypsum is used both in its native state and in a hydrated condition (as plaster and the various plaster cements) for a considerable number of purposes, the principal being in the building, brewing, and modelling trades. In the brewery trade it is used in the form of a brewer's gypsum, very largely in the manufacture of beer, and is the principal ingredient which gives the sparkle to Bass ale and Guiness. In the building trade gypsum is used in the natural crystalline form under the name of White Spar for rough cast purposes, and in the "boiled" (really of course, burnt) form, as plaster of Paris, Keene's cement, Parian cement, Sirapite, Victorite, and other patent plasters. Ordinary plaster is obtained by heating the quarried gypsum to a high temperature, which drives off the water of chemical combination, and leaves the material in a partially dehydrated condition. Keene's cement consists of plaster combined with alum—Parian cement, of plaster combined with borax. Plaster and Keene's are sold for building trade purposes usually in the form of coarse pink plaster, or coarse pink Keene's, and coarse white plaster, or coarse white Keene's. Better qualities such as fine plaster or Keene's are not often used in ordinary building work. Parian is extremely fine and a very hard white cement, mainly used for the manufacture of imitation marble pillars, panels, etc.
>
> Of late years considerable quantities of plaster slabs for partition purposes have come on the market, and this field is being extended. Considerable quantities of plaster boards (such as "Gyproc" board, "Empire" board, and others) are also now being imported from Canada, the United States, and the Continent.
>
> Plaster modelling is mainly in the hands of Italians who specialize in small statuary, cornices, ceiling centre-pieces, and other ornamental structural work.

In reference to the above extract, our past enquiries have mainly related to gypsum itself.

It seemed possible that the situation might be a little more favourable regarding some of the gypsum manufactures, in addition to wallboard, which Canada is now supplying to this country under the designation "Gyproc". The remarks made by

our informant are, however, not encouraging. A reason for this is the considerable extent to which articles of which gypsum is an ingredient are already manufactured in the United Kingdom, and the strong position of the manufacturers in question. As an example, a certain and comparatively small quantity of gypsum is used in the production of cement. This industry is mainly in the hands of a strong amalgamation: The Associated Portland Cement Manufacturers, Ltd. Similarly, the other commodities which you mentioned are made in this country, and by concerns which are in a position to take full advantage of any increased consumption which develops. The only variety which appears to be unknown is gypsum blocks and tiles, and it may be that there is some reason why these have not been adopted.

In support of this position, it should be said that the efforts of Belgian and other cheap producers of plaster and similar materials to capture the United Kingdom market have so far been wholly unsuccessful. In this connexion stress should be laid on the point that there is a very intimate and close relationship which exists between the building trade of the United Kingdom and the manufacturers of building materials. This co-operation would obviously be disadvantageous to any attempt to introduce from outside (even from a part of the British Empire) an article which is already being produced extensively in the United Kingdom and giving permanent employment to a large body of labour, as in the case of gypsum.

The only form of gypsum which Canada seems to be in a position to supply to this country advantageously at the moment is as a constituent of wallboard. As a matter of fact we have had several enquiries as to whether any company, in addition to Gypsum, Lime and Alabastine, Canada, Ltd., is manufacturing a gypsum wallboard. We are informed that the demand for this kind of wallboard is increasing, in which connexion our enquirers would like to secure the representation of other Canadian manufacturers who are in a position to export. Upon the other hand, the number of wallboards generally is always increasing, and competition here is very keen.

SCOTLAND

C. B. Johnson

Canadian Government Trade Commissioner for Scotland and Northern Ireland

(May 1929)

It will be seen from the attached tables of production and imports that the consumption of gypsum in Great Britain amounts to about 500,000 to 550,000 tons a year and that France is the only important external source of supply. The exports are quite small.

It is understood that the bulk of the material is calcined and that the calcined material is ground for making plaster of Paris and various hardwall plasters. Some is used in the manufacture of Portland cement, in the paint trade, and as a filler for paper and cotton. There is no import duty on gypsum in Great Britain. The price varies with the distance from the mine or port; the attached tables show the value of the raw material at the mine and of the imported material at the port of importation.

The production in Great Britain is obtained mainly from the counties of Cumberland, Westmorland, Durham, Derby, Stafford, Nottingham, and Leicester, and it would appear that a low freight rate would be necessary to enable Canadian material to compete in this country.

It is understood that only a small local trade in land plaster exists in Great Britain; that gypsum wallboards are used to a small extent but that the visability of the joints might prevent them from becoming generally popular; that gypsum blocks and tiles are made and used in this country to a substantial extent; but that there is no extensive trade at present in insulating and acoustic plasters.

Production of Gypsum in Great Britain

	Quantity of mineral raised or quarried in			Average net selling value per ton of mineral at mine or quarry		
	1927	1926	1925	1927	1926	1925
	Tons	Tons	Tons	£ s. d.	£ s. d.	£ s. d.
Gypsum						
Raw stone, dressed roughly	304,386	465,102	414,302	0 11 4	0 11 3	0 10 5
Ground or broken stone	201,853			0 13 10		

Imports and Exports of Gypsum

Gypsum unburnt, including alabaster

	1927		1926		1925	
	Tons	£	Tons	£	Tons	£
Imported from:						
France	45,141	38,779	33,751	29,205	31,169	26,971
Other countries	2,611	2,302	983	1,079	104	248
	47,752	41,081	34,734	30,284	31,273	27,219

Gypsum burnt, including plaster of Paris

	1927		1926		1925	
	Tons	£	Tons	£	Tons	£
Imported from:						
Germany	1,141	3,002	690	2,052	592	1,561
Belgium	1,150	2,526	358	811	111	309
Other countries	513	1,532	274	886	541	2,392
	2,804	7,060	1,322	3,749	1,244	4,262

IRISH FREE STATE

John English

Canadian Government Trade Commissioner for Irish Free State
(February 1929)

I find on investigation that the prospects of importing gypsum and gypsum products direct into the Free State from Canada are not particularly encouraging.

The official statistics, as issued by the Free State Government, do not give in detail the imports, but include under the one heading of burnt gypsum, including plaster of Paris, all the importations. In 1927 these totalled 91,710 cwt., valued at £13,451, and in 1926, 93,523 cwt., having a value of £13,401. Of this total approximately 75,000 cwt., having a value of £11,500, was purchased from Great Britain.

A short time ago my predecessor here, Mr. Fraser, made a thorough investigation of the market along these lines on behalf of the Ontario Gypsum Company, and as a result he was able to secure an agent for the gypsum wallboard manufactured by this company, and while there promises to be a fair trade in this particular line, it is doubtful whether the sales will be at all large.

It must be remembered that the Irish Free State market is exceedingly limited and that, as a result, firms here are very hesitant about taking on a line which is likely to drag. Very few are willing to actually stock supplies in any large quantities, so that the problem of buying direct from Canada is made even more difficult. The proximity of Great Britain has always had, and continues to have, this effect on practically all merchants handling those lines which do not pass quickly into consumption. As in the past they continue to purchase small lots as required, from week to week, from across the Channel, and this relieves them of placing orders far ahead, or of difficult financing. Coupled with this, of course, is the question of transportation. Even now, with the augmented freight services of the Head Line with regular fortnightly sailings from Canada to Ireland, firms hesitate to buy direct in most cases, because of the time factor. Custom plays an unusual part also, so that most firms prefer to continue to purchase small lots through English houses, even if it means slightly higher prices.

Under the circumstances, I doubt very much whether it would be possible to do any direct trade. I do believe, however, that if the Canadian manufacturers in question obtain suitable representation in England, the Irish Free State could be satisfactorily covered from there. Under such conditions, I believe, Canadian goods could be sold.

A little later, when companies are in a position to quote on specific commodities, such as fertilizer, etc., I shall be glad to receive c.i.f. prices. It may be that I can then interest some of the local importers and dealers.

There is no customs duty on gypsum or gypsum products.

I am very pleased to enclose herewith a statement kindly furnished by the Irish Free State Statistics Branch, showing, in so far as it has been possible for them to extract details from the declarations furnished by importers, the quantity and value of burnt gypsum, including plaster of Paris, and the different descriptions of plaster and plaster products imported into the Irish Free State from each country during the year 1928.

It was pointed out to me by the Statistics Branch that these descriptions are not separately required in so great detail in the Official Irish Import List, and the descriptions given are those declared by the importers, and may not in every case have been equally precise.

Imports of Gypsum, Burnt (including Plaster of Paris), and of the Different Descriptions of Plaster and of Plaster Manufactures into the Free State, Registered during the year 1928.

Description	Total		Great Britain		Northern Ireland		France		Belgium		Germany		Holland		United States	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Cwt.	£	Cwt.	£	Cwt	£	Cwt.	£	Cwt.	£	Cwt.	£	Cwt.	£	Cwt.	£
Gypsum, burnt (including plaster of Paris)	108,043	15,843	91,547	14,062	20	6	9,760	1,092	1,504	167	5,212	516	.....	.....	.....	.....
Plaster	2,762	725	2,440	623	303	96	.....	.....	19	6	.....	.....	.....	.....	.....	.....
Fibre plaster	302	169	.....	.....	302	169	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wall plaster	920	145	720	132	.....	.....	200	13	.....	.....	.....	.....	.....	.....	.....	.....
Plaster boards	4,404	1,662	3,036	1,222	117	63	1,093	285	.....	.....	.....	.....	.....	.....	158	92
Slabs	9,942	2,218	.....	.....	12	3	1,000	213	8,930	2,002	.....	.....	.....	.....	.....	.....
Casts and models	154	516	149	510	5	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Figures	14	44	10	38	.....	.....	.....	.....	.....	.....	.....	.....	4	6	.....	.....
Mouldings	12	16	12	16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Finish	10	3	.....	.....	10	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sheets	286	124	.....	.....	286	124	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Laths	27	10	.....	.....	27	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Plates	519	268	.....	.....	.....	.....	.....	.....	.....	.....	519	268	.....	.....	.....	.....
Panelling, cornice, and flowers.	34	116	30	80	.....	.....	.....	.....	4	36	.....	.....	.....	.....	.....	.....
Total	127,429	21,859	97,944	16,683	1,082	480	12,053	1,603	10,457	2,211	5,731	784	4	6	158	92

JAMAICA

F. L. Casserly

Acting Canadian Trade Commissioner for Jamaica
(February 1929)

Excepting Bermuda, where it seems to me there should be a small demand for hardwall and possibly for some other kinds of plasters, the only item for which a market exists in the territories covered by this office is gypsum wallboard; and, to date, sales of that commodity have been limited. I think we can rule out the Bahamas, Haiti, and British Honduras as possible markets for any of the commodities, save possibly for very small quantities of plaster of Paris.

One of the largest hardware firms in Jamaica imported some time ago 3,200 feet of gypsum wallboard from the Ontario Gypsum Company of Paris, Ont. This wallboard cost 3d. per square foot, and was retailed at 4d. per square foot. Since No. 1 quality pitch pine retails at 3d. per square foot, the gypsum product is somewhat at a disadvantage in this, an essentially cheap market. The wallboard was used for ceilings and partitions, and I understand that good results have been obtained, but as you will readily realize, so long as its price remains higher than that of lumber, sales are apt to be very restricted. It seems to me there is a fair potential market provided gypsum wallboard could be retailed at about the same price as pitch pine or Douglas fir lumber. The duty on gypsum wallboard would be 15 per cent ad valorem; that on American and foreign wallboard would be 20 per cent; you will appreciate therefore that business is at present very small.

As regards plaster of Paris, I find that insignificant quantities are imported from time to time by hardware stores and also by one or two individuals specializing in dental supplies.

There is absolutely no market here for the other commodities mentioned in your letter under acknowledgment. A cheap lime plaster of local preparation is in almost universal use in Jamaica, and makes quite a good finish if properly mixed and laid on. All the ingredients are obtained in the island, hence on account of its low cost this form of plaster defies the competition of any imported article such as gypsum.

With the exception of Bermuda, conditions in the other parts of my territory are practically the same as described above, save for the fact that so far as I have been able to ascertain, no gypsum whatever is imported.

As regards Bermuda, nearly every building is constructed of coral block, a porous limestone found in the country, which makes efficient building material when protected from the weather by any non-porous material or plaster. Locally prepared lime-wash is often used, but I understand that gypsum washes and plasters are also imported.

SOUTH AFRICA

J. L. Mutter

Assistant Trade Commissioner

Cape Town, S.A., 24th July, 1929: Gypsum deposits are very widely distributed throughout the Union of South Africa, but only three—one in Natal and two in the Cape Province, have been opened up commercially. The greater proportion of the output of these quarries is at present used in the manufacture of cement by three Union manufacturers of this material. In addition, gypsum is also supplied from these sources for land-fertilization purposes, but in what quantities it is impossible to say, as there are no available statistics on the subject. Plaster of Paris, hardwall plasters, and one brand of wallboard are the only refined or manufactured forms of gypsum produced in this country, and these only in limited quantities.

In the case of plaster of Paris, it is stated that the local product is not of a very high quality—a statement borne out by the upward trend of imports of this commod-

ity into the Union during the past four years. Even the quantities imported, however, are small as the appended table, giving quantities, value, and origin, will show:—

—	1927			1928		
	Quantity	Value	Per cent of value	Quantity	Value	Per cent of value
	lb.	£		lb.	£	
United Kingdom	389,200	2,152	58	407,025	2,248	49
Canada	65,220	232	6	71,478	320	7
France	300	2	.....	41,415	61	.....
Germany	742,723	1,221	32	1,206,670	1,823	40
Holland	2,240	8	.....	3,360	9	.....
Italy	4,166	18	.....	1,120	8	.....
Sweden	100	.....	.....	.....	.....	.....
United States	3,028	82	.....	3,358	69	.....
Total	1,206,987	3,715	.....	1,734,426	4,538	.....

No statistics as to the small domestic production of hardwall plasters are available. Such plasters are so far used in small quantities, and the same holds true of imported plasters. The following table specifies the origin, quantity, and value of hardwall plasters (including, and chiefly comprising that known as Keene's cement) imported into the Union during the period 1927-1928.

—	1927			1928		
	Quantity	Value	Per cent of value	Quantity	Value	Per cent of value
	lb.	£		lb.	£	
United Kingdom	109,556	1,637	55	109,943	1,987	45
Canada	399	19	0·64	4,221	149	6
Austria	.....	.....	.....	107	1	.....
Denmark	1,848	18	.....	112	20	.....
Germany	15,662	126	4	19,131	111	4·6
Holland	10	1	.....	.....	.....	.....
Switzerland	.....	.....	.....	54	7	.....
United States	43,887	1,164	39	72,732	1,020	42
Total	171,362	2,965	.....	206,300	2,395	.....

MANUFACTURED FORMS OF GYPSUM

Gypsum Wallboard: As stated above, such board is manufactured by one South African plant, and is distributed by a Johannesburg firm, under the name of Rhino Board. In this case the plaster of Paris used is German in origin, and the finished product competes with such imported articles as Asbestos cement sheets, "Beaverboard," "Ten Test" and "Gyproc."

Gypsum Blocks and Tiles and Insulating and Acoustic Plasters: These products, so far, are not known in this territory, while the quantities of stucco for outside purposes are practically negligible.

Possibilities for Canadian Products: In so far as crude gypsum is concerned, there is no market for the imported article, even though of very pure quality, because of the large quantities available locally. Attempts made to tender for Canadian gypsum for the South African cement industries have been entirely unsuccessful. The fact is, that even more of the local deposits would be worked, not merely to supply the South African demand, which is small, but for export, if the prices to be realized were

high enough to make it an economically sound proposition. For the same reason there are no openings for Canadian supplies for crude gypsum for use as land plaster. In fact, users of land fertilizers buy agricultural lime, which is produced in large quantities for this purpose, maintaining that it is superior to gypsum land plaster, in that it is more easily assimilated by plants.

As the import statistics for 1927 and 1928 show, Canadian producers have a small share of the business in plaster of Paris. Distributors here state that its high price, as compared to European plasters prevents it from holding a greater share of the trade. Modellers, and others fabricating plaster products, would prefer to take Canadian plaster, but very good German plaster is delivered in South Africa at £3 to £4 per ton as against £6 a ton asked for the Canadian article.

The situation with reference to gypsum wallboard is complicated by the fact that the railway rate on this commodity continues to be the same as that applied to the thick slabs of gypsum such as are used in building construction for insulation purposes. It is reasonable to suppose that gypsum wallboard should be placed in the same freight classification as asbestos sheets, the material which it most closely resembles, and with which it must compete. This latter rate is approximately 94 per cent lower than the rate applying to the classification in which gypsum wallboard is included. Under these circumstances it must be evident that, for the present at least, pending a possible re-adjustment in freight classifications, Canadian wallboard in competing with the domestic article at inland points where a rail haul is involved is placed under a tremendous handicap. At present the sale of wallboard is confined to the coastal area.

As stated above, gypsum blocks and tiles are not known here, and dealers are of the opinion that freight and customs duties would prohibit the possibility of importing them. Gypsum blocks and tiles are not specifically mentioned in the South African Customs, but as "titles other than asbestos cement," they would be dutiable at 20 per cent ad valorem.

Attempts have been made to sell a Canadian brand of insulating plaster in this market, but as the equable climate of the country makes special insulation unnecessary, the scope for the product has been found so limited that dealers have considered it does not justify any outlay on selling propaganda.

