remedied by any means, then the coast fishing will return; if partially remedied then the coast fisheries will only be retarded in their gradual absorption into ocean and bank fishing. The single men, who now each in his own boat takes his own fish, must club into tens, build fishing smacks, and commence ocean fishing. That is to say, capital must come to assist labour. That more fish will be produeed, it is probable, but the individual fisherman will suffer. From being a yeoman of the sea, and owning his own boat, he will become the servant of the capitalist—or the man who puts the most value in the joint stock. For one, I would be sorry to see the Nova Scotian fisherman reduced to the Newfoundland fisherman. The presence of capital has the great and good effect of tiding over temporary scarcities. It always has its accumulations. But one who is familiar with the half-dozen fishing villages, hanging up as it were on the rocks of our out-harbors, with their tidy kitchens, and neat bed rooms, their well fed children, and well clothed men, their neat boats and nets, and compares it with the state of the oppidan laborer, mechanic or truckman, living usually in one or two rooms of an evil smelling house in a dingy street, must look with concern at any causes that are slowly causing them to pass away.

Art. III. Notes on the Economic Mineralogy of Nova Scotia. By Prof. How, D. C. L., *University of King's College, Windsor, N. S.* Part IV. Gypsum and Anhydrite and the Borates and other Minerals they contain.

(*Read November 4th*, 1867.)

In the present paper I propose to consider the immense deposits of gypsum and anhydrite which have long been of great economic importance to the Province, and the minerals found in them, some of which, being useful, will add much to the value of the plaster quarries, if abundant. The term plaster, just used, being employed locally as the name both of gypsum and anhydrite, I shall avail myself of it occasionally as convenient, and may mention that gypsum is sulphate of lime with

water, while anhydrite is merely sulphate of lime. These substances are found here in quantity, exclusively in the lower carboniferous rocks in close association with the lime-stones described in the last part of these "Notes," (Trans. N. S. Inst., 1866.) In small amount fibrous gypsum and selenite are found in new red sandstone and trap. The beds of plaster are often of great thickness; á few miles from Windsor lofty white cliffs of it are seen on the road to Newport, and many fine exposures are mentioned in "Acadian Geology." Although comparatively few of the deposits have been worked to any extent, a great deal of plaster has been quarried. The following tables convey much valuable information; it appears from the last census returns that the amount of gypsum quarried was, in 1850, 79,795 tons, and in 1860, 126,400 tons: the return for the latter year shews that it was quarried in eleven out of the eighteen counties in the following quantities and gives its value:—

Gypsum quarried in Nova Scotia in 1860.

Counties.	Tons.	Value in Dollars.
Colchester,	6026	5407
Kings,	0	0
Cumberland,	259	206
Annapolis,	0	0
Pictou,	70	46
Hants,	118215	77883
Antigonish,	10	10
Inverness,	12	21
Halifax,	58	53
Lunenburg,	300	120
Yarmouth,	0	0
Digby,	0	0
Guysboro',	250	190
Victoria,	0	0
Queens,	0	0
Shelburne,	0	0
Richmond,	1470	1226
Cape Breton,	30	24
Total,	126700	85,186

No census having been taken since 1861 we have official details only with regard to exportation, and I have made out from the Trade Returns the following table, showing the

Quantity and Value of Gypsum Exported from Nova Scotia in years ending 30th September.

Year.	Tons of 2240 lb.	Value in Dollars.
1854	87283	74935
1855	95301	80875
1856	72210	61485
1857 (Windsor only, 9 months,)	33862	11050
1858 (Estimated amount,)	86291	69015
1859 " "	109243	87395
1860	105431	85936
1861 (Estimated amount,)	51013	40811
1862 " "	38031	30425
1863	46739	30625
1864	58601	43167
1865	56155	45088
1866	77091	63611
1867	103426	88486
Totals	1020677	812904

From the first of the foregoing tables it is obvious that Hants was in 1860 the chief gypsum raising county, it is so still and Windsor is its principal port of shipment. In fact by far the largest quantity of the rock is quarried at Windsor or in its neighbourhood, where operations have been carried on some eighty or ninety years, and from 1833 to 1867 there were exported from Windsor not less than 1,404,376 tons of 2240 lb., of the value of 1,031,154 dollars. During the late American War the trade was much depressed, last year, however, it had to a great extent revived, and there were

Exported from the County of Hants, N. S., of Gypsum, from Jan. 1st to Dec. 31st, 1867, from the following

Ports.	Tons of 2240 lb.	Value in Dollars.
Hantsport	9420	9112
Maitland (9 months)	2440	1708
Walton	9845	7384
Cheverie (chiefly hard plaster)	14799	8190
Windsor	63655	54106
Total	100159	80500

As regards Windsor the quantity just given has never been exceeded by a year's exportation; the price of gypsum here is on the average 90 cents a ton, shipped, at other places in the province the value is different from various causes. On the

Grand River in Western Canada, the only locality in old Canada where workable deposits exist, the price is about $2 per ton at the mine. The thickest bed there is about 7 feet only and the amount annually raised was given in 1863 as 14000 tons. (Geol. Canada, 763.)

