GEOLOGICAL SURVEY OF CANADA
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MINERAL RESOURCES OF CANADA

INFUSORIAL EARTH

Reprint of Article in Annual Report of Section of Mines for 1902, Part S, Vol. XV.

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GEOLOGICAL SURVEY OF CANADA, OTTAWA.

To Dr. ROBERT BELL, L.L.D., F.R.S., &c.,
Acting Director.

SIR:—The following pamphlet dealing with Canadian infusorial earth, is reprinted from the Annual Report of the Mines Section for 1902, constituting Part S. Vol. XV, N.S., of the Annual Report of the Geological Survey Department.

Pursuant to a policy suggested some years ago and now carried out with your permission, this report is one of a series of similar bulletins intended to give in condensed and popular form, information regarding the mineral resources and possibilities of the country, together with any data regarding similar occurrences in other countries when such would seem to be of use to prospectors and operators in Canada.

I am, sir,
Your obedient servant,

ELFRIC DREW INGALL,
Mining Engineer in Charge.

MINES SECTION,
January 9, 1904.

INFUSORIAL EARTH

Infusorial earth.

The localities where this mineral occurs have been mentioned in previous reports of the Mines Section. The following very much more complete presentment of the subject has been prepared at my request by Mr. Theo. Denis, B.Sc.

Infusorial earth, also known under the various names of tripolite, tripoli, diatomaceous earth, kieselguhr, etc., is a pulverulent silicious material, white when pure, but having often a brownish discolouration. It is derived from the silicious shells of diatoms. The material is rarely pure, but usually mixed with a certain proportion of carbonate of lime, and of magnesia, clay, etc., the silica contents varying between 75 and 90 per cent.

The Diatomaceae are an order of unicellular algae, one of the lowest and simplest forms of vegetable life. They have beautifully sculptured very minute silicious shells or skeletons, called frustules, which are favourite subjects of study with microscopists. Diatoms exist in all parts of the world in immense numbers at the bottom of the sea and of fresh water, and are also found attached to the submerged parts of aquatic plants etc., and among mosses and in other damp localities. There are many genera, and the number of known species exceeds 1,500. They vary greatly in the form and markings of the valves which are often exquisitely scupltured, forming beautiful objects under the microscope and testing its highest powers. In some species the lines are found to equal 125,000 to the inch. Extensive fossil deposits of the silicious remains of diatomaceae occur in various localities, as at Bilin in Bohemia, and in Virginia, Nevada and California. They are sometimes used as polishing powder. They are abundant in guano.

Diatomaceous earth is very porous, the specific gravity being 0.25 to 0.30, owing to the numerous interstitial spaces and air cavities between the spicules and shells and within the latter, giving lightness and great absorbent power.

The uses to which diatomaceous earth is put are very varied and are probably capable of greater extension. Formerly, it was widely used in the manufacture of dynamite as an absorbent of the nitro-glycerine,

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Infusorial Earth.

its porosity, which allows of its absorbing liquids to the extent of four to five times its own weight, rendering it eminently adapted to that purpose. But in this connection it has been wholly replaced by cheaper absorbents such as wood pulp, sawdust etc. At present its chief use is as a polishing material, the grains being sharp and cutting, but fine enough not to scratch metal surfaces; it is also used as a boiler covering, its porosity rendering it a good non-conductor of heat. It can be used in the manufacture of bricks when great lightness is required, but owing to the difficulty of manufacture, these bricks are costly and cannot on that account be used for ordinary purposes. Such bricks can be made of one quarter the weight of ordinary bricks. Diatomaceous earth is also used to some extent in the manufacture of certain soaps, and as filtering material, etc.