Neither acoustic plasters nor gypsum stucco for outside purposes are known in South Africa. In the case of the former, there may be a possibility that a market could be worked up for this product for high-class buildings—but only a limited market; as far as the latter is concerned, price would be the determining factor, if this were to compete with the cement now used for this purpose. From the architectural point of view, stucco would combine well with the exteriors of buildings, in the prevalent Dutch style. The majority of these are whitewashed over stone, brick, and cement-coated walls.

NEW ZEALAND

C. M. Croft

Canadian Trade Commissioner for New Zealand
(March 1929)

New Zealand imports her requirements of gypsum and a number of gypsum products. The imports of gypsum in 1927 amounted to 160,425 cwt. (112 pound) valued at £10,181. Australia supplied the majority of this quantity, 153,180 cwt. valued at £9,595, having come from that country. The only other sources of supply were the United Kingdom, 145 cwt. (£61) and Austria 7,100 cwt. (£525). The imports of plaster of Paris in 1927 amounted to 156,357 cwt. valued at £36,659. United States was the largest supplier with 73,789 cwt. (£15,480), followed closely by Canada with 62,258 cwt. (£13,477). Other sources of supply were Australia 19,337 cwt. (£3,368); United Kingdom, 11,485 cwt. (£4,219); Germany, 402 cwt. (£17); and France 113 cwt. (£44). During 1927 there were 10,781,374 superficial feet of plaster pulp sheets imported, the value being £58,616. United States was the largest supplier, being credited with 7,822,626 feet (£4,138). Imports from Canada accounted for 2,946,704 super. feet valued at £15,382. United Kingdom supplied 11,979 super. feet (£76) and Australia, the only other supplier, 65 super. feet (£20).

It is gratifying to observe that Canada has secured a fair proportion of the import trade in plaster of Paris and plaster boards and in the latter-mentioned commodity with a tariff preference of 20 per cent it is hoped that a still larger share of the import trade will be secured by Canadian manufacturers. Gypsum and plaster of Paris enter New Zealand free of customs duty regardless of the country of origin. Plaster pulp sheets are dutiable at 20 per cent under the British preferential tariff and 40 per cent under the general tariff. A primage duty of 2 per cent is payable on all goods imported.

CLASSES IMPORTED

Gypsum is imported from Australia and these shipments are used largely by cement manufacturers. It is considered that the proximity of Australia and consequent relatively short freight haul precludes the possibility of Canada's competing. The prices of Australian gypsum are £2.10.0. to £2.11.6. per ton of 2,240 pounds, c.i.f. cement works. This price is for gypsum in bags, the bags being included. The analysis of the gypsum being used is as follows:—

	Per cent
Moisture and ignition loss (by difference)	20·23
Silica	0·24
Iron oxide and alumina	2·42
Sulphuric anhydride[1]	45·03
Lime	32·08
Magnesia	trace
	100·00

[1] The sulphuric anhydride content represents a 96.81 per cent gypsum.

Under the heading of plaster of Paris are included the high grades used for dental purposes and plaster casts as well as that used for the manufacture of wallboard and plaster sheets. Canada has been able to secure a fair proportion of this trade, and, speaking generally, Canadian plaster has been entirely satisfactory and, in fact, one particular brand is considered as almost the standard of quality on this market. The plaster of Paris for commercial purposes is usually sold in wooden barrels containing 300 pounds or in jute-covered paper bags containing 100 pounds.

The wholesale prices of plaster in New Zealand run in the vicinity of £5.18.6 per ton of 2,240 pounds for bags and £1 per barrel.

The commercial uses of plaster in New Zealand are chiefly for the manufacture of plaster sheets, plaster wallboard, and fibre plaster wallboard. This fibre plaster wallboard is made of plaster of Paris with a fibre worked in with it, making a strong sheet with a good surface used for ceilings and walls. Lath and plaster is used to only a very limited extent in New Zealand, the walls and ceilings of private dwellings being constructed with wallboard or plaster fibre board. One importer stated that his firm handle only about one bag of hardwall plaster to one hundred of ordinary plaster of Paris.

Wallboards of various descriptions are used very extensively, plaster wallboard being in greatest demand. A considerable import trade exists, as is seen from the statistics covering "plaster pulp sheets" given above. Plaster wallboard is now being made locally, the local industry having an annual capacity of 4,000,000 feet. It is understood that the New Zealand company are progressing favourably. The wallboards in greatest demand are ¼ inch and ⅜ inch and the prices paid by the builders for these thicknesses are 21s. 6d. and 22s. 6d. per 100 super. feet.

Insulating plaster has been offered on this market but there is practically no demand. Until very recently, monolithic reinforced concrete was mostly used in the larger buildings, but now steel frame construction is being adopted more extensively. The curtain walls in the steel structure buildings are usually of hollow tiles. The absence of extremes of heat and cold eliminates the necessity for the use of insulating materials. It is possible that the use of insulating plaster will develop in time, but at present it is felt that efforts to make extensive sales will meet with little response.

Special acoustic plasters of United States manufacture have been offered on this market, but the demand is strictly limited. One of the leading merchants stated that

he is prepared to offer quotations but the demand is so small that none is kept in stock. Canadian manufacturers of this plaster should furnish their New Zealand representatives with prices so that what little demand which exists may be catered to.

Stucco is being used to a limited extent. It has been ascertained that the prices quoted for special stucco plasters have been somewhat high. The great majority of the private dwellings in New Zealand are constructed of wood, and it is questionable whether or not a sufficient market could be developed to warrant much consideration on the part of Canadian manufacturers.

(NOTE:—The standard of weight in New Zealand is the long ton of 2,240 pounds and the hundredweight of 112 pounds, and where "ton" and "cwt." are referred to in the above report, they refer to these weights.)

TRINIDAD

R. T. Young

Canadian Government Trade Commissioner for Trinidad
(February 1929)

There is no demand for crude gypsum, land plaster, hardwall plasters, gypsum blocks and tiles, gypsum wallboard, insulating plaster, acoustic plaster, and stucco. A small quantity of plaster of Paris is imported for the use of dentists, but this is usually purchased through dental supply houses either in the United States, England, or Canada.

You will understand that for building purposes plaster is not used in tropical houses, which are usually of wood construction throughout. An attempt has been made to market gypsum wallboard, but proved unsuccessful due to the fact that it was altogether too high class an article for the market, and the price would not permit it to compete with cheaper types of wallboard.

In view of the situation existing it is unnecessary to answer in further detail the questions you have asked, perhaps at a later date as these markets become somewhat more developed, and the demand is for a higher class article there may be a possibility of using gypsum products.

AUSTRALIA

C. Hartlett

Acting Canadian Trade Commissioner for Australia
(March 1929)

In response to inquiries received from Canadian sources of supply, the possibilities of marketing gypsum and its products in Australia have been investigated and a general review of the position is submitted below for the information of those interested in the industry.

In at least four Australian states there are large deposits of gypsum which are very pure in quality and can be easily worked. Many of these deposits are not utilized owing to the home demand being well supplied and difficulty of obtaining markets abroad. The principal ones being worked are those in South Australia where the largest plaster works are established. That state in 1925 produced 72,276 tons of crude gypsum of a value of £63,246 out of a total of 90,150 tons valued at £69,375 for the whole of Australia. The bulk of the output is used in the manufacture of plaster and cement and for agricultural purposes, while some four or five thousand tons are annually exported to New Zealand.

CUSTOMS DUTIES

Gypsum, plaster of Paris, and other like preparations having sulphate of lime as a basis, are dutiable on importation into Australia at 1s. 6d. (37 cents) per cwt. (112 pounds) when from the United Kingdom; and at 2s. (49 cents) per cwt. if from any other country, including Canada to which the British preferential rate is not extended. These duties, combined with heavy freight and landing charges, preclude the importation of crude gypsum and greatly restrict those of all plasters and preparations composed of gypsum.

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The tariff officials advise that the same rates of duty apply to gypsum fertilizer as to plaster, and that on gypsum wallboard the rates are 27½ per cent net British preferential and 38½ per cent net under the general tariff. Blocks and tiles and other products, of which gypsum is the basis, are likewise subject to duties which adversely affect importations.

IMPORTS

During the fiscal year 1926-27 (the latest for which detail of imports are available) no crude gypsum was received from overseas countries. The imports of plaster of Paris recorded at 91,506 cwt. (112 pounds) valued at £28,327, of which the United Kingdom supplied 9,012 cwt.; the United States, 39,240 cwt.; France, 19,914 cwt.; Germany, 17,718 cwt.; Canada, 4,688 cwt.; and all other countries, 583 cwt. Generally speaking, these imports of plaster are confined to a few well-known brands which have had an established reputation on this market for many years and in the main depend on their specification by architects who continue to stipulate their use because of their proved qualities. Owing to their high landed cost in comparison with the selling price of the local product the tendency is towards a diminishing demand for imported plasters which in former years, when the duties and freight rates were much lower, reached considerable dimensions. The same conditions govern other gypsum products such as wallboard, land plaster, blocks and tiles, stucco, etc., the importation of which is now negligible.

PRODUCTION AND PRICES

The high customs duties and natural protection afforded by freight rates from overseas sources of supply have stimulated the Australian manufacture of all gypsum products for which there is a demand in the home market. The abundance of high-grade raw material which can be easily worked at reasonable cost, is another helpful factor in Australian production.

There are fifteen plaster of Paris plants at present in operation in Australia, three or four of which are quite large concerns. The output is considered to compare very favourably in quality with well-known overseas brands and can be extended to meet all possible demands of the future. One prominent company engaged an expert from the United States to organize and manage its plant in accordance with the latest methods of manufacture.

The principal uses of Australian plaster are in the manufacture of plaster boards and ordinary building construction and the competition for business is very keen. In interviews with leading distributors it was found that Australian plaster of the best quality is quoted to them at £6 ($29.20) and at times as low as £5 ($24.33) per long ton delivered in store in bags of fifteen to the ton. This price is considerably lower than the duty paid cost of leading American brands, which varies from £1.7.0 ($6.15) to £1.11.0 ($7.54) per cask of a gross weight of 320 pounds, of which seven are reckoned to the ton. Some few months ago plaster in bags from the United States was offered here at £5.10.0 ($26.75) per ton, duty paid, but the price was considered too high in comparison with local plaster for any business to be done, besides which there was the danger when bagged of dampness on the ocean voyage. The local product thus has a considerable advantage in price, besides being readily available to dealers in small or large quantities as required.

A well-known German brand is quoted at £1.12.6 ($7.91) per barrel, but the most expensive one on the market is an English brand which is sold in 7-pound tins of three qualities, the delivered prices to distributors being 2s. 4d. (57 cents), 2s. 8d. (65 cents). and 3s. (73 cents) respectively, the lowest (2s. 4d. per tin) being also sold in tin-lined cases of 2 cwt. at £2.1.10 ($10.20) per case. This plaster is for the best dental, surgical, and other fine casts, and is considered by users to be superior to any other on the market for such purposes.

Plaster board is made and used very extensively throughout Australia and has almost entirely displaced overseas gypsum wallboard for which at one time there was quite a demand. Plaster board, which is merely plaster reinforced with sisal hemp, can be made at a price that permits it to be retailed profitably at as low as 2s. (48 cents) per square yard, as against the duty paid cost of approximately 10d. (20 cents) per square foot of wallboard. It is made in sheets of three-sixteenths of an inch in thickness, 3 and 4 feet wide and up to 20 feet in length, as well as in

panels of 10 by 10 feet up to 20 by 20 feet. Apart from price, it is claimed that the fact that it is finished for putting on walls and ceilings and requires no further treatment when erected is a further advantage over wallboard.

Gypsum fertilizer of Australian manufacture is also largely used here by orchardists and wheat farmers. It is procurable at about £3 ($14.60) per ton free on rail or wharf in sacks of about twelve to the ton, and considerably cheaper in bulk. It is stated to be 91·07 per cent gypsum and to give excellent results in wheat and other lands found to be deficient in lime.

The general opinion of dealers interviewed is that Australia is now practically self-contained so far as ordinary gypsum products are concerned, and that the present supplies of overseas plaster, two-thirds of the total (91,506 cwt.) of which are landed in Sydney owing to its distance of approximately 1,000 miles from the plants in South Australia, will gradually cease and be entirely replaced by the Australian material.

A limited market may be developed for special preparations such as "Insulex," which is understood to be a mixture of gypsum plaster and chemicals for use between walls and ceilings for insulation purposes. It does not appear to be known to the building trade here, hence samples, prices, and other details would be of interest and possibly lead to business.

UNITED STATES

Frederic Hudd

Trade Commissioner for Canada at New York
(January 1929)

Consumption of gypsum in the United States in 1928 amounted to about 6,000,000 tons of which some 4,750,000 tons were produced locally. In 1927 about 700,000 tons of gypsum in its crude state and about 100,000 tons in partly or fully manufactured form were imported. Of this quantity imported in 1927 Canada supplied 676,594 tons of crude and about one-fifth (in value) of the further processed gypsum.

Imports of gypsum and its manufactures by countries and by articles follow:—

Gypsum Imports by Countries—Calendar Year 1927

Crude—free. Ground, calcined, cement and other manufactures—dutiable.

—	Crude		Ground, etc.
	Tons	$	$
Belgium	196	543	2,720
Austria	.....	.....	920
Czechoslovakia	.....	.....	141
Denmark	.....	.....	2,440
France	.....	.....	40,275
Germany	1	8	83,589
Greece	.....	.....	574
Irish Free State	.....	.....	88
Italy	.....	.....	1,471
Netherlands	.....	.....	389
Spain	.....	.....	4,503
Sweden	.....	.....	232
United Kingdom	1	40	38,761
Canada	676,594	1,099,131	47,722
Mexico	61,060	62,035	.....
Cuba	.....	.....	281
Ceylon	.....	.....	3
China	.....	.....	5
Hong Kong	.....	.....	17
Japan	.....	.....	75
Palestine	.....	.....	12
Philippine Islands	.....	.....	16
Total	739,838	1,167,581	224,234

Imports by Articles—Gypsum

——	Rate, per ton	Quantity	Value	Duty	Equiv. ad valorem
	$	Tons	$	$	$
Crude	Free	739,838	1,167,581	.....	.....
Ground	1.40	2,316	30,231	3,242·40	10·73
Calcined or plaster of Paris	1.40	5,407	84,716	7,569·80	8·94
Keene's cement or other gypsum.					
Valued at $14 or less per ton	3.50	5	74	17·50	23·65
Over $14, not over $20	5.00	181	3,175	900.00	28·35
Over $20, not over $40	10.00	325	9,612	3,250.00	33·81
Over $40	14.00	75	3,341	1,050.00	31·43
Manufactures of plaster of Paris or gypsum	35%	88,822	31,087·70	.....	.....

DOMESTIC EXPORTS

Gypsum and plaster, crude, ground, calcined, and manufactures, n.e.s. Total 36,858,985 pounds valued at $471,106 in 1927.

DOMESTIC PRODUCTION

Domestic production estimated at 4,750,000 tons for 1928.
Imports estimated at 1,000,000 tons for 1928.

COST

Imports said to cost, laid down at N.Y., $6.85 a ton, domestic production cost—$11.85 per ton.

Mention has already been made of the large export trade of crude gypsum to the United States. This material has entered free of duty. During the early part of the year 1928 endeavour was made by certain parties in the United States to have the U.S. Government rule that crushed gypsum, that is, the crude rock crushed to 3-inch size for convenience in handling in shipment, was really partially manufactured, and as such should be classed as ground gypsum, and dutiable at the rate of $1.40 per ton under paragraph 205 of the U.S. Tariff Act. Accordingly a letter from the United States Treasury Department dated June 12, 1928, was addressed to the collector of Customs, New York City, in which it was stated that in the Department's opinion crushed gypsum was properly dutiable as ground gypsum at the rate above stated, but as it was the practice to admit crushed gypsum free of duty as crude gypsum under paragraph 1643, authorization was given to continue that practice until 30 days after the letter appeared in the weekly "Treasury Decisions."

So many protests were received by importers of crushed gypsum against this ruling that it was deemed wise to withhold publication of the letter and to grant a hearing in order that the question might be fully considered and the Department might have the benefit of the arguments on both sides. Accordingly a hearing was held in the Bureau of Customs on July 20, 1928, which was largely attended. Arguments for both sides were heard and arrangements made for further hearings.

As a result of these hearings a further letter dated February 4, 1929, signed by A. W. Mellon, Secretary of the United States Treasury Department, addressed to the Collector of Customs, New York City, the last three paragraphs of which are as follows:—

On account of the importance of the issue involved in this case the Department has given careful consideration to the arguments advanced by the conflicting interests and has granted several hearings since that of July 20, and in addition had a further investigation made by an investigating officer of this Department who followed the various operations from the time the gypsum was quarried in Canada until its complete manufacture in this country. The purpose of this investigation was to determine whether the operations in Canada in bringing the gypsum to a crushed state dispensed with operations in this country.

A very exhaustive report was submitted by the investigating officer and from a perusal thereof the Department is not inclined to view that the crushing in Canada would be held by the courts to be a process of manufacture, and this conclusion would seem to be justified in view of the report of the investigating officer that the cost of the crushing in Canada is approximately 2c. per ton, and the report of the officer would seem to be in harmony with a monograph published by the Deputy Inspector of Mines in Canada, dated January 8, 1926, in which he gives the value of lump gypsum as $1.80 per ton and the value of the crushed as $1.82 per ton. The investigating officer also states in his report that the costs of the operations in Canada are approximately ½ of 1 per cent of the total cost of operations.