The produce of several quarries within a few miles of Windsor are brought here for shipment. In this district the quarries are worked on parallel beds running E. and W., the most northerly extending from Windsor through Wentworth and Newport probably as far as Shubenacadie some 30 miles to the east, where plaster is also worked. The distance across the strike from the north at Windsor to the most southerly quarries is about three miles: at Windsor the dip is gently to the south. The largest quantity of plaster is raised in the Clifton Quarry, the property of Mr. Pellow, close to the town of Windsor, where operations have been carried on about forty years. The principal rock is gypsum, the anhydrite or hard plaster, is found in lenticular masses from 2 to 10 feet thick in the centre and sometimes 50 feet long, imbedded in the soft plaster. Mr. Pellow considers that the amount quarried here has varied for the last thirty years from 10,000 to 30,000 tons per annum and for the last ten or twelve years from 20,000 to 30,000 tons. The quarry is roughly estimated to be 800 feet long, 180 broad, and 40 deep. The rock cropped out near the surface at the north side and on the south side a face of about 30 feet plaster with a little limestone here and there is to be seen. Operations in depth can now only be carried on by aid of pumps, and a steam pump has lately been erected.

On another range to the south are extensive quarries, owned respectively by Messrs. Wilkins, M'Letchey and Pellow, about 1¼ mile from Windsor. The rock found here is of good quality, a face of from 15 to 40 feet can be got, and the beds have been traced across the strike for 300 feet. It is estimated that much more than 100,000 tons have been extracted.

On the last range south are the quarries of Mr. Black, south of these are the metamorphic rocks of the Ardoise Hills. From the Wentworth quarries about two miles from Windsor some 40,000 tons have been raised during the last two years. The

great distinction made in the qualities of gypsum is between blue and white plaster. The former is chiefly used for agricultural purposes, probably the greater part of that exported is so employed; it is sent to Boston, New York, Philadelphia, Richmond and Baltimore. The chief consumption I understand to be in Virginia, Maryland and Pennsylvania, where the ground plaster is used as manure for tobacco and Indian corn; before the late war gypsum was becoming a favourite fertilizer in cotton growing and large orders were sent, but the war interfered, and as yet, trials have not, I believe, been further made as regards this application. The white gypsum is sought for boiling and burning by which it is prepared for the making of plaster for walls, ceilings, cornices, etc. Gypsum consists of—

Lime,	32.55
Sulphuric acid,	46.51
Water,	20.94
	100.00

and its property of furnishing plaster depends on the fact that its water can be expelled and afterwards taken up again. Calcined gypsum is what remains after burning or boiling; the burning is effected by building up lumps of the rock into heaps with cord-word intermixed and maintaining a very moderate fire for some hours, the burnt plaster is afterwards beaten to powder and is fit for use: in boiling, the ground gypsum is heated in caldrons and the peculiar agitation caused by the escape of water is so like that of a liquid in ebullition that the plaster is said to boil. The burnt or boiled gypsum is mixed with water to a paste and when left it soon hardens. The best plaster, that which sets most quickly into a hard mass, is got by heating to about 500° Fah., if the heat attains redness, the gypsum becomes very dense and does not set with water. Most important properties are gained by the addition of one or two per cent. of certain salts, such as borax and sulphate of potass. Gypsum which has been thus treated will endure a red heat without losing its power of setting with water; it becomes much more dense than common plaster, sets in a few hours, becomes hard and takes a fine polish. Keene's, Martin's and Keating's

cements are the names under which such plasters are known. Stucco is coloured plaster mixed with size. (Miller's Chemistry, II. 801). If gypsum is mixed with a certain amount of water and soaked in hot pitch it parts with water and takes up pitch and forms a substance so hard and susceptible of polish that it could be employed in making a variety of useful and ornamental articles. Although the foregoing cements or most of them are well known and much valued, it is said by a recent observer that with one exception all admixtures impair the hardness of plaster. The exception is iron filings. When these are mixed with plaster they rapidly oxidise, and the coherent mass of oxide of iron formed adds its own strength to that of the plaster making a very firm material which has also the advantage of uniting itself to surfaces of iron: it is supposed that the filings should form about one-fifth of the whole weight to give the best result. (Chem. News, No. 436, p. 182). It is obvious that the manufacture of such substances as those mentioned could be carried on here with the greatest possible advantage, the quantity of gypsum being perfectly inexhaustible, and the varieties numerous.