For the purpose of comparison a few analyses of infusorial earth from various countries are here tabulated.*

Composition.	Hanover.	Germany.	Scotland.	Auvergne, France.	Maryland, U.S.	Virginia, U.S.	New Brunswick, Canada.
Silica	86.4	68.01	92.0	87.2	81.53	75.85	80.487
Ferric Oxide	1.5	6.82	2.5	.....	3.33	2.92	.951
Alumina	1.6	7.13	.....	2.0	3.43	9.88	3.146
Lime	1.3	.....	.....	.....	2.61	0.29	.342
Magnesia	.....	.....	.....	.....	5.63	1.63†	.283
Water	6.9	8.45	.....	10.0	3.47	8.37	13.332‡
Other volatile and organic matter	2.3	8·17	5.5	.....	.....	.....	.....
	100.00	98.58	100.00	99.2	100.00	98 95	98.548

*From the Mineral Industry Vol. VII. †Including potash and soda.
‡Also organic matter and carbonic acid.

A series of experiments as to the applicability of Canadian diatomaceous earths to commercial uses, was conducted by Dr. Hoffmann in the laboratory ofthe Geological Survey of Canada and the results were published at the time in the reports of the Department**. As those publications may not in some cases be easy of access it is thought that a reproduction *in extenso* of these tests would not be out of place here.

"The sample, the results of the examination of which are here given, came from Pollet River lake, Mechanic Settlement, King's county, New Brunswick, and was collected by Dr. R. W. Ells. It occurs in considerable quantity in this lake, the deposit, it is stated, being about

** Reports of Progress 1878-79 and 1879-80.

four feet deep and readily obtainable either by dredging or by draining the lake..... ABRASIVE MATERIALS.

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"In texture it resembled an earthy chalk; it is very fine grained but harsh to the feel; adheres to the tongue; in colour is light greyish white. Heated in a closed tube, it assumes a dark-grey colour, due to the separation of carbon and gives off an abundance of a somewhat ammoniacal, light brownish-yellow coloured water, the material evidently containing nitrogenous organic matter. After ignition with free access of air, its colour is reddish-white; if treated with hydrochloric acid previous to ignition, the colour is white or at most has a just perceptible reddish tinge.

"When digested, either before or after ignition, with a boiling solution of caustic potash or soda, the silica readily passes into solution leaving a small amount of insoluble residue, which after ignition, has a light reddish-brown colour. The insoluble residue readily subsides from the solution. This latter, if the material has been treated before ignition, has a brownish yellow colour; if after ignition, and consequently when free from organic matter, the solution is colourless.

"This sample had been kept in the dry atmosphere of the laboratory for a lengthened period, and was regarded as perfectly air-dried. At 100° C., the oxygen of the air exercises a modifying influence upon this material, so that in order to ascertain the correct loss by water at this temperature, it is necessary that the operation should be conducted in an atmosphere of hydrogen or carbonic acid.

"An analysis of the air-dried material gave the following results :—

Silica	80·487
Alumina	3·146
Ferric Oxide	0·951
Lime	0·342
Magnesia	0·283
Carbonic Acid	0·011
Phosphoric Acid	?
Potash and Soda	?
Water—combined and hygroscopic and organic matter	13·321
	98·541

1. Water and organic matter—	
(*a*). Loss on drying over sulphuric acid	6·535
(*b*). Loss (in addition to that of *a*) on drying at 100° C., in a current of pure and dry hydrogen	3·582
(*c*.) Loss (in addition to that of *a* and *b*) on ignition (and after correction for carbonic acid)	3·204
Total	13·321

ABRASIVE MATERIALS.

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"The air-dried material left, on treatment with a boiling solution of caustic potash, 7·994 per cent. insoluble residue of a light reddish-brown colour (after ignition).

"As regards the economic value of this infusorial earth, it may be said to constitute an excellent polishing material; and although no experiments have been made to determine its absorbent power, it may reasonably be expected to prove well adapted for the preparation of dynamite. Again, the extreme facility with which it is dissolved by caustic alkalies (potash or soda) would suggest its advantageous employment for the manufacture of what is commonly known as "water glass" or "soluble glass," a preparation which meets with many important applications in the arts, as for instance, as a cement for the manufacture of artificial stone; for the hardening and preserving of building stones; in fixing fresco colours by the process of stereochromy; as an addition to soap in the preparation of the so-called "silicated soaps," etc."