In view of the foregoing, and the reasoning announced in the decisions cited above, the Department has reached the conclusion that crushed gypsum of the character the subject of its decision of June 12, 1928, is neither crude gypsum nor gypsum wholly or partly manufactured, but is crude gypsum within the meaning of paragraph 1643 and entitled to admission free of duty as such under the said paragraph. For the reasons stated the Department concluded to withhold publication of its letter of June 12, supra.

Whether any further action will be taken in this matter remains to be seen.

BRAZIL

Mr. A. S. Bleakney, Canadian Trade Commissioner at Rio de Janeiro, Brazil, submitted the circular letter regarding gypsum to a prominent importer in that city and the following letter was received in reply:—

"Rio de Janeiro, April 16, 1929.

Dear Sir,—We have received the circular letter of the Department of Mines of Canada, of February 15, which you were kind enough to submit to our appreciation.

As a matter of fact, we have in past years done quite some business importing gypsum, especially of the type called "gesso para estuque."

The experience we have made is that the freight figures out about 50 per cent of the value of the merchandise, if not more.

We have dropped the business since a few years, as we could not compete any more with the cheap Scandinavian producers, which dispose of better shipping opportunities than, for instance, the mills of Germany and Central Europe.

Our last transactions were made on a basis of between £25 and £30, f.o.b. European port, and the freight we had to figure with was more or less £18 per ton.

The duties on this class of merchandise would come out, on the actual exchange basis, on 200 to 250 reis per kilo.

You will easily realize that the business in this article depends merely upon the freight, and we doubt that from Canada this can be done better than from European ports.

The other commodities enumerated in your favour we have so far not handled, but if the import of the crude material does not appear favourable, the import of ready products should be even less remunerative, for the duties are much higher in order to protect the National Industry.

Anyhow, should you find out that the freight rates from your ports can compete with European ones, and that your production price is low, we should be very glad to hear from you.

Hoping that our information may help you to answer the enquiries put before you by your home office,

We are, dear sir,

Yours faithfully,

(Sgd.) JAMES MAGNUS & CIA.

MEXICO

J. Noel Wilde

Canadian Government Trade Commissioner in Mexico
(March 1929)

The present consumption of gypsum in Mexico is not known, but it may be said that it is not so large as either the size of the country or the density of population would suggest. The reason for this is that the type of building construction in Mexico is such that many substitutes for gypsum can be used. At the same time, there is a fair demand for both gypsum and manufactures of gypsum.

There are very large deposits of gypsum in Mexico, and practically nothing is imported. As an illustration of the nature of these imports, the official statistics of the United States give the following figures of exports to Mexico of "gypsum or plaster, crude, ground, calcined, and manufactures":—

1922	$ 5,714
1923	6,187
1924	7,606
1925	4,794
1926	6,903

and the Mexican statistics give the following imports of "stucco and gypsum in powder or paste":—

1925	nil
1926	$ 373

For "articles of gypsum or stucco", the Mexican statistics give:—

	1925	1926
From Spain	$ 4,900	$ 5,478
Other countries	7,022	6,417
	$ 11,922	$ 11,895

Of the above, the imports from Spain are not of such a nature as could be imported from Canada, consisting as they do of such things as cheap statuary and ornaments, and similar articles. It may be taken that all imports into Mexico of such kinds of gypsum and its products which Canada is in a position to supply, come from the United States, and the total value of these does not exceed $8,000 in any given year.

With regard to prices, these are dealt with in the detailed report given below.

The customs duty upon gypsum is as follows:—

In powder or paste, 5 centavos per gross kilo (about $1.13 per 100 lb.)
Bricks, slabs, and tubes of gypsum, 10 pesos (about $5) per 1,000.
Manufactures of gypsum, not specified in the complete tariff, 30 centavos per legal kilo, equal to 6·8 cents per lb.

To these duties there is added a surcharge of 23 per cent of the tariff, thereby increasing the figures given to that extent.

The possibility of entering the market would depend entirely upon price delivered at points of consumption, in comparison with prices at present paid. This question is dealt with below.

Crude Gypsum. Crude gypsum is mined in Mexico largely by hand labour, wages being about 50 cents to $1 a day; the labourers are native Indians, with a low standard

of living and it is stated that the cost of crude gypsum at the quarries is equal to $1.05 per ton. Delivered in Mexico City, the price is from $4 to $4.50 per ton.

Land Plaster. Nothing is known of this in Mexico as an import from foreign countries. There are large quantities of peanuts grown, and if land plaster is used as a fertilizer, it would appear that it is obtained locally.

Plaster of Paris. This highly refined gypsum is manufactured in Mexico. The present price is 66 cents a sack of 6·6 pounds (3 kilos).

Hardwall Plasters. This is manufactured on a substantial scale in Mexico, one of the producers being also the largest manufacturers of cement, and a branch of the English Cement trust. The price at which this is sold to users varies in accordance with demand, but current quotations are 27 pesos per metric ton, delivered in Mexico City; an allowance of 4 pesos per ton is made for bags when returned in good condition, which reduces the price to 23 pesos per metric ton, or $9.70 per short ton.

Gypsum Wallboard. Efforts have been made in the past to introduce this product into Mexico, but without success. Samples were received, and supplied to building contractors, who used them in the first place as ceilings and also as partition walls. It was then ascertained that the gypsum board for partition walls would cost 14 cents per super. foot, laid down in Mexico City, and when erected the total cost would be 32½ cents per superficial foot. As against this, the cost of cement block walls, in place and finished, comes to 23¼ cents per square foot. Bricks (delivered but not erected) cost only 4½ cents per superficial foot of wall. For ceilings the wall board competes with plaster, and also with "manta", which is a coarse white cotton cloth stretched between the side walls without other support; the cost of this latter is 4½ cents per square foot.

Gypsum Blocks and Tiles. These are also made locally, but the company above referred to says there is little demand. The price at which one particular type is selling is 13½ cents per block, the dimensions being 4 to the square metre; this is equal to about 1¼ cent per square foot. The block in question is about 3 inches thick, and is hollow.

Insulating Plaster, Acoustic Plaster, and Stucco. These products were not known by my informant.

In order to ascertain the full possibilities of the market, exporters should first of all ascertain the cost of any product in which they are interested, on the following basis:—

Price at works
Railway freight to seaboard
Handling at port of exit
Steamer freight
Insurance
Handling at port of entry
Customs duty
Inland freight to Mexico City
(about $18 per ton).

If the sum of these items is less than the figures of cost given above, samples of the product should be sent to me, together with quotations, c.i.f. Vera Cruz.

JAPAN

James A. Langley

Canadian Trade Commissioner for Japan
(April 1929)

Kobe, Japan, April 25, 1929. Large deposits of gypsum are to be found throughout Japan and quarries are being operated in Shimane, Akita, Ishikawa, Fukushima, and Miyagi Prefectures, but the chief producing centres of the gypsum mining industry are in the northeastern part of the Islands in the vicinity of Tottoriken and Akitaken. Production data are not available, but according to an official of one of the leading cement manufacturing companies, the quantity of gypsum produced in Japan

is quite sufficient to meet the requirements of the various industries employing this product, although there is an increasing quantity imported annually which under certain conditions is preferred. The production of gypsum is dependent largely on the activity of the building and cement industries, possibly more so on the latter than on the former. The demand for concrete roads and to carry out extensive building operations in which ferro-concrete is used, have of late increased the demand for gypsum. Japanese gypsum, when tested for SO_3, shows 35 per cent of sulphur trioxide, while foreign gypsum coming into Japan averages 43 per cent, and as pure gypsum rock will test in the vicinity of 46⅓ per cent the foreign product that is being imported at the present time is of a very good quality.

According to the following figures supplied by the Department of Finance, the total importations into Japan of all grades of gypsum during 1928 were placed at 22,755 tons valued at $198,579 as against 15,078 tons with a value of $154,119 imported during 1927.

Ground raw gypsum is not used to any extent in Japan as a fertilizer or land conditioner. The chief use of this commodity is in the cement industry, and in a lesser degree as a wall plaster and in the manufacture of wallboard. The largest consumers of crude gypsum are, however, the cement manufacturing concerns, who put 10 kin or 13⅓ pounds of gypsum into each barrel of cement produced. As the annual production of cement in Japan is placed at 20 million barrels, the total yearly consumption of gypsum rock in this industry is 121,212 long tons, which, as mentioned before, is obtained at present largely from Japanese mines, with small quantities coming in from Germany, Italy, Mexico and other countries.

It is understood that the domestic manufacturers prefer the foreign product owing to its superior quality, but give the domestic gypsum preference for various reasons: the chief reason being the fact that cement manufacturing concerns must have deliveries constant and positive and so purchase their requirements at fifteen day intervals. Up to the present time deliveries of foreign gypsum have never been properly arranged, and the factories are not anxious to change from a sure source of supply to one in which there is considerable element of risk, in so far as deliveries are concerned. Then again there is the question of the laid down cost of foreign gypsum, for when all is said and done the Japanese market is a price one. Contracts entered into by various cement concerns usually stipulate an analysis of 35 per cent sulphur trioxide, for which Yen 1·20 will be paid per 100 kin, or 133⅓ pounds. If the gypsum supplied shows a higher or lower test than that stated, then a corresponding change in price takes place. The method followed in arriving at the percentage of content of the product supplied is as follows:—

Four samples are taken from the shipment on arrival. One is tested by the purchaser, one by the Official Government testing bureau, one is held for the supplier, and the fourth sample is retained in the event of a disagreement taking place, and is used in a final test. An average is struck, and the price fixed on that basis. The price of Yen 1·20 per 100 kin, or 133⅓ pounds, varies but little and might be referred to as a standard price.

In following certain foreign importations to their source, it was found that one or two shipments came in as ballast in ships owned by the Mitsui interests, and were sold in price competition with the domestic product, having regard, of course, to the difference in analysis. These were from Italy and Africa.

Gypsum is calcined at several plants in Japan. The method used is to crush the rock in large crushers and this is followed by grinding in a mill. The ground gypsum is then charged in batches into a calcining kettle where it is kept at a certain temperature for several hours. The calcined gypsum is then discharged, cooled, and screened. For building purposes the dry plaster is mixed with hair and other ingredients and bagged for the market.

Hardwall Plaster. In so far as it is possible to ascertain no large quantities of hardwall plaster or plaster of Paris have been imported recently into Japan, although a small tonnage of a special grade has been coming in from the United States and Germany from time to time. This is for use in buildings that are being erected for the wealthier Japanese firms, and that have been designed by foreign architects, such as the new Mitsui Building in Tokyo, where the best of material has been used. The ordinary demand is almost entirely taken care of by domestic products. Of the American plaster, Calvin Tompkins (XXX) Brand) is the most popular on this market,

and is imported from New York and quoted at Yen 17·50 per 220-pound keg. German and Japanese plasters are both quoted at about the same wholesale price.

As this material deteriorates very rapidly in Japan, and the margin of profit is small, few firms are willing to take a chance and stock it. So it is usually ordered as required; that is to say a specific tonnage for a certain job. Another point is that contractors leave their requirements uncovered until the last minute, play one quotation against the other, and buy where they can secure the lowest price, regardless of the specifications covering the work. Japanese returns do not show separately the importations of either hardwall plaster, plaster of Paris, or gypsum.

Gypsum in Chemical Industries. So far the use of gypsum in the manufacture of sulphuric acid from gypsum, coal, and clay has not been undertaken, although there is some talk of it. Neither do coal and gas-making plants producing sulphate of ammonia use gypsum as a substitute for the more expensive chemicals now being used, but the expansion of these industries will no doubt lead to a further demand for a high-grade gypsum.

Land Plaster. Gypsum as a fertilizer is not used to any extent in Japan, and in order to introduce it considerable money would have to be spent in advertising and the people educated to its use. One of the drawbacks to the use of new fertilizers, or land conditioners in Japan is that the farmers and land owners think they know exactly what is needed, and will not change to an unknown article when they have something that they have been using for years, and from which they consider they are obtaining the maximum result.

Gypsum Wallboard. During the last few years, or to be exact since the earthquake of September 1923, there has been a small but increasing growth in the use of plaster wallboards. It has been found that they have certain fire-resisting properties and freedom from warping under existing climatic conditions in Japan. There is one wallboard produced in Japan known as "Tiger" wallboard. This costs about Yen 4·00 per tsubo (approximately 36 square feet) delivered to buyers in either Osaka or Tokyo. Quantity orders are given a special discount ranging from 10 to 20 per cent according to the extent of the purchase. The firm producing this wallboard has obtained a patent, which excludes all foreign makes. The board manufactured by this concern is of gypsum, hardened between two layers of paper, and, as in the case of Canadian wallboards, comes in various thicknesses. The quality cannot be compared to foreign products, but the price is exceedingly cheap, and the producers are without competition.

Stucco, gypsum blocks, and tiles are not used to any extent in Japan.

Insulating Plaster. The ordinary Japanese house is of a light framework structure, and there are no walls, at least no continuous walls. The side of the house, composed at night of wooden sliding doors, is stowed away in boxes during the daytime. The rooms are divided from each other by opaque paper screens, which run in grooves at the top and bottom. The floors of all the living rooms are covered with thick mats, made of rushes and perfectly fitted together so as to leave no interstices. The ceilings are made of panels, one overlapping the other. What walls there are are made of a network of bamboo strips plastered over with a composition of some kind or other, but consisting largely of mud. Therefore, owing to the nature of the construction of Japanese dwellings, it would not be possible to use this insulating plaster in houses of Japanese construction. It might be used in foreign style houses, but the construction of these is so limited that the demand would be very small. The demand for insulating plaster in Japan was recently investigated by the representative of a Canadian firm, and the conclusion that they came to was that the business was so small that it was not worth going after.

Acoustic Plaster. Up to the present time acoustic plaster has been unknown to the Japanese market. It might be possible to work up a demand for this for use in some of the proposed larger buildings, or even for those under construction. In the older buildings, even to abolish echoes, etc., I doubt very much if it could be introduced.

TARIFF

Crude gypsum enters Japan free of duty. The general tariff on imports of ground or calcined gypsum (other) is 45 sen per 100 kin. Manufactures of gypsum 40 per cent ad valorem.

DETAILS OF IMPORTS

The following statement gives the imports of crude, as well as other gypsum, into Japan during the year 1928, showing the countries of origin and the ports through which the gypsum entered Japan. This information has been collected from the officials at the various ports and while taken from official records does not agree with that supplied by the Finance Department, Tokyo, and shows a difference of some 3,000 tons. However, the table will serve its purpose by showing where the largest demands for foreign gypsum come from. All weights are long tons, and for convenience the yen has been taken at 0·46.

Port of	Yokohama		Nagoya		Osaka		Moji		Total imports	
Country from	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$
Gypsum (raw)										
China	272	1,545	.....	.....	362	8,572	827	22,113	1,461	32,230
Germany	645	7,691	.....	.....	332	2,599	1,508	12,112	2,485	22,402
Great Britain	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
France	1	196	.....	.....	.....	.....	5	72	6	268
United States	3,024	19,478	.....	.....	3	636	.....	.....	3,027	20,114
Australia	.....	.....	2	32	.....	.....	.....	.....	2	32
Italy	.....	.....	.....	.....	.....	.....	3,831	34,960	3,831	34,960
Africa (Algeria)	66	842	3,119	32,431	.....	.....	1,795	12,406	4,980	45,679
Mexico	3,112	20,928	.....	.....	.....	.....	.....	.....	3,112	20,928
Total imports	7,120	50,680	3,121	32,463	697	11,807	7,966	81,663	18,904	176,613
Other										
Germany	242	7,846	.....	.....	18	330	174	4,854	434	13,030
United States	16	3,350	74	4,358	10	642	.....	.....	100	8,350
England	10	569	.....	.....	.....	.....	.....	.....	10	569
Total imports	268	11,765	74	4,358	28	972	174	4,854	544	21,949
Grand total	7,388	62,445	3,195	36,821	725	12,779	8,140	86,517	19,448	198,562

HOLLAND

J. C. MacGillivray

Canadian Trade Commissioner at Rotterdam
(April 1929)

No gypsum is produced in the Netherlands. All supplies must be imported, and if the Canadian product is able to compete in price with Germany and France it can be sold. There are no imports of crude gypsum; it all enters in the burnt, powdered form. There are no facilities in Holland for this processing. During the past five years there has been a steady increase in consumption, which is due entirely to the heavy building construction which has been taking place. The weight and value of imports of powdered gypsum from 1924 to 1928 inclusive were as follows: —

	Kilograms	Florins
1924	17,789,392	447,793
1925	19,088,491	448,263
1926	21,516,918	459,745
1927	24,833,872	502,496
1928	26,166,000	522,000

No figures are as yet available showing the countries in which the 1928 imports originated but the 1927 statistics may be regarded as a good criterion as to the comparative importance of the exporters. These, with the weights and values, and the percentage of the weight and value supplied by each were:—

Countries of origin	Kilograms	Florins	Weight	Value
			per cent	per cent
Germany	10,403,870	248,875	41·9	49·5
France	9,230,130	146,258	37·2	29·1
Belgium	4,974,322	88,557	20·0	17·6
United States	210,024	18,328	0·8	3·6

German gypsum comes from the Harz mountains in Central Germany, while the French product originates in the neighbourhood of Paris. Belgium has no quarries of its own, and, consequently, this was in the first place crude gypsum imported from France and Germany. Imports from the United Kingdom consist for the most part gypsum which has been subjected to two burnings such as Keene's and Robertson's marble cement and Parian cement. These dry very quickly and are in demand when the work done must be immediately painted. English gypsum is the most expensive on the market and costs 60 fl. per ton free Rotterdam, while the ultimate consumer pays 100 fl. per ton. The cost of German, French, and Belgian gypsum is 22 fl. per metric ton to users, while importers pay 10 fl. to 11 fl. ex quay Rotterdam for French and Belgian gypsum and about 12 fl. for German gypsum.