Of these varieties the "isinglass" of the quarrymen, selenite of mineralogists is the purest. It is colourless and transparent as flint-glass: it is abundant in some quarries. It has been used in filling fire-proof safes. It cannot be used in place of mica, with which it is often confounded under the incorrect name of talc, in stove doors, etc., as it becomes opaque in the heat. Fibrous gypsum is found in veins, it affords very white plaster as well as the foregoing. Compact white opaque gypsum, called alabaster, is met with at Antigonish and also near Windsor at Three Mile Plains and in Falmouth. That from Antigonish is suitable for carved work as was shewn by a small piece of work, executed by the late C. Harding, Esq., of Windsor, sent to the Dublin and Paris Exhibitions: some remarks on the durability of this material and the propriety of having illustrations in the Provincial Museum will be found in the last Part of these Notes. (Trans. N. S. Inst., 1866). Between the other varieties of gypsum there is a difference in composition from the admixture of variable amounts of oxide of iron, carbonates of

lime and magnesia, and other ingredients do not interfere with their use as manure, but prevent their affording the best plaster. An opinion prevails that "rotten plaster" or that which has been exposed to the weather and crumbled down has lost its "strength". I analysed such a gypsum from the property of O. King, Esq., of Windsor, and found it to contain—

Water and trace of carbonic acid,	21.16
Lime,	33.02
Sulphuric Acid,	45.99
	100.17

or almost exactly the quantities of ingredients proper to pure gypsum: hence the rock was entirely unchanged, chemically, by exposure, and fit for all the purposes to which it can be applied. Unweathered gypsum varies very much in hardness but is never so hard as anhydrite, which is called from obvious property, "hard plaster."

Anhydrite is composed of—

Lime,	41.18
Sulphuric acid,	58.82
	100.00

it is of various colours, as dark blue, grey, and purple; exposed to the weather it becomes white with a peculiarly rough surface, hence it is often called in this condition "sandstone." It varies much in hardness, some samples give a clear sharp sound under the hammer, others sound dull; hard plaster is often a mixture of anhydrite and gypsum, and affords some water on being heated. It is used at Windsor as a building stone for the foundations of houses, and walls to support fences. It makes apparently a good substitute for marble in in-door work; a small table-top and a pedestal were made and polished at Windsor, by Mr. Wood, and shewn at the last Paris Exhibition; the latter especially was much admired at the preliminary Exhibition in Halifax. How long the beauty of surface will be retained remains to be seen; since blocks of almost any useful dimensions can be obtained a trial of its qualities is well worth making, and a very suitable place for the experiment is the

Provincial Museum. Anhydrite does not admit of use as plaster by burning or boiling but is equally good with gypsum for agricultural purposes, in fact it is about 21 per cent. more valuable so far as its ingredients are of use as it is free from water. It is not ground in mills but crushed by stampers. The rock from Cheverie is chiefly anhydrite, it goes mostly to Bridgeport, near New York, where it is almost the only kind employed. It is valued at Cheverie at 55 cents a ton.

Minerals contained in Gypsum and Anhydrite.

In the deposits just described no attention has been given practically to foreign minerals, indeed no considerable amount of these has been found; but small quantities of various kinds have been met with which are very interesting from a scientific point of view, and some of these will prove very valuable if abundant. What the quarrymen call "salts" is said to be often found, especially at the line of junction of hard and soft plaster, where there is often a narrow seam partly filled with it. It is described as having strong purgative properties, and as "salts" is the common name for sulphate of magnesia, I once thought it might be the substance found, but I have never seen this here, while Glauber-salt or sulphate of soda has been brought me more than once as found in the Clifton quarry: it is said to be plentiful occasionally. I have also had common salt brought from the same quarry in small quantity.

Borates. The most important minerals of possible future value are certain borates, the first of which made known as occurring in the gypsum, was described by myself about ten years ago; I have since found two others which are quite new and peculiar to this province. The first mineral was brought me by one of our students, and I shewed it to be natroborocalcite, which at that time had only been found in Peru, where it is called Tiza, and perhaps in Tuscany, and which I had seen imported to Scotland from the former country: I found it to contain when washed free from a little sulphate of soda:—

