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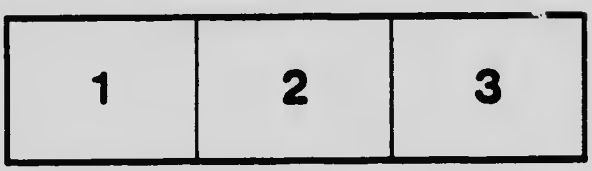

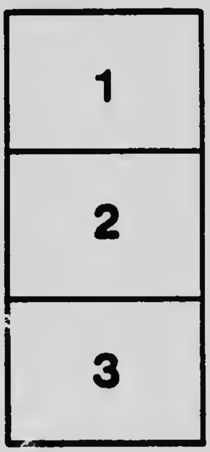

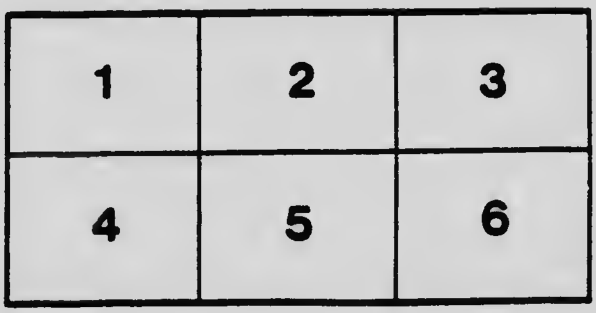

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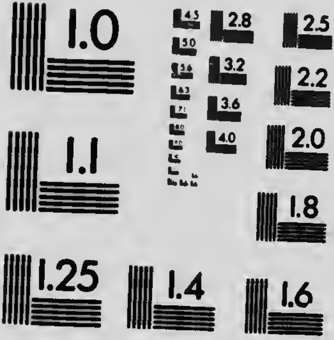

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DEPARTMENT OF MINES

MINES BRANCH

HON. W. TEMPLEMAN, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, PH. D., DIRECTOR.

REPORT

ON THE

EXAMINATION OF SOME IRON ORE DEPOSITS IN THE DISTRICTS OF THUNDER BAY AND RAINY RIVER, PROVINCE OF ONTARIO.

BY

F. HILLE, M.E.

OTTAWA
GOVERNMENT PRINTING BUREAU.
19[illegible]

No. 22.

Frontispiece.

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OTTAWA,
GOVERNMENT PRINTING BUREAU.
1908.

No. 22.

Fort William, May 1, 1907.

Dr. Eugene Haanel,

Director of Mines,

OTTAWA

Dear Sir,—I beg to present herewith my report on the examination of some iron ore deposits in the districts of Thunder Bay and Rainy River, Province of Ontario.

On account of the great number of deposits scattered over so large a territory, I examined only those which seemed to me to be of the greatest importance at the present moment; not only on account of their proximity to railway and lake communication, but also on account of the attention which has been recently directed to them.

In connexion with some explored locations in the township of McTavish, I made mention of the greater Animikie iron range, which I consider of too great importance not to draw attention to it at this moment, owing to its similarity to the Mesabi and other Lake Superior iron ranges.

In reporting, I have followed your instructions as closely as each case would permit.

Yours respectfully,

F. HILLE.

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ILLUSTRATIONS.

REPORT ON THE EXAMINATION OF SOME ORE DEPOSITS IN THE DISTRICTS OF THUNDER BAY AND RAINY RIVER, PROVINCE OF ONTARIO.

BY

F. HILLE, M.E.

The total output of the iron ore mines of the United States last year was in the neighborhood of 49,683,000 tons[1], in addition to which there was imported from Cuba 1,090,000 tons, making a total of 50,773,000 tons. Out of this amount, however, there was exported 305,000 tons, principally to Canada. So that for home consumption in the United States there remained 50,468,000 tons. From this large quantity there was produced 25,307,190 tons of pig iron[2], which would be equal to 1.99 tons of raw ore to one ton of pig. This proportion is somewhat higher than the average of the previous year, which was 1.87 tons. These facts would seem to indicate that last year a larger quantity of lower grade ore was mined and smelted, and for this several causes might be assigned.

(1) The working of lower grade mines.

(2) The exhaustion of the higher grades of ore in some of the older mines.

(3) The reservation of the high grade ores.