French gypsum has the advantage of being less inclined to cake than the German, but the specific gravity of the latter is said to be lower and it spreads over a larger surface, which makes it the more popular.

Gypsum arriving in Holland is packed in bags with a net weight of 50 kilos and a quantity of 500 tons is usually the minimum for a shipment. Canal and river barge is the common method of transportation. The bags, which cost 0·51 fl., are not included in the cost of the gypsum, but are billed against the buyers as an additional charge. They are, however, returnable.

No prepared acoustic plaster is on the market in the Netherlands, and when it is needed it is mixed by the individual plasterers. Insulating plaster is also not known. As a substitute a special brick is used which is very light and porous and which will float on water. Hardwall plasters are made on the spot as needed and consist of a mixture of Belgian or shell lime with sand. After drying the walls are whitened with a mixture of Belgian lime and gypsum.

Stuccoed walls are very seldom seen in Holland. Brick is the all-popular building material; the occasional stuccoed houses which are to be seen are covered with a cement compound. Artificial stone tiles have also been introduced for this purpose. Land plaster is not used in the Netherlands. Gypsum wallboard has been successfully introduced and its sale is increasing substantially.

With the exception of wallboards, which pay 8 per cent ad valorem, all gypsum plaster products as well as blocks and tiles enter Holland duty free.

GERMANY

L. D. Wilgress

Canadian Trade Commissioner at Hamburg
(February 1929)

I might state that there would appear to be no possibility at the present time of developing trade in above gypsum products with the countries under my jurisdiction. There are extensive deposits of gypsum in the Harz mountains of Central Germany, so that this country is able to supply the domestic requirements for all gypsum products and also to export fair quantities to neighbouring countries. Unfortunately no figures are available to indicate the production or consumption of gypsum in Germany, but the trade statistics show that in the year 1928 there was imported into Germany a total of 15,658 metric tons (1 metric ton=2,204 pound) of raw gypsum, of which 9,405 tons came from France. On the other hand there was an export of 144,301 metric tons of a value of approximately one million dollars, of which 55,332 tons went to Czechoslovakia, 16,078 tons to Finland, 12,621 tons to Denmark, 10,425 tons to Holland, 6,162 tons to Sweden, and around 3,800 tons to Poland.

Two years ago the representative of a Canadian firm thoroughly investigated the possibilities of selling gypsum wallboard to Germany, but it was then found that the Canadian price worked out at around R.M. 1·90 (45 cents) per square metre c.i.f. Hamburg, for a width of 8 mm., whereas similar material was being quoted by German firms at R.M. 1·50 (36 cents), R.M. 1·43 (34 cents) and R.M. 1·09 (26 cents) respectively, f.o.b. Hamburg. The lowest price was that quoted by the firm of A. & F. Probst, Neidersachswerfen a/Harz. It was found that in general the use of gypsum wallboard was not favoured by German architects for the reason that most of the buildings are of stone construction and the use of such light material was not approved. Finally the Customs authorities ruled that Canadian gypsum wallboard would be dutiable at the rate of R.M. 72·00 ($17.14) per 100 kilos (220 pound), the rate applying to paste board products combined with other materials.

For similar reasons it is not thought possible to import other gypsum products into Germany. Raw gypsum is free of duty on importation into this country, but gypsum products are dutiable under items 700 to 703 of the German tariff, which provide for the following rates:—

Gypsum goods, also those with a mixture of gypsum with sulphur, chalk, glue, etc.

		Duty per 100 kilos (220 lb). R.M.
700	Building slabs and building stones, also with fillings:	
	Undecorated	1 (24 cents)
	Decorated	2 (48 cents)
701	Other uncoloured goods, also gypsum models with sulphur fillings	3 (71 cents)
702	Coloured, bronzed, varnished, polished (or saturated with stearine, wax, or similar substances) ivory articles, chrome paste, polishing paste, (kallipasta)	12 ($2.86)
703	Goods of all kinds in combination with other stuffs insofar as they do not come under higher duties	12 ($2.86)
	Note to 700 to 702. Moulded work of sulphur (also spence metal) infusorial silica, chalk masses or talc are dutiable as gypsum goods.	

In view of the above it would appear that an outlet for Canadian gypsum products can be better sought for in other markets than Central Europe in view of the extensive deposits of this mineral in Germany.

FRANCE

Hercule Barré

Canadian Trade Commissioner at Paris

1. *Annual consumption of gypsum products:*

Gypsum is used in France:

(*a*) In the form of crude powder as fertilizer in agriculture (sulphate of lime), alone or mixed with some other fertilizer as the superphosphate, for instance.

(*b*) Burned in powder form of different siftings:
Ordinary burned plaster, lump, used in the coarse plasterings.
Burned plaster, sifted fine, used in the interior coatings.
These two categories are commonly used in construction work.

(*c*) Plaster half sifted, sifted, extra fine, used in the marble industry for permanent works.

(*d*) Plaster of Paris for the fabrication of mouldings, stucco-works, moulds, etc., very high fineness, very great strength. Total annual consumption, about: 1,500,000 tons.

2. *Actual origin, i.e. original products:*

France has in nearly all her area important masses of gypsum in the form of natural sulphate of lime.

These masses vary as to their thickness.

In certain regions, especially in the Paris basin, the masses are worked from a thickness of 20 to 30 metres. In others, as the eastern region, Seine and Marne, Aisne, the masses are worked from a thickness of only 4 to 6 metres.

In the centre and the south, the southeast and the southwest, the masses are of a similar thinness and are often represented in different forms, and are less regular.

There are actually in activity in France 200 quarries and plants spread over 50 departments.

The most important centres as regards the deposits and the plants, are the Parisian basin, the exploitations being situated on the shores of the Marne and Seine rivers, next come the south and the southeast and Savoie, the east with the Haute Saone, the Jura, the Saone et Loire, and the Cote d'Or.

The Alsace-Lorraine group. The centre with the Nievre and the Allier.

The southwest with the Charentes.

The amount of production of these plants, having regard also to the possibilities of the deposits, is from about 2,500,000 to 3,000,000 tons.

3. *Sale of the product:*

Plasters are sold by the ton (1000 kilos) on the cars at the shipping point, or on board the boats at the ports near the plants.

The actual prices are as follows for the different categories:

Ordinary burned Paris plaster: 85 fr. a ton.

Burned plaster sifted fine: 95 fr. a ton.

The prices of the other grades vary according to their fineness grading up to the moulding plasters which are sold from 250 to 280 fr. a ton.

The prices of the rockplaster, or in fines, or in sifted powder, are from 35 to 45 fr. a ton.

4. *Customs duties:*

There are no customs duties in France on the foreign plasters.

5. *Possibilities of the French market concerning the Canadian product:*

France is an exporting country for the crude plaster rock or in the crude powder form to her most immediate neighbours. She exports overseas her special plasters and her moulding plasters. The consumption in France of burned plaster must reach, at the maximum, 1,500,000 tons, the normal production being 2,500,000 to 3,000,000 tons. There exists an overproduction and in consequence there is naturally a great tendency to exportation.

The actual sale-prices are profitable only on condition that the plants and the quarry grounds remain on the basis of the pre-war evaluation, without having regard to revalorization coefficient which this sale-price would not be able to pay.

CUBA

James Cormack

Canadian Trade Commissioner at Havana
(June 1929)

Crude Gypsum. No crude gypsum is imported into Cuba.

Considerable quantities are mined: at Mariel, the Cuban Portland Cement Corporation, with a daily output of 7,000 barrels of cement, mine all the gypsum required in the manufacture of cement.

There is a small factory operating in Matanzas, manufacturing plaster of Paris from gypsum mined in the hills in the vicinity of Jaruco; this, however, is not a pure white product. The output of this factory is small, not exceeding 200 barrels per month.

Land Plaster. Land plaster is not imported for fertilizer purposes.

Plaster of Paris. Some 6,000 bags are imported per month. Costs of plaster of Paris in this market are as follows:—

Native manufacture	$0 80	per 100 lb.	
Acme	0 90	"	c.i.f. Havana
New York plaster of Paris	1 05	"	f.o.b. Havana
German plaster of Paris	1 00	"	f.o.b. Havana

Importation is effected by building supply houses; contractors do not import direct but purchase from the local supply houses. Some refined plaster of Paris is imported, but only for dental use, and the amount is very small. Plaster of Paris (in Spanish "Yeso") is covered by paragraph 3-B of the Cuban Customs Regulations, the duty being fifty cents (50c.) per 100 kilograms with a surcharge of 3 per cent for Public Works Special Tax.

Gypsum Wallboard. All comes from the United States. Consumption of this material is approximately one carload per month. The demand is not great as masonry construction predominates throughout the Island, and financial conditions are such as to prevent experimenting with new ideas at present.

Gypsum Blocks or Tiles. The high duty on this class of product would make it very difficult to compete with the Hydraulic Tile manufactured in practically every town on the island. The trade has no call for this class of material and it would have to be built up from the beginning.

Stucco. Prepared stucco is not imported. Decorators prepare their own material where used, and stucco is not in general use for interior decorating.

ARGENTINA

O. M. Armstrong

Acting Trade Commissioner

BUENOS AIRES, June 27, 1929. Gypsum is found in almost all parts of the Republic but not always in sufficient quantities to permit of exploitation. Enormous mines are found in the Mesozoic strata of the Cordillera range in the provinces of San Juan, Mendoza, and Neuquen. At times these deposits are so huge that they form entire hills, for example in the Aconcagua region, province of Mendoza. The exploitation of these deposits is not now practicable due to the long rail haul and costly freight rates. Gypsum is also found in exploitable quantities in the soil strata of Patagonia in the south and in Paganzo in the north.

To the north of Neuquen Territory a very large deposit is found in the region bordering on the 31st parallel of latitude; in the swamps stretching from Cerro Peinado to the Rio Grande deposits 450 metres thick are found extending over a distance of 45 miles. These deposits, however, are now unexploitable due to the lack of transportation facilities.

Of more important note, at least for the present, are the gypsum deposits found in layers north of Puerto Madryn, Chubut Territory, and the highly important deposits found in Hernandarias and Curtiembre in the province of Entre Rios. These latter two deposits have been exploited for some years past, the product being brought down the Uruguay river by boat to Buenos Aires.

Following are analyses published by the Argentina Department of Mines and taken from the mineral obtained from the "4th of November" quarry near General Roca, Rio Negro.

—	1	2
	per cent	per cent
Water	21·00	21·00
Calcium sulphate	78·54	73·10
Silica (SiO_2)	vestiges	4·05
Iron and aluminium	"	1·10
Undetermined	0·46	0·75
	100·00	100·00

The consumption of gypsum in the Argentine Republic in the year 1927 was about 53,268,306 kilos. This amount, which can be checked from figures listed below, is made up as follows: production 52,111,410 kilos, plus imports 1,707,218 kilos, less exports 550.312 kilos.

Production

1926

Station	Transportation	Province or territory	Amount in kilos
Rio Negro (City of San Antonio Oeste).....	Southern Railway..	Rio Negro.....	15,097,000
Curtiembre.....	River boat.....	Entre Rios.....	5,030,000
Hernandarias.....	"	"	15,994,256
			36,121,256

NOTE.—The figures for Curtiembre and Hernandarias noted above are for the first nine months only. The amount transported on the Uruguay river during the last three months of 1926 is not known.

1927

Mosmota.....	Pacific Railway.....	San Luis.....	1,224,400
Rio Negro (City of San Antonio Oeste).....	Southern Railway..	Rio Negro.....	14,887,000
Hernandarias.....	River boat.....	Entre Rios.....	36,000,000
			52,111,400

Two firms have made large installations of machinery in the quarries near the station Rio Negro at San Antonio Oeste in the Territory of Rio Negro and have now been operating on a large scale for some time past.

Three private individuals are working the mines in Hernandarias, province of Entre Rios, on their own account. In Puerto Brugo, 45 miles from Parana the capital of the province of Entre Rios, three private companies are operating mines. In San Antonio on the Central Cordoba Railway, province of Catamarca, a private individual is operating a mine.

There are four qualities of gypsum manufactured in the Argentine Republic. These in order of quality and fineness are Black, White, Special, and Extra (slow drying). The price of these per M. kilos f.o.b. cars Buenos Aires, as taken from "El Constructor" of April 8, 1929, a local builders' periodical, is 40 pesos for Black, 50 pesos for White, 65 pesos for Special, and 90 pesos for Extra (slow drying). These prices are given in paper pesos (one Argentina paper peso equals 42 cents Canadian).

Black and White are employed in the first and second coats of ceilings, while Special is used for ornamental and moulding purposes in the building trade. Extra quality (slow drying) is used for statues and dental purposes.

The qualities imported are usually superior to the local article and are used for sculptural work, dental purposes and for the finishing coats of walls and ceilings. One party in the trade states that local gypsum has been used in sculptural work mixed with the imported article.

The imports of gypsum in 1926 were 1,412,688 kilos, with countries of origin as follows: France 831,175 kilos, Germany 241,484 kilos, United States 211,702 kilos, United Kingdom 48,750 kilos, Italy 43,044 kilos, Belgium 21,600 kilos, Spain 9,590 kilos, Uruguay 5,343 kilos.

Gypsum in powder form entering Argentina is dutiable at $0.00891 (Canadian currency) per kilo. Incidental to this are charges for stamps, crane service, cartage, and brokers' commission.

Exports in 1926 were 1,012,728 kilos, with countries of destination as follows: Uruguay 976,383 kilos, Paraguay 36,088 kilos, Bolivia 127 kilos, Brazil 85 kilos, Denmark 45 kilos.

According to "El Constructor", issue noted above, the price of foreign brands in the market were as follows:

	Per 100 kilos
"Diamond" U.S.A., in cases of 115 kilos.....	18·50 paper pesos
"Cisne" Paris, in cases of 120/140 kilos.....	25·00 "
"Espada", Belgian, in cases of 130 kilos.....	12·00 "

A German brand c.i.f. Buenos Aires is quoted as follows:

Gypsum, fine quality, in bags of 50 kilos, per 10,000 kilos gross weight,	£37 sterling
Gypsum, ordinary quality " " " "	£34 "

Very large quantities of locally made raw gypsum are used as a mix with cement in order to effect slow setting. Three per cent is the percentage usually employed. Imports of cement were 343,366 metric tons in 1926 and 415,884 metric tons in 1927. The local production of cement amounts to 350,000 metric tons annually. Imported cement is of course not treated with gypsum. There are little or no exports of cement from Argentina.

Crude Gypsum. There are no imports of crude gypsum into Argentina.

Plaster of Paris. No facilities exist for the making of plaster of Paris; plenty of lime, however, is found in the country. The best is probably Cordoba lime, a quick-setting hydraulic lime. It is mined in large quantities in the Cordoba hills. Practically all the lime for outside plastering or building purposes is Cordoba lime. It is of very high quality and would pass any high test for this class of material.

Land Plaster. There is no market for land plaster as a fertilizer.

Hardwall Plasters. Hardwall plasters in Argentina are made of slaked lime from Cordoba and Azul; gypsum, of course, is required in the making of these.

Gypsum Wallboard. This product is not known here and would have to be introduced. A possible use might be found in the camp for lining wooden huts or corrugated iron buildings. Expanded metal, however, is in such wide use that gypsum wallboard would be introduced with difficulty.

Gypsum Blocks and Tiles. These would be subject to rough handling and many breakages would probably result, perhaps up to 25 per cent. Another objection is that they deteriorate rapidly if they get wet. Due to the loss in handling these are not made in the country. It is also reported that they do not join up well.

Insulating Plaster. According to the trade this would have no sale for insulating walls. If, on the other hand, it could be used for insulating pipes, it might have a very ready sale.

Acoustic Plaster. This is not known here and would have to be introduced. Up to the present fibreboard has had a large sale, principally for the reason that it is easily and readily applied. It is quite possible, however, that in many of these cases its demand was created by its sound-absorbing qualities.

Stucco. There is a great deal of stucco work done here but the materials used are all mined and made locally. In order to decide whether or not import could be made the fullest information would have to be supplied as regards c.i.f. prices, weights, and mode of application. Shipments, if any, should be effected in bags of 50 kilos each. Stucco outside plastering is made of one part of cement to one to three parts of sand according to requirements. Local industry supplies about 25 per cent of the trade.

One Argentina importer interviewed expressed an interest in receiving quotations on first quality Canadian gypsum in powder form. Please furnish samples and best prices c.i.f. Buenos Aires, together with particulars regarding method of packing, to the Canadian Trade Commissioner at Buenos Aires.

JAVA

R. G. Heasman

Acting Canadian Government Trade Commissioner in Java

For information on the volume of trade in gypsum and its products in the markets of the Middle East, we have to depend largely on statistical returns. Even these only provide a detailed summary for Java and Madura during the last two years for some of the gypsum products, while British Malaya returns are absorbed in group classifications including a variety of non-specified materials. Not only would these figures obviously admit of no comparison with other countries, but they would not give any idea of the extent of trade carried on in the country itself. For similar reasons Siam and Indo-China are not dealt with in this report.

Of the Netherlands East Indies comparative figures are available for Java and Madura. Only in two cases, however, is gypsum shown as such in statistical returns. Total imports for the years 1927 and 1928 were valued at guilders 39,936 and 51,411

(or $15,975 and $20,565) respectively. These figures are made up almost entirely of crude, or rock gypsum valued for 1921 at guilders 4,536 ($18,615), and guilders 32,862 ($13,145) for 1927.