"It has been desirable to ascertain experimentally its suitableness for the manufacture of bricks in imitation of the so-called "light or swimming bricks." These latter, owing to the porous nature of the silica composing the material from which they are made, combine great lightness with infusibility, and are remarkably bad conductors of heat on which account they constitute for many purposes of construction a valuable building material.

"In these experiments the earth was employed alone as well as in admixture, the addition being in the one case clay (a white pipe-clay) and in the other lime, the material from which the test-bricks were prepared consisting—

In the case of experiment 1. Of the infusorial earth alone.
" " 2. Of a mixture of infusorial earth and clay 95 parts of the former to 5 of the latter.
" " 3. Of a mixture of infusorial earth and clay: 90 parts of the former to 10 of the latter.
" " 4. Of a mixture of infusorial earth and lime: 99 parts of the former to 1 of the latter.
" " 5. Of a mixture of infusorial earth and lime: 98 parts of the former to 2 of the latter.

"The infusorial earth and clay were in an air dried condition; the lime had been but recently prepared. The amount of dried material and water employed to form the various bricks was in all instances the same. The bricks were all moulded of exactly the same size and measured 76 mm. in length, 28 mm. in breath, and 15 mm. in thickness.

"A small hand press was used in the moulding; the pressure employed however, was not great, and did not very much exceed that which might have been obtained by hand. The freshly moulded bricks having been exposed to a dry atmosphere until they had parted with the greater part of their moisture, were next dried at a temperature of 100° C, after which they were inserted in covered crucibles and placed in an air furnace, the temperature of which was gradually raised until at the expiration of an hour a white heat had been obtained, at which temperature it was maintained for an additional two hours.

The experiments were carried out in duplicate with the following results.

"*Refractoriness.*—The bricks had in all instances retained their form perfectly intact; they had neither warped nor cracked; their edges remained perfectly sharp and showed no indication of having undergone even the most incipient fusion. They were all highly absorbent, adhering strongly to the tongue; exceedingly firm and very tough. Bricks of experiments 1, 4 and 5 appeared to possess this latter property in about an equal degree; they could not be readily broken between the fingers; those of experiment 2 broke only with great difficulty, whilst those of experiment 3 could not be broken in this way. The fracture was uneven; in the case of experiments 1, 2 and 3, somewhat jagged. The bricks of experiments 1, 2 and 3 presented very smooth surfaces and possessed a fine and close texture; when suddenly plunged into the flame of a blast lamp they decrepitated strongly; this however was not the case when the heat was gradually applied.

"Bricks of experiments 4 and 5 were looser in texture, and when suddenly plunged into the flame of the blast lamp, stood well; they proved excellent non-conductors of heat; the brick could be held between the fingers without the slightest inconvenience whilst the other end was heated to redness in the blast lamp.

"*Contraction.*—The linear contraction (for the temperature and duration of firing afore-specified) amounted to, in the case of test brick,

Of experiment	1....	9·87 per cent of	the original moulded size,
"	2....	11·18 "	"
"	3....	11·18 "	"
"	4....	9·20 "	"
"	5 ...	7·89 "	"

"From this it will be seen that the contraction was most marked in those bricks containing an admixture of clay, and least so in those containing an admixture of lime.

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"*Colour.*—The bricks previous to firing were all perfectly white. After firing those of experiments 1, 2 and 3 were of a uniform cream colour, externally and internally. Those of experiments 4 and 5 were perfectly white; this is in accordance with the fact that the presence of the alkaline earths in ferruginous clays, especially of lime and magnesia, has a singular bleaching power in the kiln, arresting the development of the bright red colour. It has been found that a marl containing six per cent of ferric oxide and thirty-five per cent of carbonate of lime, burned of a greyish-buff, instead of the rich red such a proportion of iron would otherwise have produced. Experiment has shown that so small a proportion as five per cent of caustic magnesia mixed with a red clay entirely destroys its red colour in the kiln. In the case of the yellow brick, manufactured in the neighborhood of London, England, the colour is dependent on the admixture of ground chalk with the brick earth, the latter by itself burning of a red colour.