Soda,	7.21
Lime,	14.20
Water,	34.49
Boracic Acid,	[44.10]
	100.00

Soon after I had sent an account of the discovery of the mineral here to a Nova Scotian newspaper, I received a letter from Mr. George Outrim, Stoke-upon-Trent, Staffordshire Potteries, in which he made inquiries to which I replied, and a correspondence ensued, the nature of which will appear from a few abridged extracts from Mr. Outrim's letters. "June 16th, 1857.—I take the liberty to ask what this mineral is, as I see it contains boracic acid to the amount of 40 per cent. As this district, the seat of the pottery trade, is by far the largest consumer of this article either as an acid or as borax, and as its present price makes it an exceedingly heavy article in our trade, any prospect of an additional source will be looked to with anxious interest. I presume it is a borate of lime, if so, it would not be so valuable for our purpose, but if the acid could be separated, or it could be converted into borax on the spot, it would be doubtless very valuable; if the supply should prove abundant it would be a great pity that so rare a substance should rest unused." "Sept. 21st, 1857.—Your mineral contains nearly the same amount of acid as a specimen of the same in my possession from South America. There has latterly been a large importation of borates into this district, and more of the manufacturers have been induced to use it in this state, so that, although in the state of borax it is more generally used, it can be now pretty readily sold in the state of borate of lime. Of course it is not so valuable in this latter condition, and the current price in this market has lately been such that it should be delivered in Liverpool free of charges at about £20. May I ask you to send me about an ounce to make such a trial of it as will enable me to judge if it be suitable for pottery." The late discoveries of borax in California must have materially altered the value of borates if the company working them can "place borax in London cheaper than it

can be made there, which, at the lowest estimate is five cents a pound." (J. Ross Browne on Resources of States West of Rocky Mountains, 1866, p. 187). However this may be, the borate found here is itself valuable as a glaze, as seen from the next letter of Mr. Outrim's. "Nov. 23rd, 1857.—I have just put a portion of your mineral through the tests usually employed here, and I have the pleasure to enclose you a small bit of pitcher to which the borate has been applied as glaze, and, as you will see, the result is really very good; the borate was applied alone and simply passed through the potter's oven in the usual way—of course the glazes in ordinary use, being composed of various other ingredients, possess more evenness and opacity, but the fact that your borate will of itself produce such a glaze speaks strongly in favour of its quality. In short, it is as good as any I have seen of the same mineral."

A short time ago I observed in a heap of gypsum, consisting of about 300 tons, from the quarry of Mr. Black, at Brookville, about 3 miles south of Windsor, the first that had been taken out for some twenty years, a considerable intermixture of the borate just spoken of. Scarcely a stone of a particular sort was free from it, and in some specimens, in a few square inches of surface, several lumps were present. Sometimes lumps the size of hens' eggs were readily detached. I have found this borate also in plaster from Newport, and from accounts received it probably has been met with elsewhere.

The second borate found here was in very small amount, but it bore sufficient resemblance to the first to leave no doubt that it could be used for the same purpose. It is described (Edin. Phil. Journ. and Silliman's Journ., 1861,) under the name of cryptomorphite.

The third borate, just discovered, is a most interesting addition to known mineral species as there is only one other mineral which resembles it in chemical constituents, namely datholite, which also contains water, lime, silica and boracic acid, the proportions, however, are very different. I am about publishing an account of the new species under the name of silicoboro-

calcite* in my "Contributions to the Mineralogy of N. S.," in the "L. E. D. Phil. Magazine," and only name it here in connection with economic minerals because it contains almost exactly the same amount of boracic acid as natroborocalcite, and like it would no doubt give a good pottery glaze. I think it would also be found specially adapted for glazing iron vessels, as I find a borosilicate of soda is now preferred to silicate of lead for this purpose, as not affording lead in culinary operations to the contents of vessels so glazed. I found on analysis of the mineral :—

Water,	11.62
Lime,	28.04
Sulphuric acid,	80
Magnesia,	trace
Silica,	15.44
Boracic acid,	[44.10]
	100.00

Salt from Brine Springs. Although no deposit of rock salt of any importance has yet been found with gypsum, the brines of the gypsiferous districts, of which some account will be found in a former paper of mine, (Trans. N. S. Inst., 1865,) have furnished excellent salt at R. Philip, at Springhill, and Pictou, and a company is now making salt at Antigonish.

Art. IV. Magnetism and its Connection with the Telegraph. By Thos. R. Fraser, M. D.

(*Read January* 6, 1868.)

The object of this paper will be to give the philosophy and practical working of the *Magnetic* Telegraph. The term magnetic is chosen in preference to electric, as commonly used, Magnetism being the *primary* power or force which causes the magnetic action. Electricity being *merely an effect* of that

*Since this paper was written, Prof. Dana, to whom I sent specimens of the borates mentioned, has, in the new edition of his 'Mineralogy,' given the name of ulexite to natroborocalcite, retained the name of cryptomorphite, and given the name howlite to the new species here called silicoborocalcite.