The bulk of the imports during both 1927 and 1928 is shown as coming from China. In 1928 Germany was credited with 204½ (metric) tons, and Singapore with approximately 17 (metric) tons. This latter, however, is likely transhipment cargo with origin unknown.

Under the general heading "Gypsum" would be included dental plaster, powdered gypsum, plaster of Paris, and stucco. Total imports under this heading for 1928 were valued at guilders 4,875 ($1,950), as against guilders 7,074 ($2,830) for 1927. Holland and Germany are the main supplying countries.

Alabaster is shown in import statistics both under the group heading "Gypsum" and under "Minerals" (both crude and manufactured). What is locally known as "alabaster gypsum" is used to a large extent by dental surgeons on account of its tendency to set at a more rapid rate than hydrous calcium sulphate, added to which alabaster gypsum is said to make a harder mould.

An analysis of the imports of ground and crude gypsum and alabaster (minerals) is given in the following table, with countries of origin and percentages for each supplying country. The percentages refer to quantities imported. No detailed statistics are available prior to 1927.

Java and Madura

Products	1927		1928		Percentages	
	Kilograms	Florins	Kilograms	Florins	1927	1928
Gypsum						
Holland	18,329	2,924	6,887	1,840	41·74	26·19
Germany	11,200	1,796	18,141	2,613	25·50	68·98
Other countries	14,387	2,354	1,271	422	32·76	4·83
Total	43,916	7,074	26,299	4,875	100	100
Crude (rock) gypsum						
China	314,262	30,875	364,747	35,768	93·99	58·33
Hong Kong	10,840	1,074	39,171	3,847	3·24	6·27
Germany	.....	.....	204,500	5,260	.....	32·70
Singapore	.....	.....	16,886	1,661	.....	2·70
Other countries	9,247	913	.....	.....	2·77	.....
Total	334,349	32,862	625,304	46,536	100	100
Minerals (crude) including alabaster						
Holland	25,376	2,886	22,000	3,816	2·92	32·59
Italy	8,674	1,571	16,000	3,305	1·00	23·70
Singapore	28,200	1,410	.....	.....	3·25	.....
United States (Pacific coast)	.....	.....	2,600	5,398	.....	38·51
Other countries	805,572	948	3,511	530	92·83	5·20
Total	867,822	6,815	67,511	13,049	100	100
Minerals (manufactured) including alabaster						
Germany	6,024	1,141	.....	.....	6·13	.....
China	87,219	44,559	171,000	48,378	88·83	68·67
Hong Kong	.....	.....	68,000	1,535	.....	27·31
Other countries	4,946	844	10,000	1,463	5·04	4·02
Total	98,189	46,544	249,000	51,376	100	100

USES AND PRICES

Crude Gypsum. As already mentioned, the largest portion of imports is made up of crude, or rock gypsum. To what use this product is being adapted locally, we have not been successful in finding out; nor have we any record of prices.

Land Plaster. So far as we have been able to ascertain this commodity is not imported into Java. This same remark applies to precast and preshaped gypsum blocks, tiles, insulating, and acoustic plaster.

Hardwall Plaster. It is not possible to give any idea of imports (if any) under this caption, as this would be absorbed under the group classification of "building materials—n.o.p."

Plaster of Paris. This product finds application in dentistry (including alabaster gypsum), surgery (for plaster dressings), and moulds for metal casting, etc.

Plaster of Paris and other dental plasters are put up in air-tight tins, of 5, 10, and 25 kilograms, to withstand the action of the moist climate existing in this part of the world. Wholesale prices range from 20 to 24 cents per kilogram.

Gypsum Wallboard. Until recently gypsum wallboard was practically an unknown material on the Java market. However, one large Canadian company has been successful in concluding agency arrangements for this territory and imports started this year. Competition is from a U.S.A. firm who have coincidentally established a line on this market.

Information supplied by a large firm of local architects and building contractors seems to indicate that the use of gypsum wallboard is gaining in popularity. Locally it is used chiefly for the upper structure of partitions in permanent and semi-permanent buildings. For exterior construction and ceilings it is apparently less suitable due to its behaviour under exposure to the torrential rains of the Tropics, alternated by high temperatures. Gypsum wallboard does not seem to be proof against this interaction of climatic conditions. In ceilings, heavy leaks are of course frequently encountered, in view of the fact that the majority of residential and other buildings are usually roofed with brick (pan) tiles. Wholesale prices for this material vary from 50 cents to 64 cents per square metre. (Approximately 5 to 6 cents Canadian per square foot.)

Gypsum wallboards are included in the following table of imports covering the years 1927-1928.

Java and Madura

Boards and other material for flooring, walls, ceiling, or roofing of asbestos, cement, gypsum, sawdust	1927		1928		Percentages	
	Square metres	Value, $	Square metres	Value, $	1927	1928
United States (Pacific coast)	.....	.....	36,381	4,459	.....	38·43
United States (Atlantic coast)	18,589	9,137	46,559	20,656	72·94	49·50
Holland	.....	.....	8,120	1,402	.....	8·63
Other countries	6,895	1,344	3,329	927	27·06	3·53
Total	25,484	10,481	94,389	27,444	100·0	100·0

Stucco. Available information seems to show that the use of this commodity is very limited and imports negligible. One firm of leading architects maintained that to the best of their knowledge there is only one building in the whole of Java that has been stuccoed. In its stead asbestos-cement boards (Eternit Martinit, etc.) are extensively used.

IMPORT DUTIES

The following duties are levied on gypsum and gypsum products:—

Calcium sulphate (artificial)	Ad valorem—	6 per cent
Calcium sulphate (other, marble chalk, gypsum, etc., manure or paintware not included)	Ad valorem—	6 "
Crude (rock) gypsum	Free	
Gypsum wallboards	Ad valorem—	6 "
Gypsum wares	Ad valorem—	6 "
Plaster dressing	Ad valorem—	10 "
Plaster of Paris	Ad valorem—	6 "
Powdered gypsum	Ad valorem—	6 "
Fertilizer (if recognized as such)	Free	

In addition to this duty, all commodities are subject to an ad valorem "Statistical duty" of 5 guilder cents for every 20 guilders or part thereof.

Both import duty and statistical duty are levied on the c.i.f. value of the goods declared for entry.

POSSIBILITY OF CANADIAN GYPSUM PRODUCTS ENTERING THE JAVA MARKET

In view of the limited imports of manufactured gypsum (such as plaster of Paris, dental plaster, plaster dressings, etc.) it would be hardly worth while for Canadian manufacturers to attempt marketing these products in the Java market. Apart from this, there is of course the question as to whether Canadian gypsum products would be sufficiently competitive to secure an entry in the face of the present sources of supply.

For fertilizers it is very doubtful whether gypsum would have any market at all. Peanut growing is almost exclusively in the hand of native cultivators who could not afford any layout on scientific manuring.

For other "estate" crops double superphosphate, sulphate of ammonia, coprah, "bungkil" (cakes), etc., are largely used, and unless "land plaster" could successfully take the place of any of these manures at competitive prices, we do not believe this fertilizer would find an outlet in the Java market.

Hardwall plasters would not be sufficiently competitive against the local product which is the ordinary mixture of sand and lime, to which sometimes some cement or "trass" is added.

Insulating and acoustic plasters are unknown materials in Java. If any application could be found for them at all it would be in office buildings, for the average dwelling house in the Tropics is of open construction where sound and air have free play. It would be futile to attempt to use any sound-absorbing material that would overcome this convenience.

In regard to "Insulex" we are not very optimistic. Although new buildings and residential houses are everywhere seen in course of erection, the one consideration is "economy." As an instance, where houses were built only a few years ago with main outer walls 12 inches thick, these have now been gradually decreased to 6 inches, and many of the houses under construction have walls of even 2 to 3 inches in thickness. The tendency among the building trade is to obtain the highest interest on one's money with the smallest possible expenditure, regardless of "finish" or comfort. In one or two isolated instances buildings have been constructed with double walls and airspaces between them as a heat-insulator. While this method seems just as effective as if insulating material were used, it means a saving in expenditure. In Batavia there is to the best of our knowledge only one bank building that has "air-spaced" walls.

In regard to gypsum blocks and tiles for use in building construction, unless these could compete with locally manufactured bricks and cement tiles, there would be no market at all for them.

The only article that might capture a share of the Java market would be gypsum wallboards, and if there are any other Canadian manufacturers desirous of exporting this product to the Middle East, they would be well advised to communicate with the Trade Commissioner at Batavia (Java). Samples and full particulars covering its application, together with price c.i.f. main Java ports, or at least f.o.b. seaboard, with shipping weights and measurements should be sent in the first instance.

ITALY

A. B. Muddiman

Canadian Government Trade Commissioner, Italy
(April 1929)

Milan, April 19, 1929.—There are numerous plaster zones in Italy: in Piedmont, on the lake of Iseo, Reggio Emilia and especially in Tuscany, where there is the famous "Alabastro". With the exception of Tuscany, where they still employ the old methods with German machinery (furnaces) which can make the plaster constantly at 200° C., there are two kinds of plaster in Italy:

(1) Baked plaster } Sulphate of calcium.
(2) Crude plaster }

It may be "Idrato," that is, with water, or "Anhydrous," that is without water. The latter cannot be baked and then pulverized, as it would not set if mixed with water. It, therefore, is only ground and is called "Caolino." "Caolino" is in different kinds of whiteness and fineness and the price varies from lire 4·50 (24 cents) to lire 8 (42 cents) per 100 kilos (220 pound.) It is classified as follows:—

"Caolino" 0
"Caolino" 00 (of which a chemical analysis is given)
"Caolino" 000
"Caolino" Powder

There is a mixed quality of "Caolino" with talc which costs lire 9 (47 cents) per 100 kilos (220 pound). Crude plaster is obtained from the waste of the quarry. That used for chemical manures costs lire 2·50 (13 cents) to lire 4 (21 cents) per 100 kilos (220 pound).

Chemical Analysis of "Caolino" 00

	Per cent
Lime sulphate	97·95
Moisture	0·26
Free calcium oxide	1·16
Various salts oxide	0·14
Insoluble residue	0·44
Lime carbonate	0·05

There are special qualities of "Caolino" called "Volpiniti." These are heavier in weight and are specially used for mixtures of greases and oils. The price is from lire 8 (42 cents) to lire 8·50 (45 cents) per 100 kilos (220 pound).

All the above prices are from wagon on departure at Lovere. These wagons generally hold 15,000 kilos (33,000 pound). The goods are sent from the original place in jute sacks of 50 kilos (110 pound) each and the sacks cost lire 2 (10 cents) each. If it is for export to countries near Italy, such as Tripolitania, the plaster is packed in double sacks (two sacks), but if it is for a very long distance, such as America, the plaster is packed in wooden casks of 200 kilos (440 pound) each. These casks are lined inside with black waterproof parchment paper.

There are many qualities of baked plaster which are distinguished by the whiteness, grinding, and the way in which they set, namely:—

(1) Building Plaster (Wall Plaster). This costs lire 5 (26 cents) per 100 kilos (220 pound) and serves for ceiling repairs, etc. Also lire 8 (42 cents) per 100 kilos (220 pound).

(2) Furnace Plaster. This serves for castings of cements, cast-iron and porcelain. Price lire 7 (37 cents) per 100 kilos (220 pound).
(3) Stucco Plaster. This is used for ceiling and frame decorations and costs lire 7·50 (40 cents) per 100 kilos (220 pound). There is also a much finer quality which costs from lire 13 (71 cents) to lire 14 (77 cents) per 100 kilos (220 pound).
(4) Special Plasters. These are Fornage and Stucco plasters, but in superior quality to the above and cost lire 8·50 (45 cents) per 100 kilos (220 pound).
(5) Alabastrini Plaster. This is a quality of "presa" like the above, but the mineral is carefully chosen in quality and whiteness, and the baking is specially accurate; it is ground very finely. Price lire 9·50 (50 cents) per 100 kilos (220 pound).
(6) Plaster for Dentistry and Surgery. It is understood that this must be of the finest. Price lire 15 (79 cents) to lire 20 ($1.05) per 100 kilos (220 pound).

There are also boards made of plaster, such as insulating plaster, of the following sizes:—

Depth.. .. ..from cm. 2½ to cm. 10
Length.. .. ..2 metres
Width.. .. ..from cm. 25 to cm. 50

This plaster is used for ceiling purposes and making walls.

Stucco, treated as a chemical composition of baked plaster with vegetable fibres, is used on a large scale for decorating ceilings, theatres, and churches, etc. This product is obtained in great quantities in Italy and is exported to every country in the world.

There is a consumption of baked plaster in Italy of about 80,000,000 kilos (88,000 short tons) per year.

IMPORT DUTY

Crude plaster is exempt from duty. For the import of baked plaster, there is a duty of lire 0·30 ($0·058) gold per 100 kilos (220 pound). There is also a registration duty to pay at the customs, lire 0·30 ($0·058) gold per 100 kilos.

On the jute sacks (which weigh from gr. 300 to gr. 350) there is a duty of lire 31·70 ($6.01) gold per 100 kilos (220 pound), but this duty, which is paid at the Customs House, can be reimbursed, if it is proved that they are for temporary import only, usually a period of three months, and it may be prorogued under special concession. In this case, there is lire 0·20 (1 cent) paper to pay per sack for the Customs stamp.

CHINA

W. J. Riddiford

Assistant Government Trade Commissioner

China is a gypsum-producing country, this material being extensively mined in the Yangtsze valley, principally in the provinces of Szechuen, Hupeh, and Yuunan. As these three provinces are in the upper reaches of the Yangtsze river, the port of Hankow has long become the market place and main export centre for this commodity.

According to Customs Statistics, the exports from Hankow for 1926 were 332,307 piculs valued at Haikwan T591,506 and in 1927—354,257 piculs valued at Haikwan T708,514 (1 picul=133⅓ pounds and the value of Haikwan T1=G$0.76 in 1926 and G$0.69 in 1927. These figures being the average worked out by the Chinese Customs authorities).

The amount exported from Hankow, includes that exported abroad (to Japan and Foreign possessions in the Orient) which amounted to 62,517 piculs, valued at Haikwan T111,714 in 1926 and 40,835 piculs, valued at Haikwan T81,436 in 1927. As Customs statistics for 1928 are not yet out, there are no figures at hand, but it may be assumed that, owing to the political situation in China being more normal, the figures should be more favourable than 1926 and 1927.

As far as imports into China are concerned, there is no mention whatever. There may be small quantities of plaster of Paris, and wallboard coming into China under

the headings of Chemicals and Building material, but not in appreciable quantities. Crude gypsum is certainly not being imported at all, owing to its cheap cost in this country.

Uses in China. In China the chief uses for gypsum are for manufacturing cement, medicinal purposes, and Chinese-made plaster of Paris, etc., and the supply seems to be quite sufficient to meet the demand.

To the knowledge of this office, there is only one foreign concern, situated in the village of Tsinwan, New Territory, Honk Kong, turning out gypsum products, such as enumerated in your questionnaire. This factory is not a large-sized one and seems to execute orders for clients requiring gypsum products, and very little effort is being made by them to popularize their products, which seems to be rather strange.

In such a modern and up-to-date city as Shanghai, very little is heard of gypsum products for building purposes, so this line of business can be considered to be in its infancy in this territory.

A study of these reports in detail shows that the cost of gypsum products laid down in the different countries is the governing factor in nearly all cases. There are undoubtedly chances for the expansion of the Canadian export trade in gypsum and gypsum products, but it will be necessary for any company contemplating embarking on an extensive export business, to thoroughly investigate the possibilities first. In this connexion the Canadian Government Trade Commissioners in the several countries are only too willing to assist any company in such an investigation and by writing to them they will gladly co-operate to the fullest extent.