"*Weight.*—As compared with that of a fire brick.—The fire brick measured 9 inches in length, $4\frac{1}{2}$ inches in breadth and $2\frac{1}{2}$ inches in thickness and weighed 7 pounds.

"From the data obtained in these experiments it was found that a brick of the foregoing dimensions, made under the same conditions and from material similar to that employed in the preparation of the test brick,—

Of experiment	1	would weigh	3	lbs.	6·2	oz.
"	2	"	3	"	10·9	"
"	3	"	3	"	12·4	"
"	4	"	3	"	1·6	"
"	5	"	3	"	1·9	"

"As compared with that of a common brick.—The brick measured 8 inches in length, $3\frac{3}{4}$ inches in breadth and $2\frac{1}{2}$ inches in thickness and weighed 4 pounds 15 ounces.

"In like manner it was here found that a brick of these dimensions, made under the same conditions and from material similar to that from which the test brick,—

Of experiment	1	was prepared,	would weigh	2	lbs.	10·5	oz.
"	2	"	"	2	"	14·2	"
"	3	"	"	2	"	15·4	"
"	4	"	"	2	"	6·9	"
"	5	"	"	2	"	7·1	"

'The known deposits of importance of diatomaceous earth in Canada are so far confined to the maritime provinces of Nova Scotia and New

Brunswick. Deposits of this material are known in other provinces, but the occurrences do not seem to be of economic importance."

Following is an annotated list of deposits, compiled from various sources, but mainly from the reports of the Geological Survey of Canada:—

NOVA SCOTIA.

Cumberland County.—Folly Lake.—The deposit at this place is the largest yet known in Nova Scotia. It occupies the bed and shores of Folly lake, on the Intercolonial railway, at its passage over the Cobequid Mountains. The lake has an area of over 200 acres, two-thirds of which are probably covered with this deposit. Its surface is 600 feet above sea level. The deposit has been worked to a small extent for the manufacture of polishing material and for use as a non-conductor of heat.

Cumberland County.—Fountain Lake.—A valuable deposit of tripolite has been found at this place by Mr. David Grant. It occupies the bed of Fountain lake, on the road to River Philip, West Chester mountains. It is of remarkable purity and the lake is said to be easy to drain. It is eight miles distant from Minas basin at Port au Pic, and about the same distance from the Intercolonial railway. The deposit is worked to a small extent.

Cobequid Mountains Region.—Other deposits of less extent occur in the numerous lakes of this region.

Pictou County.—Upper Barney River.—In 1886, four tons of infusorial earth were shipped from a deposit at Alex. Sutherland's, in a marsh. The extent of the deposit is not known. The marsh is 50 yards wide and of indefinite length. The deposit of tripolite is two feet thick, and is immediately under the sod.

Cape Breton.—Englishtown.—St. Anns.—A deposit of infusorial earth, said to be of excellent quality, has been largely dug by Mr. F. Torrence. The deposit is in a small lake behind the village.

Inverness County.—River Dennys.—A deposit at this place has had a certain amount of work done on it.

Cumberland County.—Near Castlereagh.—A large deposit of infusorial earth occurs in Bass River Lake. This lake has been drained for the purpose of working the deposit of tripolite.

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Victoria County.—St. Anns.—For several years an important deposit of infusorial earth has been worked on a lake near St. Anns. The deposit is from 3 to 4 feet thick and extends over a large area.

Nova Scotia.

Other places at which only preliminary observations have been made and reported as having occurrences of tripolite are :—

Cape Breton County.—Ainsley lake.

Antigonish County.—Lochaber lake.

Pictou County.—Mackay lake.
Black Brook lake.
Garden of Eden lake.
Grant lake.
McLean lake.
Calder lake.
Forbes lake.
Ben lake.
Toney lake.

Colchester County.—Mackintosh lake.
Earltown lake.
Gully lake.

Halifax County.—Grand lake.
Dartmouth lake.

These two lakes supply the city of Halifax with water.

King's County.—Kempt lake.

New Brunswick.

NEW BRUNSWICK.

Only two important deposits of infusorial earth are known in this province, although there is no doubt that should need arise, other large occurrences would reward careful search.