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Department of Mines, Mines Branch

TABLE I

***Output* of Crude and Milled Asbestos and 'Asbestic', Calendar Years 1910-1929**

Calendar year	Number of operating companies	Average number of men employed: Mine	Mill	Total	Wages paid *d*	Number of fatal accidents	Rock Mined: Short tons	Tons per mine worker	Rock Milled: Short tons	Tons per mill worker	Per cent rock milled to rock mined *a*	Output: Crude Asbestos (by Grades): *No. 1* Short tons	*No. 2* Short tons	*Other* Short tons	Total	Ratio crude to milled output
1910	14	2,519	1,174	3,693	$1,528,544	8	2,035,705	808	1,556,015	1,325	76	2,181	3,268	.....	5,449	1 : 17
1911	10	2,061	646	2,707	1,231,896	3	1,759,064	853	1,384,691	2,143	84	1,468	3,594	.....	5,062	1 : 18
1912	10	1,945	1,010	2,955	1,401,653	9	1,870,608	962	1,630,743	1,615	87	1,459	3,290	.....	4,749	1 : 21
1913	9	1,933	1,018	2,951	1,687,957	10	2,527,410	1,308	2,110,990	2,074	84	2,015	3,010	.....	5,025	1 : 25
1914	9	1,890	1,102	2,992	1,283,977	5	2,151,423	1,138	1,717,629	1,559	80	1,451	2,611	.....	4,062	1 : 25
1915	8	1,528	866	2,394	1,091,076	6	2,136,863	1,398	1,795,472	2,073	84	2,306	1,681	.....	3,987	1 : 26
1916	10	1,653	1,168	2,821	1,659,913	12	2,291,132	1,412	1,882,461	1,560	80	1,902	2,742	*b* 1,453	6,097	1 : 18
1917	13	1,865	1,249	3,114	2,312,110	2	2,635,010	1,413	2,260,191	1,810	86	2,103	3,128	1,037	6,268	1 : 22
1918	12	1,674	1,400	3,074	2,871,643	17	2,462,381	1,471	2,185,572	1,561	89	1,339	2,497	477	4,313	1 : 32
1919	15	2,060	1,507	3,567	3,954,407	7	3,082,384	1,496	2,636,783	1,750	86	1,474	2,022	389	4,065	1 : 38
1920	18	2,150	1,422	3,572	4,765,305	17	3,142,827	1,462	2,668,946	1,877	85	1,394	1,394	770	4,098	1 : 40
1921	15	1,684	886	2,570	2,399,406	7	2,063,821	1,226	1,673,685	1,889	81	653	1,741	668	3,062	1 : 35
1922	12	1,613	805	2,418	2,187,738	10	2,562,933	1,589	2,166,385	2,691	85	759	2,190	120	3,069	1 : 45
1923	14	1,651	1,370	3,021	3,253,616	8	3,768,542	2,283	3,217,580	2,349	85	1,029	3,066	220	4,315	1 : 50
1924	15	1,429	1,043	2,472	2,688,845	7	3,323,505	2,326	2,760,470	2,647	83	995	2,805	190	3,990	1 : 52
1925	*c* 14	1,315	1,150	2,465	2,717,022	9	4,121,258	3,134	3,386,752	2,945	82	806	2,701	260	3,767	1 : 69
1926	8	1,521	1,135	2,656	3,215,284	12	4,483,375	2,947	4,002,626	3,527	89	842	2,952	328	4,122	1 : 72
1927	7	1,707	1,128	2,835	3,411,758	12	4,834,761	2,838	3,820,024	3,386	79	527	2,835	370	3,732	1 : 71
1928	7	1,739	1,284	3,023	3,617,574	8	5,171,060	2,973	4,118,044	3,201	80	706	2,784	507	3,997	1 : 68
1929	7	1,835	1,359	3,194	3,990,736	7	6,208,970	3,836	4,384,120	3,226	71	883	2,864	1,053	4,800	1 : 64
Total	.....	.....	.....	.....	51,270,461	176	62,633,032	.....	51,299,179	.....	.....	26,292	53,895	7,842	88,029	.....
Twenty-year average.	11	1,789	1,136	2,925	2,563,523	9	3,131,652	1,844	2,564,959	2,260	82	1,315	2,695	(523)	4,401	1 : 39

Calendar year	Output: Mill Fibre No. 1: Short tons	Per cent	Output: Mill Fibre No. 2: Short tons	Per cent	Output: Mill Fibre No. 3: Short tons	Per cent	Total	Milled fibre produced: To rock mined	To rock milled	Average tons milled fibre produced: Per mill worker	Per total workmen	'Asbestic': Output Short tons	Tons 'Asbestic' to: Tons rock milled	Tons mill fibre output
								%	%					
1910	16,720	17·6	56,395	59·4	21,866	23·0	94,981	4·67	6·10	81	26	24,745	1 : 63	1 : 4
1911	20,379	22·3	39,289	43·0	31,572	34·7	91,240	5·19	6·59	141	34	30,189	1 : 49	1 : 3
1912	21,522	21·9	36,872	37·6	39,616	40·5	98,010	4·24	6·01	97	33	25,452	1 : 64	1 : 4
1913	23,444	18·4	58,592	45·9	45,503	35·7	127,539	5·05	6·04	125	43	24,795	1 : 85	1 : 5
1914	16,144	15·6	58,362	56·3	29,101	28·1	103,607	4·82	6·03	94	35	20,942	1 : 82	1 : 5
1915	21,709	21·2	41,973	40·9	38,890	37·9	102,572	4·80	5·71	118	43	35,429	1 : 51	1 : 3
1916	7,228	6·4	20,577	18·3	84,345	75·3	112,150	4·90	6·15	96	40	51,373	1 : 45	1 : 2
1917	9,338	6·9	30,018	22·2	96,119	70·9	135,475	5·14	5·99	108	44	18,285	1 : 123	1 : 7
1918	8,772	6·3	30,414	21·9	99,957	71·8	139,143	5·65	6·37	99	45	16,860	1 : 130	1 : 8
1919	9,898	6·4	30,301	19·8	113,303	73·8	153,502	4·98	5·82	102	43	54,137	1 : 49	1 : 3
1920	9,316	5·6	26,626	16·1	129,406	78·3	165,348	5·26	6·20	116	46	20,903	1 : 128	1 : 8
Total or average for period	164,470	12·4	429,419	32·5	729,678	55·1	1,323,567	5·10	6·10	105	39	323,110	1 : 67	1 : 4

Calendar year	Spinning stock: Short tons	Per cent	Shingle stock: Short tons	Per cent	Paper stock and millboard: Short tons	Per cent	Fillers, floats, and other short fibres: Short tons	Per cent	Total	Sand and gravel	Tons 'Asbestic' to: Tons rock milled	Tons mill fibre output
					f		*g*					
1921	9,914	9·2	19,325	17·9	36,383	33·7	42,276	39·2	107,898	†12,397	1 : 135	1 : 9
1922	11,030	7·9	18,587	13·4	47,126	33·9	62,200	44·8	139,943	†16,011	1 : 135	1 : 9
1923	10,439	4·7	28,861	13·4	69,251	32·0	107,622	49·9	216,173	†16,171	1 : 199	1 : 13
1924	8,623	4·2	15,734	7·6	73,282	35·6	108,376	52·6	206,015	16,464	1 : 168	1 : 13
1925	13,509	5·2	25,301	9·7	94,350	36·1	128,382	49·0	261,542	16,409	1 : 206	1 : 16
1926	13,839	4·7	39,678	13·4	101,293	35·2	141,272	46·7	296,082	15,672	1 : 255	1 : 19
1927	12,273	4·6	45,784	17·2	59,490	22·4	148,430	55·8	265,977	20,280	1 : 188	1 : 13
1928	14,051	5·2	41,975	15·6	71,141	26·3	142,701	52·9	269,868	23,441	1 : 176	1 : 12
1929	19,615	6·4	34,038	10·9	91,892	29·5	160,859	51·7	306,404	18,976	1 : 231	1 : 16
Total from 1921	113,293	5·4	269,283	13·0	644,208	31·1	1,042,118	50·5	2,068,902	155,821	1 : 190	1 : 13

a Between 15 and 20 per cent of the tonnage mined consists of waste rock, some of which goes to the dumps without treatment, as being too lean or barren in asbestos for milling; while in some districts all rock tonnage passes directly through mills. *b* Included as "*milled*" product in 1916, now revised. *c* Several of these companies were amalgamated at the close of the year. *d* To mine and mill employees only.

f Of the total "millboard and paper stock" produced during the years 1921, 1922, and 1923, "millboard" contributed 9·3 per cent. of the total quantity of "floats, fillers, and other short fibres" produced during 1921, 1922, and 1923. *g* "Paper Filler" contributed 61 per cent. † Shipments.

TABLE Ia

Recovery of Milled Fibres and of 'Asbestic', 1910-1929

(Percentages of milled grades to tonnage of rock milled)

Calendar year	Tonnage rock milled	Milled No. 1	Milled No. 2	Milled No. 3	Total fibre	Asbestic (by-product)	Total mill recovery*
	Short tons						
1910	1,556,015	1·07	3·62	1·41	6·10	1·59	7·69
1911	1,384,691	1·47	2·84	2·28	6·59	2·18	8·77
1912	1,630,743	1·32	2·26	2·43	6·01	1·56	7·57
1913	2,110,990	1·11	2·78	2·15	6·04	1·16	7·20
1914	1,717,629	0·94	3·39	1·70	6·03	1·20	7·23
1915	1,795,472	1·22	2·33	2·16	5·71	1·97	7·68
1916	1,822,461	0·39	1·13	4·63	6·15	2·82	8·97
1917	2,260,191	0·41	1·33	4·25	5·99	0·80	6·79
1918	2,185,572	0·40	1·39	4·58	6·37	0·77	7·14
1919	2,636,783	0·37	1·15	4·30	5·82	2·05	7·87
1920	2,668,946	0·35	1·00	4·85	6·20	0·78	6·98
Period 1910-1920	21,769,493	0·76	1·97	3·35	6·08	1·48	7·56

Calendar year	Tonnage rock milled	Milled product recovered: *a*	*b*	*c*	*d*	Total fibre	Asbestic (by-product)	Total mill recovery*
	Short tons							
1921	1,673,685	0·59	1·16	2·17	2·53	6·45	0·75	7·20
1922	2,166,385	0·51	0·86	2·17	2·87	6·41	0·74	7·15
1923	3,217,580	0·32	0·90	2·16	3·34	6·72	0·50	7·22
1924	2,760,470	0·31	0·57	2·66	3·92	7·46	0·59	8·05
1925	3,386,752	0·40	0·75	2·78	3·79	7·72	0·48	8·20
1926	4,002,626	0·35	0·99	2·53	3·53	7·40	0·39	7·79
1927	3,820,024	0·32	1·20	1·56	3·88	6·96	0·53	7·49
1928	4,118,044	0·34	1·02	1·73	3·46	6·55	0·57	7·12
1929	4,384,120	0·45	0·77	2·10	3·67	6·99	0·43	7·42
Period 1921-1929	29,529,686	0·39	0·91	2·18	3·53	7·01	0·53	7·54

*Balance to waste or dumps. *a* Spinning stock. *b* Shingle stock. *c* Paper stock and millboard. *d* Fillers, floats, and other short fibres.

TABLE II

Annual *Shipments* of Asbestos, 1879–1902

(As reported by Operators)

Calendar year	Total number producers	Firsts			Seconds			Thirds			Fibre, paper stock and waste					Total asbestos shipped			'Asbestic'			Range of prices Dollars per short ton, f.o.b. mines									
																						Firsts		Seconds		Thirds		Fibre		Paper	
		Short tons	Value	Average	Short tons	Value	Average	Short tons	Value	Average	Short tons	Value	Average	Quantity	Value	Short tons	Value	Average	Short tons	Value	Average	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
			$	$		$	$		$	$		$	$	%	%		$	$		$	$										
1879	2	300	19,500	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	*g*	*g*	300	19,500	65	.....	.....	.....	.....	65	.....	.....	.....	.....	.....	.....	.....	.....
1880	2	380	24,700	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	380	24,700	65	.....	.....	.....	.....	65	.....	.....	.....	.....	.....	.....	.....	.....
1881	3	540	35,100	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	540	35,100	65	.....	.....	.....	.....	65	.....	.....	.....	.....	.....	.....	.....	.....
1882	3	810	52,650	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	810	52,650	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1883	4	805	61,250	76	150	7,500	50	.....	.....	.....	.....	.....	.....	.....	.....	955	68,750	72	.....	.....	.....	80	65	.....	50	.....	.....	.....	.....	.....	.....
1884	6	996	72,507	73	57	1,710	30	88	880	10	.....	.....	.....	.....	.....	1,141	75,097	66	.....	.....	.....	80	65	.....	30	.....	10	.....	.....	.....	.....
1885	7	1,861	133,856	72	120	3,600	30	459	4,985	11	.....	.....	.....	.....	.....	2,440	142,441	58	.....	.....	.....	80	60	.....	30	12	10	.....	.....	.....	.....
1886	8	2,566	181,651	71	477	19,850	42	415	4,750	11	.....	.....	.....	.....	.....	3,458	206,251	60	.....	.....	.....	80	40	45	40	12	10	.....	.....	.....	.....
1887	10	2,218	167,391	75	798	38,990	49	†1,603	†20,595	13	.....	.....	.....	.....	.....	†4,619	†226,976	49	.....	.....	.....	80	60	50	30	15	10	.....	.....	.....	.....
1888	9	2,123	182,080	86	1,120	56,235	50	1,161	16,692	14	.....	.....	.....	.....	.....	4,404	255,007	58	.....	.....	.....	90	70	60	40	20	10	.....	.....	.....	.....
1889	13	3,192	303,235	95	1,367	84,699	62	1,554	38,620	25	.....	.....	.....	.....	.....	6,113	426,554	70	.....	.....	.....	100	80	80	60	35	15	.....	.....	.....	.....
1890	16	2,952	930,590	188	2,463	235,535	96	2,445	94,115	38	.....	.....	.....	.....	.....	9,860	1,260,240	128	.....	.....	.....	250	125	100	60	50	30	.....	.....	.....	.....
1891	18	5,297	741,165	140	1,326	112,840	85	2,656	145,873	55	.....	.....	.....	.....	.....	9,279	999,878	108	.....	.....	.....	200	125	110	80	60	30	.....	.....	.....	.....
1892	19	940	136,365	145	1,349	99,185	74	2,585	137,719	38	*a* 208	17,193	83	3·4	4·4	6,082	390,462	64	.....	.....	.....	175	110	100	60	50	10	.....	83	.....	.....
1893	13	843	105,400	125	2,346	126,840	54	2,943	68,244	23	*a* 199	9,672	49	3·1	3·1	6,331	310,156	87	.....	.....	.....	150	120	100	50	47	16	.....	49	.....	.....
1894	9	1,228	155,162	126	3,325	196,786	59	2,915	64,960	22	*b* 162	3,917	24	2·1	0·9	7,630	420,825	55	.....	.....	.....	180	110	65	50	35	25	.....	30	.....	.....
1895	10	780	88,800	114	2,184	139,323	64	3,514	123,020	25	*b* 2,278	17,032	7	26·0	4·6	8,756	368,175	42	.....	.....	.....	130	100	75	60	50	20	.....	20	.....	.....
1896	10	840	99,132	118	1,912	107,775	56	1,498	59,568	40	*c* 6,642	156,591	24	61·0	37·0	10,892	423,066	39	1,358	6,790	5 00	150	100	75	40	50	30	.....	30	18	12
1897	10	1,443	145,070	101	2,475	107,653	44	3,696	61,750	17	*d* 5,588	85,055	15	42·2	21·3	13,202	399,528	30	17,240	45,840	2 66	110	80	65	35	25	7	12	10	30	10
1898	7	1,011	103,130	102	2,878	157,825	55	125	2,374	19	*e*12,110	211,802	17	75·1	44·6	16,124	475,131	29	7,761	16,066	2 10	110	100	60	35	26	18	20	.....	30	10
1899	6	1,297	129,700	100	2,644	140,200	53	5,571	113,133	20	*e* 8,278	85,602	10	46·5	18·3	17,790	468,635	27	7,746	17,214	2 22	100	.....	65	50	20	9	12	9	.....	10
1900	8	1,850	197,636	107	2,543	184,700	73	3,514	54,685	16	*e*13,714	292,865	21	63·4	40·1	21,621	729,886	34	7,520	18,545	2 47	125	100	75	50	20	10	40	25	20	10
1901	9	2,134	352,789	165	2,993	249,705	83	18,287	446,759	24	*d* 9,478	199,392	21	28·8	16·0	32,892	1,248,645	38	7,325	11,114	1 52	200	150	125	75	60	10	40	9	25	15
1902	10	1,229	206,062	168	2,933	285,321	97	11,738	273,625	23	*d*14,329	362,680	25	48·4	32·2	30,219	1,126,688	37	10,197	21,631	2 20	220	140	110	70	60	20	.....	.....	20	18
Total for period	.....	39,635	4,624,921	117	35,460	2,356,272	66	67,757	1,731,347	26	72,986	1,441,801	20	.....	.....	215,838	10,154,341	47	59,047	137,200	2 32	250	65	110	30	83	9	60	7	30	10
*Per cent.	.....	18	46	.....	17	23	.....	31	17	.....	34	14	.....	.....	.....	100	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

a Fibre; *b* Fibre and waste; *c* Of which paper stock was 1,500 tons valued at $22,500; *d* Paper only; *e* Paper and fibre; *g* Per cent "fibre, paper stock and waste" to total asbestos shipped.

† Includes 400 tons of actinolite valued at $6,000, included with asbestos that year.

* Per cent of total asbestos shipments for period.

TABLE III

Annual *Shipments* of Crude and Milled Asbestos and of 'Asbestic', Calendar Years 1903-1929

(As reported by Operators)

Calendar year	Crude No. 1			Crude No. 2			Fiberized Crude No. 3			Total Crude					Mill Fibre No. 1			Mill Fibre No. 2			Mill Fibre No. 3			Total Mill Fibre					Total Crude and Milled			'Asbestic'		
	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Per cent of yearly total	Value	Per cent of yearly value	Average per ton	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Per cent of yearly total	Value	Per cent of yearly value	Average per ton	bShort tons	Value	Average per ton	Short tons	Value	Average per ton
		$	$		$	$		$	$		%	$	%	$		$	$		$	$		$	$		%	$	%	$		$	$		$	%
1903	1,001	157,097	157	2,133	204,770	96	.....	.....	.....	3,134	10·1	361,867	39·5	115	4,891	187,293	38	11,437	225,314	20	11,667	141,414	12	27,995	89·9	554,021	60·5	20	31,129	915,888	30	10,548	13,869	1·31
1904	1,619	252,689	156	2,791	282,185	101	.....	.....	.....	4,410	12·4	534,874	44·1	121	9,860	294,972	30	9,658	204,860	21	11,683	178,796	15	31,201	87·6	678,628	55·9	22	35,611	1,213,502	34	12,854	12,850	1·00
1905	1,331	231,373	174	2,436	241,486	99	.....	.....	.....	3,767	7·4	472,859	32·3	126	5,331	244,361	46	25,796	541,825	21	15,775	227,314	14	46,902	92·6	1,013,500	68·2	22	50,669	1,486,359	29	17,594	16,900	0·96
1906	1,357	308,280	227	2,484	327,065	132	.....	.....	.....	3,841	6·4	635,345	31·2	165	9,152	448,620	49	31,189	691,903	22	16,579	260,560	16	56,920	93·6	1,401,083	68·8	25	60,761	2,036,428	34	21,424	23,715	1·11
1907	1,419	374,275	264	2,908	456,357	157	.....	.....	.....	4,327	7·0	830,632	33·4	192	3,675	300,925	82	43,821	1,247,078	28	10,307	106,132	10	57,803	93·0	1,654,135	66·6	29	62,130	2,484,767	40	28,296	20,275	0·72
1908	858	257,752	301	2,488	411,480	165	.....	.....	.....	3,346	5·0	669,232	26·2	200	5,283	425,448	81	45,545	1,345,750	29	12,374	114,931	9	63,202	95·0	1,886,129	73·8	30	66,548	2,555,361	38	24,225	17,974	0·74
1909	912	246,655	270	2,162	328,855	152	.....	.....	.....	3,074	4·9	575,510	25·2	187	14,776	785,731	53	32,417	800,728	25	13,082	122,618	9	60,275	95·1	1,709,077	74·8	28	63,349	2,284,587	36	23,951	17,188	0·72
1910	1,817	471,675	260	1,923	192,833	100	.....	.....	.....	3,740	4·8	664,508	26·0	178	13,480	735,244	55	43,414	1,013,251	23	16,874	142,971	8	73,768	95·2	1,891,466	74·0	26	77,508	2,555,974	33	24,707	17,629	0·71
1911	1,301	342,855	263	3,563	402,107	113	.....	.....	.....	4,864	4·8	744,962	25·5	153	18,315	916,678	50	47,826	991,370	21	30,388	269,052	9	96,529	95·2	2,177,100	74·5	23	101,393	2,922,062	29	26,021	21,046	0·81
1912	1,938	510,154	263	3,725	380,197	102	.....	.....	.....	5,663	5·1	890,351	28·6	157	21,679	945,994	44	44,819	895,322	20	39,400	385,905	10	105,898	94·9	2,227,221	71·4	21	111,561	3,117,572	28	24,740	19,707	0·80
1913	1,853	531,200	287	3,807	457,962	120	.....	.....	.....	5,660	4·1	989,162	25·8	175	26,198	1,229,908	47	60,164	1,201,215	20	44,929	410,624	9	131,291	95·9	2,841,747	74·2	22	136,951	3,830,909	28	24,135	19,016	0·79
1914	1,336	402,417	301	2,812	370,776	132	.....	.....	.....	4,148	4·3	773,193	26·7	186	19,388	932,893	48	47,851	963,973	20	25,155	222,207	9	92,394	95·7	2,119,073	73·3	23	96,542	2,892,266	30	21,031	17,540	0·83
1915	2,737	754,174	276	2,633	322,123	122	.....	.....	.....	5,370	4·8	1,076,297	30·3	200	24,471	1,287,502	53	42,031	840,132	20	39,270	349,235	9	105,772	95·2	2,476,869	69·7	23	111,142	3,553,166	32	25,700	21,819	0·85
1916	2,197	1,028,984	468	2,924	790,398	270	1,452	153,587	106	6,573	4·9	1,972,969	37·9	317	9,273	784,582	85	18,678	828,746	44	98,915	1,613,500	16	126,866	95·1	3,226,828	62·1	26	133,439	5,199,797	39	20,710	29,072	1·40
1917	2,310	1,739,830	753	2,137	839,342	393	936	168,899	180	5,383	4·0	2,748,071	38·3	510	8,409	1,093,599	98	16,569	854,279	52	105,141	2,487,150	24	130,119	96·0	4,435,028	61·7	34	135,502	7,183,099	53	18,279	47,284	2·59
1918	1,837	1,688,247	919	1,334	612,675	459	521	177,441	341	3,692	2·6	2,478,363	27·7	671	10,656	1,871,503	176	11,890	986,382	83	115,224	3,600,656	31	137,770	97·4	6,458,441	72·3	47	141,462	8,936,804	63	16,797	33,993	2·02
1919	1,099	1,379,742	1,255	2,234	1,661,025	744	595	173,355	291	3,938	2·9	3,214,022	29·5	818	13,400	2,999,221	224	15,590	1,186,782	76	103,847	3,509,427	34	132,837	97·1	7,695,430	70·5	58	136,765	10,909,452	80	22,471	65,917	2·93
1920	1,043	1,519,698	1,457	2,113	2,095,754	992	738	196,310	266	3,894	2·2	3,811,762	25·9	979	10,548	3,430,821	325	22,470	2,505,645	112	141,705	4,986,371	35	174,723	97·8	10,922,837	74·1	63	178,617	14,734,599	82	20,956	57,602	2·75
															Mill: Spinning Stock			Mill: Shingle Stock			a Mill: All Other													
1921	222	273,007	1,230	563	334,132	594	141	59,350	421	926	1·2	666,489	13·6	720	4,969	1,272,700	256	10,990	1,031,634	94	63,479	1,920,871	30	79,438	98·8	4,225,205	86·4	53	80,364	4,891,694	60	†12,397	14,536	1·17
1922	433	277,492	641	1,351	447,845	331	328	64,506	196	2,112	1·4	789,843	14·3	374	6,739	1,326,920	197	19,647	1,085,174	55	119,197	2,335,383	21	145,583	98·6	4,747,477	85·7	34	147,695	5,537,320	38	†16,011	15,403	0·96
1923	603	275,101	456	3,246	794,834	245	5	1,306	261	3,854	1·8	1,071,241	14·3	278	11,708	1,456,904	124	25,533	1,215,892	48	174,216	3,760,675	22	211,457	98·2	6,433,471	85·7	30	215,311	7,504,712	35	†16,171	17,794	1·18
1924	980	403,304	412	3,808	762,166	200	71	12,080	170	4,859	2·3	1,177,550	17·6	242	10,205	1,112,796	109	19,292	903,775	47	174,924	3,506,775	20	204,421	97·7	5,523,346	82·4	27	209,280	6,700,896	32	16,464	9,934	0·60
1925	1,046	381,926	365	3,777	778,895	206	348	49,030	141	5,171	1·9	1,209,851	13·5	234	16,070	1,710,379	106	30,010	1,523,980	51	222,273	4,533,336	21	268,353	98·1	7,767,695	86·5	29	273,524	8,977,546	33	16,865	10,814	0·64
1926	1,108	401,373	370	3,494	802,304	230	446	92,394	207	5,048	1·8	1,305,071	12·9	259	15,182	1,885,835	124	36,497	2,139,780	59	222,676	4,768,737	21	274,355	98·2	8,794,352	87·1	32	279,403	10,099,423	36	15,672	10,257	0·65
1927	1,107	468,980	424	3,014	752,277	250	667	151,231	227	4,788	1·7	1,372,488	12·9	287	14,348	1,855,425	129	44,573	2,889,124	65	211,069	4,503,976	21	269,990	98·3	9,248,525	87·1	34	274,778	10,621,013	37	20,280	12,407	0·61
1928	893	477,640	535	2,757	818,174	297	516	65,868	128	4,166	1·5	1,361,682	12·1	327	13,570	2,017,884	149	34,961	2,580,160	74	220,336	5,278,634	24	268,867	98·5	9,876,678	87·9	37	273,033	11,238,360	41	22,787	13,469	0·59
1929	802	447,259	558	2,625	870,888	332	931	168,226	181	4,358	1·4	1,486,373	11·3	341	17,545	3,110,848	177	34,177	2,572,216	75	249,975	6,003,144	24	301,697	98·6	11,686,208	88·7	39	306,055	13,172,581	43	18,976	7,303	0·38
Total (1903-29)	35,159	15,612,079	.....	71,242	16,738,905	.....	7,695	1,533,583	.....	114,096	*3·0	33,884,567	**21·5	.....	339,121	34,664,986	.....	826,845	33,266,190	.....	2,510,460	55,740,394	.....	3,676,426	97·0	123,671,570	78·5	.....	3,790,522	157,556,137	42	540,042	585,313	.....

* Per cent of 1903-1929 total quantity. ** Per cent of 1903-1929 total value. † Quebec Bureau of Mines reports. *a* See Table IV for details. *b* Excludes 'Asbestic'.

TABLE IV

Detail of "All Other" Mill Shipments, 1921–1929

—	Millboard			Paper stock			Paper fillers			Floats, other short fibres, etc.			Total "All other" mill fibres	
	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Value
		$	$		$	$		$	$		$	$		$
1921	3,242	222,343	69	26,944	1,263,266	47	20,262	308,379	15	13,031	126,683	10	63,479	1,920,871
1922	4,386	128,164	29	44,135	1,426,533	32	43,275	565,671	13	27,401	215,015	8	119,197	2,335,383
1923	7,268	089,200	26	69,745	2,292,804	33	62,689	980,964	16	34,516	297,707	9	174,216	3,760,675

—	Millboard and paper stock			Paper fillers, floats, other short fibres, etc.			Total "All other" mill fibres	
	Short tons	Value	Average per ton	Short tons	Value	Average per ton	Short tons	Value
		$	$		$	$		$
1924	70,387	2,208,698	32	104,537	1,298,077	12	174,924	3,506,775
1925	93,935	2,915,046	31	128,338	1,618,290	13	222,273	4,533,336
1926	86,746	2,940,675	34	135,930	1,828,062	13	222,676	4,768,737
1927	60,396	2,284,021	38	150,673	2,219,955	15	211,069	4,503,976
1928	79,443	3,038,227	39	141,893	2,240,407	16	220,336	5,278,634
1929	91,157	3,515,209	39	158,818	2,487,935	16	249,975	6,003,144

Summary of Shipments (as reported by operators)

	Short tons	Valued at
Table II—Firsts, Seconds, and Thirds (1879–1902)	215,838	$10,154,341
Table III—Crude and Milled asbestos (1903–1929)	3,790,522	157,556,137
	4,006,360	167,710,478

	Short tons	Valued at
Table II—Shipments of 'Asbestic' (1896-1902)	59,047	$137,200
Table III—Shipments of 'Asbestic' (1903-1929)	540,042	585,313
	599,089	722,513

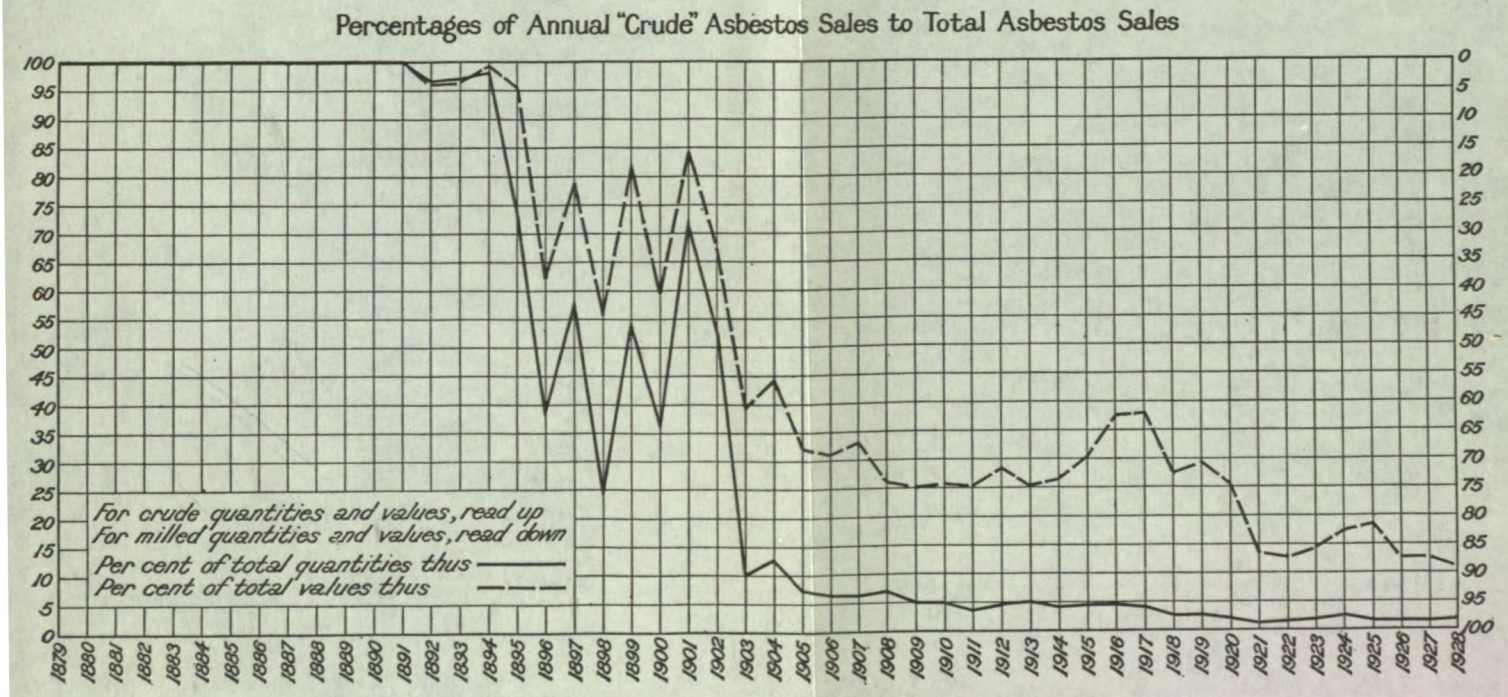
Total "Asbestos and Asbestic" 4,605,449 short tons, valued at $168,432,991.

TABLE IVa

Annual Shipments of Crude and Milled Asbestos—In Percentages of Total Sales

—	Percentage of Quantities										Percentage of Values									
	Crude Asbestos				Milled Fibres					Total	Crude Asbestos				Milled Fibres					Total
	No. 1	No. 2	No. 3	*Total*	No. 1	No. 2	No. 3	—	*Total*		No. 1	No. 2	No. 3	*Total*	No. 1	No. 2	No. 3	—	*Total*	
1903	3·2	6·9	.....	*10·1*	15·7	36·7	37·5	.....	*89·9*	100	17·2	22·3	.....	*39·5*	20·4	24·6	15·5	.....	*60·5*	100
1904	4·5	7·9	.....	*12·4*	35·6	27·1	24·9	.....	*87·6*	100	20·8	23·3	.....	*44·1*	24·3	16·9	14·7	.....	*55·9*	100
1905	2·6	4·8	.....	*7·4*	10·5	50·9	31·2	.....	*92·6*	100	15·6	16·7	.....	*32·3*	16·4	36·5	15·3	.....	*68·2*	100
1906	2·2	4·2	.....	*6·4*	15·1	51·3	27·2	.....	*93·6*	100	15·1	16·1	.....	*31·2*	22·0	34·0	12·8	.....	*68·8*	100
1907	2·3	4·7	.....	*7·0*	5·9	70·5	16·6	.....	*93·0*	100	15·1	18·3	.....	*33·4*	12·1	50·2	4·3	.....	*66·6*	100
1908	1·3	3·7	.....	*5·0*	7·9	68·4	18·7	.....	*95·0*	100	10·1	16·1	.....	*26·2*	16·7	52·7	4·4	.....	*73·8*	100
1909	1·4	3·5	.....	*4·9*	23·3	51·2	20·6	.....	*95·1*	100	10·8	14·4	.....	*25·2*	34·4	35·1	5·3	.....	*74·8*	100
1910	2·3	2·5	.....	*4·8*	17·4	56·0	21·8	.....	*95·2*	100	18·5	7·5	.....	*26·0*	28·8	39·6	5·6	.....	*74·0*	100
1911	1·3	3·5	.....	*4·8*	19·1	47·2	29·9	.....	*95·2*	100	11·7	13·8	.....	*25·5*	31·4	33·9	9·2	.....	*74·5*	100
1912	1·7	3·4	.....	*5·1*	19·4	40·2	35·3	.....	*94·9*	100	16·4	12·2	.....	*28·6*	30·3	28·7	12·4	.....	*71·4*	100
1913	1·4	2·7	.....	*4·1*	19·1	43·9	32·9	.....	*95·9*	100	13·9	11·9	.....	*25·8*	32·1	31·4	10·7	.....	*74·2*	100
1914	1·5	2·8	.....	*4·3*	20·1	49·6	26·0	.....	*95·7*	100	13·9	12·8	.....	*26·7*	32·3	33·3	7·7	.....	*73·3*	100
1915	2·5	2·3	.....	*4·8*	22·0	37·8	35·4	.....	*95·2*	100	21·2	9·1	.....	*30·3*	36·2	23·6	9·9	.....	*69·7*	100
1916	1·6	2·2	a1·1	*4·9*	6·9	14·1	74·1	.....	*95·1*	100	19·8	15·2	a2·9	*37·9*	15·1	15·9	31·1	.....	*62·1*	100
1917	1·7	1·6	0·7	*4·0*	6·2	12·2	77·6	.....	*96·0*	100	24·2	11·7	2·4	*38·3*	15·2	11·9	34·6	.....	*61·7*	100
1918	1·3	0·9	0·4	*2·6*	7·5	8·4	81·5	.....	*97·4*	100	18·9	6·8	2·0	*27·7*	20·9	11·0	40·4	.....	*72·3*	100
1919	0·8	1·6	0·5	*2·9*	9·8	11·4	75·9	.....	*97·1*	100	12·7	15·2	1·6	*29·5*	27·5	10·9	32·1	.....	*70·5*	100
1920	0·6	1·2	0·4	*2·2*	5·9	12·6	79·3	.....	*97·8*	100	10·3	14·2	1·4	*25·9*	23·3	17·0	33·8	.....	*74·1*	100
1921	0·3	0·7	0·2	*1·2*	b6·2	c13·7	d37·6	e41·3	*98·8*	100	5·6	6·8	1·2	*13·6*	b26·0	c21·1	d30·4	e8·9	*86·4*	100
1922	0·3	0·9	0·2	*1·4*	4·6	13·2	32·9	50·9	*98·6*	100	5·0	8·9	0·4	*14·3*	24·0	19·6	28·1	14·0	*85·7*	100
1923	0·3	1·5	.....	*1·8*	5·4	11·9	35·8	45·1	*98·2*	100	3·7	10·6	.....	*14·3*	19·4	16·2	33·1	17·0	*85·7*	100
1924	0·5	1·8	.....	*2·3*	4·9	9·2	33·6	50·0	*97·7*	100	6·0	11·4	0·2	*17·6*	16·6	13·5	33·0	19·3	*82·4*	100
1925	0·4	1·4	0·1	*1·9*	5·9	11·0	34·3	46·9	*98·1*	100	4·3	8·7	0·5	*13·5*	18·1	17·0	32·5	18·9	*86·5*	100
1926	0·4	1·3	0·1	*1·8*	5·4	13·2	31·0	48·6	*98·2*	100	4·0	7·9	1·0	*12·9*	18·7	11·8	29·1	27·5	*87·1*	100
1927	0·4	1·1	0·2	*1·7*	5·2	16·3	22·0	54·8	*98·3*	100	4·4	7·1	1·4	*12·9*	17·5	27·2	21·5	20·9	*87·1*	100
1928	0·3	1·0	0·2	*1·5*	5·0	12·9	29·1	51·5	*98·5*	100	4·3	7·3	0·5	*12·1*	18·0	23·0	27·0	19·9	*87·9*	100
1929	0·3	0·9	0·2	*1·4*	5·7	11·2	29·9	51·8	*98·6*	100	3·4	6·6	1·3	*11·3*	23·6	19·5	26·9	18·7	*88·7*	100
Average	0·9	1·9	0·2	*3·0*	8·9	21·8	67·3	.....	*97·0*	100	10·0	10·5	1·0	*21·5*	22·0	21·1	35·4		*78·5*	100