King's County.—Pollet River lake, Mechanic Settlement.—This deposit covers the bed of the lake and has an average thickness of four feet. A sample from it was the subject of experiments conducted in the laboratory of the Geological Survey, the results of which are given above.

King's County.—Pleasant Lake.—This is situated six miles south-west of Pollet lake. This deposit has not been examined as to its commercial value.

St. John's County —Lake Fitzgerald.—A very large bed of tripolite occurs at this place. The lake has been drained by the St. John Water Company, exposing a considerable bed of earthy tripolite. According to Mr. Wm. Murdock, C.E., of St. John, the area covered by the deposit is fully fifty acres, and the depth probably reaches fifty feet. The upper layer of this material, about one foot in thickness, is of a light gray colour; on drying it becomes perfectly white. Below this stratum the colour is reddish-brown when fresh, and gray when dry.

QUEBEC.

In the Province of Quebec the deposits of infusorial earth are neither as extensive nor as numerous as in the maritime provinces. The deposits known have not so far been examined very closely as to their economic value, but some may on further investigation prove important

Montmorency County.—Laval Settlement, Range II, Lot 20.—At this place a deposit of infusorial earth occurs, which appears to be extensive. It is found on the right bank of the Bras at its junction with the Montmorency.—The bed is 15 feet thick; is at a height of 40 feet above the river, and is covered by fifty feet of overburden. In colour it is partly yellowish and partly gray.

Portneuf County.—Gosford Township, Range IX. A deposit is known on the east side of the north branch of St. Ann River. This is half an acre in area, four feet thick; the colour of the infusorial earth is a lead gray.

Maskinonge County.—St. Justin, Concession Trompe Souris.—In a sand bank which is sixty to seventy feet high, small quantities of infusorial earth are found a few feet below the surface.

Montcalm County.—Chertsey Township, Range V, Lot 15. A small deposit of infusorial earth occurs on this lot in the bottom of a marshy bay of Lake Michel. It has an area of three to four acres and a thickness of eighteen inches.

Other deposits are known to occur in the neighborhood of Shawenegan, also on lot 69 of Stoneham, county of Quebec, and another in the valley of the Petawawa river.

In Ontario, a few deposits of infusorial earth are known, but they are unimportant, being small and out of the way.

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BRITISH-COLUMBIA.

Infusorial Earth.

British Columbia.

Head of Loon Lake.—Interior Plateau of British Columbia. An extensive deposit of this material is said to occur at this place. A sample taken from it was examined by Dr. Hoffmann of the Geological Survey who described it as being * "fine-grained, closely compacted and tough, with a coarse, dull, earthy fracture; is meagre and rough to the feel, adheres strongly to the tongue; colour light reddish. Some slides of this material.....showed it to be almost entirely made up of frustules of diatomaceae....." This material has been used by the Indians in the vicinity of Cache creek for making tobacco pipes.

Blackwater River, B.C.—The occurrence of a diatomaceous earth in the Tertiary beds on Blackwater river, just above the bridge is referred to by Dr. G. M. Dawson in the Report of the Geological Survey of Canada, 1875-76, p. 256.

Fraser River, B.C.—A deposit of infusorial earth is reported to occur on the south side of the Fraser river opposite Mission City.

PRODUCTION OF TRIPOLITE.

Calendar Year.	Tons.	Value.
		$
1896	664	9,960
1897	15	150
1898	1,017	16,660
1899	1,000	15,000
1900	336	1,950
1901	850	15,300
1902	1,052	16,470

Shipments of tripolite en 1902, amounted to 1,052 tons, valued at $16,470. This is mined at Bass river lake, Colchester county, and St. Anns, Victoria county, Nova Scotia, and sold chiefly in the United States. The operators are:—The Premier Tripolite Company; New York, operating under lease the property at St. Anns owned by the Victoria Tripolite Company, of North Sydney, Cape Breton.

The Fossil Flour Company, New York, operating at Bass river lake.

It is the custom of the Fossil Flour Company to operate their plant at Bass river every second season only, and usually only a portion of the product is shipped during the year of operation, the shipments being continued during the year following.

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