a Fiberized crude. *b* Spinning stock. *c* Shingle stock. *d* Paper stock and millboard. *e* Paper fillers, floats and all other short fibres



1873-1890—Reported as 1st., 2nd., and 3rd. class asbestos (considered "crude").
1892-1902—Reported as 1st., 2nd., and 3rd. class asbestos, with fibre, paper stock, and waste taken out when possible.
1896—Six mills were operating—one at Danville, two at Thetford, two at Black Lake, and one at Pointe au Chêne.
1900—General remodelling of mills and erection of new ones.
1903-1927—"Crude" asbestos and mill stock reported separately. Percentages are actual.

Chart I

TABLE V

Annual *Exports* of Asbestos from Canada, Fiscal Years 1888–1930

NOTE.—Exports of Asbestos were not separately recorded in Customs classification prior to July 1, 1887
Asbestos mining operations in the Thetford region began about 1879, and the fibre marketed in the United States and in Europe.

Fiscal years	Asbestos, 1st Class					Asbestos, 2nd Class					Asbestos, 3rd Class					Total Asbestos			Re-exports of Asbestos *a*	
	Short tons	Value	Average per ton	Per cent of yearly total		Short tons	Value	Average per ton	Per cent of yearly total		Short tons	Value	Average per ton	Per cent of yearly total		Short tons	Average per ton	Value	Tons	Value
				Quan.	Value				Quan.	Value				Quan.	Value					
		$	$				$	$				$	$				$	$		$
1888	2,555	193,052	76	74·5	84·5	621	26,566	43	18·1	10·4	252	8,737	35	7·4	5·1	3,428	67	228,355	.....	.....
1889	4,228	304,336	72	90·9	94·0	238	11,192	48	5·1	3·5	183	8,358	46	4·0	2·5	4,649	70	323,886	.....	.....
1890	5,716	412,598	72	87·5	92·9	480	20,571	43	7·3	4·6	367	10,990	30	5·2	2·5	6,533	68	444,159	.....	.....
1891	5,180	413,231	80	73·7	80·4	1,449	83,639	58	20·6	16·3	393	17,039	43	5·7	3·3	7,022	73	513,909	.....	.....
1892	2,398	191,494	80	32·8	37·2	4,243	292,598	69	58·0	56·9	675	30,320	45	9·2	5·9	7,316	70	514,412	.....	.....
1893	1,399	114,058	82	23·7	28·8	4,073	267,518	66	69·1	67·4	426	15,142	36	7·2	3·8	5,898	67	396,718	.....	.....
1894	2,173	115,056	53	34·9	33·9	3,178	191,840	61	51·0	56·5	878	32,860	37	14·1	9·6	6,229	55	339,756	4	280
1895	5,696	312,572	55	66·2	63·4	1,744	126,921	73	20·3	25·7	1,153	53,582	46	13·5	10·9	8,593	57	493,075	12	250
1896	1,839	114,569	63	19·2	23·7	4,691	276,713	59	48·9	57·3	3,058	91,397	30	31·9	19·0	9,588	50	482,679	.....	.....
1897	1,679	98,697	59	15·3	19·3	4,320	252,760	59	39·4	49·4	4,970	159,459	32	55·3	31·3	10,969	47	510,916	.....	.....
1898	1,737	87,728	51	9·4	17·2	4,934	216,217	44	26·8	42·4	11,753	206,423	18	63·8	40·4	18,424	28	510,368	14	340
1899	672	59,350	88	4·6	13·1	2,875	153,961	54	19·8	34·0	10,973	239,865	22	75·6	52·9	14,520	31	453,176	.....	.....
1900	1,419	89,655	63	7·8	18·3	4,276	205,712	48	23·5	41·9	12,469	195,542	16	69·8	39·8	18,164	27	490,909	.....	.....
1901	5,976	327,688	55	22·4	37·9	3,522	173,824	49	13·2	20·1	17,217	363,061	21	64·4	42·0	26,715	32	864,573	180	4,300
1902	3,509	368,983	105	10·6	32·6	2,359	97,191	41	7·1	8·6	27,204	665,028	24	82·3	58·8	33,072	34	1,131,202	.....	.....
Total period	46,176	3,203,067	.....	25·5	41·6	43,003	2,397,023	.....	23·7	31·1	91,971	2,097,223	.....	50·8	27·3	181,150	42	7,698,093	210	5,171
1903	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30,661	31	955,405	.....	.....
1904	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34,636	28	984,836	.....	.....
1905	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41,127	32	1,311,524	.....	11
1906	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57,075	27	1,578,137	.....	.....
1907*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41,008	29	1,206,776	.....	.....
1908	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59,033	29	1,730,575	18	180
1909	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59,707	29	1,757,648	25	409
1910	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64,038	29	1,886,613	.....	.....
1911	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	69,829	30	2,076,477	.....	.....
1912	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	76,316	27	2,097,814	.....	.....
1913	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	91,820	28	2,486,769	.....	.....
Total period	Exports by class or kind not separately recorded.										Exports by class or kind not separately recorded					625,250	29	18,072,574	43	600

Fiscal years	Asbestos					*b* Asbestos sand and waste					*c* Sub-total					Asbestos manufactures		Total Asbestos	Re-exports of Asbestos *a*	
	Short tons	Value	Average per ton	Per cent of total		Short tons	Value	Average per ton	Per cent of total		Short tons	Value	Per cent of total value	Average per ton		Value	Per cent of total value	Value	Tons	Value
				Quan.	Value				Quan.	Value										
		$	$				$	$				$		$		$		$		$
1914	105,971	2,891,669	27	78·8	91·7	28,433	162,767	6	21·2	5·2	134,404	3,054,436	96·9	23		98,274	3·1	3,152,710	.....	444
1915	74,904	2,227,387	30	77·9	92·1	19,928	111,727	6	22·1	6·7	94,832	2,339,114	96·8	25		78,329	3·2	2,417,443	.....	964
1916	88,833	2,962,010	33	77·3	91·1	26,050	170,030	7	22·7	5·3	114,883	3,132,040	96·4	27		118,287	3·6	3,250,327	.....	381
1917	95,994	4,141,968	43	69·8	92·8	41,570	313,642	8	30·2	7·0	137,564	4,455,610	99·8	32		6,858	0·2	4,462,468	.....	4,285
1918	98,659	5,331,593	54	69·9	92·7	42,440	361,560	9	30·1	5·3	141,099	5,693,153	98·0	40		56,007	2·0	5,749,160	.....	7,178
1919	125,361	8,910,210	71	84·0	96·8	23,883	247,812	10	16·0	2·7	149,244	9,158,022	99·5	61		45,146	0·5	9,203,168	.....	1,599
1920	105,694	8,532,027	81	81·8	94·5	23,508	235,829	10	18·2	2·9	129,202	8,767,856	97·4	68		232,316	2·6	9,000,172	.....	66,113
1921	154,152	12,255,793	80	80·6	94·6	37,147	377,596	10	19·4	2·9	191,299	12,633,389	97·5	66		321,694	2·5	12,955,083	.....	29,639
1922	63,287	4,397,332	69	72·1	91·9	24,446	235,868	10	27·9	4·9	87,733	4,633,200	96·8	53		153,830	3·2	4,787,030	.....	2,946
1923	105,336	6,486,340	62	63·2	90·3	61,250	621,086	10	36·8	8·6	166,586	7,107,426	98·9	43		81,507	1·1	7,188,933	.....	13,523
1924	141,188	7,640,923	54	62·6	87·4	84,298	1,037,241	12	37·4	11·9	225,486	8,678,164	99·3	38		64,462	0·7	8,742,626	.....	5,836
1925	108,245	6,413,405	59	50·8	82·4	104,693	1,329,334	13	49·2	17·0	212,938	7,742,739	99·4	36		47,349	0·6	7,790,088	.....	1,538
1926	139,123	8,180,988	59	51·6	82·0	130,529	1,739,912	13	48·4	17·4	269,652	9,920,900	99·4	37		56,504	0·6	9,977,404	.....	6,947
1927	138,732	8,692,037	63	52·1	81·4	127,214	1,922,657	15	47·9	18·0	265,946	10,614,694	99·4	40		59,431	0·6	10,674,125	.....	9,055
1928	129,402	8,549,366	66	49·0	79·7	134,725	2,127,805	16	51·0	19·8	264,127	10,677,171	99·5	40		48,162	0·5	10,725,333	.....	6,593
1929	134,072	9,090,392	68	49·9	80·1	134,807	2,176,796	16	50·1	19·2	268,879	11,267,188	99·3	42		76,043	0·7	11,343,231	.....	13,118
1930	136,333	9,560,889	70	47·6	78·3	150,164	2,513,176	17	52·4	20·6	286,497	12,074,065	98·9	42		137,833	1·1	12,211,898	.....	8,862
Total period	1,945,286	116,264,329	60	61·9	87·0	1,195,085	15,684,838	13	38·1	11·7	3,140,371	131,949,167	98·7	42		1,682,032	1·3	133,631,199	.....	179,021
1888–1902	181,150	7,698,093	42	100·0	100·0	Included with "Asbestos"					181,150	7,698,093	100·0	42		*d*	.....	7,698,093	210	5,171
1903–1913	Not separately recorded.										625,250	18,072,574	100·0	29		*d*	.....	18,072,574	40	600
1914–1930	1,945,286	116,264,329	60	61·9	87·0	1,195,085	15,684,838	13	38·1	11·7	3,140,371	131,949,167	98·7	42		1,682,032	1·3	133,631,199	.....	179,021
†Grand total	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	‡3,946,771	157,719,834	98·9	40		1,682,032	1·1	159,401,866	.....	184,792

The per-ton averages are rounded to the closest dollar.
* Nine-month period ending March 31st. † Total from July 1, 1887 to March 31, 1931. ‡ See Note *e*, Table VI.
a Not the produce of Canada. *b* Apparently includes a broader category of products than similarly named material as classified by mine operators. *c* Totals of raw asbestos exported. *d* "Not separately recorded."

TABLE VI

Summary of Exports of Asbestos from Canada, showing *Principal Destinations*

*Short Tons—Fiscal Years**

(Compiled from "*Trade of Canada*" Annual Reports)

Period	1888 to 1902						1903 to 1913		1914 to March 31, 1930				1888–1930				1914–1930	Total exports to Mar. 31, 1930
Country to which exported	Asbestos: 1st class		Asbestos: 2nd class		Asbestos: 3rd class		Asbestos		Asbestos		Asbestos, sand and waste		*c* Sub-totals				Asbestos manufactures	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Percent of total quantity	Value	Per cent of total value	Value	Value
		$		$		$		$		$		$			$		$	$
Argentina	.....	.....	.....	.....	.....	.....	.....	.....	15	375	.....	.....	15	.....	375	.....	2,448	2,823
*a*Austria-Hungary	.....	.....	.....	.....	.....	.....	1,684	40,424	5,656	213,252	45	500	7,385	0·2	254,176	1·6	659	254,835
Belgium	1,358	126,452	1,208	87,458	1,590	51,790	29,933	1,078,362	83,522	5,372,742	2,804	53,208	120,415	3·0	6,770,012	4·3	786	6,770,798
Brazil	.....	.....	.....	.....	.....	.....	.....	.....	26	1,540	.....	.....	26	.....	1,540	.....	4,720	6,260
British Empire	8,685	660,211	5,790	405,543	9,773	285,098	71,825	2,366,431	159,472	10,663,551	19,034	355,480	274,579	7·0	14,736,314	9·3	573,146	15,309,460
Colombia	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13	192	13	.....	192	.....	14,248	14,440
Cuba	.....	.....	.....	.....	.....	.....	.....	.....	401	19,915	30	502	431	.....	20,417	.....	10,852	31,269
Denmark	.....	.....	.....	.....	.....	.....	.....	.....	1,217	81,335	.....	.....	1,217	.....	81,335	.....	10,546	91,881
*b*France	717	76,485	369	31,340	421	17,575	19,514	669,646	67,293	5,304,308	3,298	736	91,612	2·3	6,153,090	5·9	*d* 446,293	6,599,383
Germany	798	90,048	3,748	254,499	9,035	233,994	15,172	465,226	96,596	8,572,787	16,190	340,523	141,539	3·6	9,961,077	6·3	5,317	9,966,394
Italy	173	15,540	36	2,350	427	9,025	4,426	168,100	39,550	3,008,302	430	9,185	45,042	1·1	3,212,502	2·0	2,657	3,215,159
Japan	.....	.....	.....	.....	.....	.....	202	6,408	77,835	4,451,243	615	11,717	78,652	2·0	4,469,368	2·8	3,516	4,472,884
Mexico	.....	.....	.....	.....	.....	.....	.....	.....	205	13,825	20	200	225	.....	14,025	.....	6,318	20,343
*c*Netherlands	20	3,200	121	5,590	373	10,730	463	36,455	21,318	1,975,274	7,757	173,392	30,052	0·8	2,204,641	1·4	27,754	2,232,395
Norway	.....	.....	.....	.....	.....	.....	15	450	63	1,640	.....	.....	78	.....	2,090	.....	710	2,800
Peru	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	169	11	.....	169	.....	3,567	736
Roumania	.....	.....	.....	.....	.....	.....	218	4,791	70	5,110	.....	.....	288	.....	9,901	.....	nil	9,901
Russia	.....	.....	.....	.....	.....	.....	20	400	.....	.....	.....	.....	20	.....	400	.....	nil	400
Spain	.....	.....	.....	.....	.....	.....	.....	.....	2,817	175,613	8	100	2,825	.....	175,713	0·1	196	175,909
Sweden	.....	.....	.....	.....	.....	.....	.....	.....	495	25,414	.....	.....	495	.....	24,414	.....	9,882	35,296
Switzerland	.....	.....	.....	.....	.....	.....	.....	.....	587	89,075	.....	.....	587	.....	89,075	.....	nil	89,075
Syria	.....	.....	.....	.....	.....	.....	.....	.....	30	2,475	.....	.....	30	.....	2,475	.....	nil	2,475
United States	34,425	2,227,131	31,731	1,610,443	70,352	1,489,591	481,778	13,235,861	1,387,747	76,258,399	1,142,994	14,644,304	3,149,027	79·8	109,465,749	69·4	490,265	109,956,014
Other Countries	.....	.....	.....	.....	.....	.....	.....	.....	371	28,154	1,836	41,630	2,207	.....	69,784	.....	68,152	137,936
	46,176	3,203,067	43,003	2,397,223	91,971	2,097,803	625,250	18,072,574	1,945,286	116,264,329	1,195,085	15,684,838	*e*3,946,771	100·0	157,719,834	100·0	1,682,032	159,401,866

a Includes Austria-Hungary and Czechoslovakia. *b* Includes St. Pierre de Miquelon and other French dependencies. *c* Holland and dependencies. *d* Of which over 99% was exported during the three fiscal years 1920, 1921, 1922. *e* To these should be added asbestos shipments reported by operators between 1879 and 1887 and which were practically all exported. Exports of asbestos were not separately classified in Trade records prior to July 1, 1887. * Years ending March 31.