It is hardly probable that the latter is the case on account of the extreme pressure of the iron market and the low stocks of iron ore that were on hand at the beginning of 1906. However, whatever may be the reason for it, there can be no doubt that the quality of ore that it will be necessary to use in the future will continue to deteriorate. That is to say, the percentage of metallic iron will decrease and the percentage of silica will increase. And especially will this be the case with the ores coming from the Lake Superior ranges.

The increase in the manufacture of pig iron during the last ten years was 162.2%, it having risen from 9,652,680 tons in 1897 to 25,307,191 tons in 1906, being an increase of 15,654,511 tons. If this rate of increase were to be maintained during the next ten years, which is far from being an impossibility when we consider the rapid increase of the population of the United States, the consequent demands for increased comforts, and last, but not least, the growth of their exports to the other markets of the world, we should have to face the manufacture of 66,355,454 tons of pig iron, which at that date would probably necessitate the mining of 2¼ tons of ore to every ton of pig, which would mean mining a total of 149,299,771 tons of ore in the year 1916. If we calculate, at the same rate of increase, the total amount of ore smelted in the decade 1906 to 1916, we then arrive at the stately figure of 1,048,254,735 tons of iron ore.

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(1) Engineering and Mining Journal No. 1 for 1907.
(2) Iron Trade Review No. 7 for 1907.

Now, according to the calculations of Prof. Törnebohm[1], of Sweden, the iron ore reserves of our neighbours to the south amount only to 1,100,000,000 tons. Assuming this to be correct, in twenty years the United States will have completely exhausted its iron resources. I am inclined, however, to take a more liberal view, and would credit the United States with five times the above amount, which seems not unreasonable when we take into consideration the large deposits of low grade ores in the Lake Superior ranges and the deposits in Utah and other western States And, moreover, we must not overlook those in the eastern and southern parts of the Union, especially those in Alabama and Tennessee, in which two States alone it has at times been stated that there are over two billion tons.

The foregoing calculations have been based on a yearly increase of 162.2%, the ratio of increase that has been maintained during the last five years. But it would, perhaps, be nearer to the mark to take the average of the last twenty-five years, which is little over 100%. Let us for convenience sake call this a round 100%. By doing this we would arrive at the following figures:—

Pig iron produced in the year 1916	50,614,382	tons
Ore mined for the year 1916	113,882,359	"
Ore mined for the whole ten years	853,458,974	"

I have calculated upon 2¼ tons of ore being used for the production of one ton of pig iron, which is a fair average for the next ten years. Now if the United States should continue the manufacture of pig iron at the same rate of increase for twenty-five years, by that time not a ton of ore out of the whole five thousand million tons would be available for smelting. And even if we credit the United States with double that amount of ore, then by the year 1940 their whole supply of iron ore will be consumed.

After the above was written, a very interesting article appeared in the Iron Trade Review, written by Dr. William Kent, Dean of the L. C. Smith College of Applied Science, Syracuse University, entitled "Forty-two Years in the Iron Trade," in which he recapitulates the principal events in the iron trade for each year, concluding with an essay on the future outlook. In this Prof. Kent uses a similar method of arriving at practically the same conclusion as I did. He shows us to what colossal dimensions it is possible for the pig iron production in the United States to attain by calculating at the same ratio of increase as that of the last twenty-five years, viz., 104.742% per decade, and he tabulates his conclusions, from which I reproduce a few of his figures:—

For 1910	32,900,000	tons
" 1916	50,560,000	"
" 1920	67,340,000	"

He then goes further and estimates the production at the end of each decade, basing his figures on a ratio of increase of 100% only, arriving at the following quantities:—

1910	33	million tons of pig
1920	66	" "
1930	132	" "
1940	264	" "
1950	528	" "

---

(1) Report to Swedish government 1905.

Supplementing Prof. Kent's tables with an estimate of the production of pig iron for the whole of each decade, will give us:—

1910 to 1920	511.5 millions
1920 to 1930	1023 "
1930 to 1940	2046 "
1940 to 1950	4092 "

With these totals as a basis, how many tons of iron ore would be necessary to produce such an immense amount of pig iron? Assuming now, for the purposes of this calculation an average of three tons of ore to one ton of pig, an estimate which should be very moderate indeed in the face of an ever-decreasing supply, there would be needed iron ore as follows:—

For the decade of	1910 to 1920	1534.5 million tons
" " "	1920 to 1930	3069 " "
" " "	1930 to 1940	6138 " "
" " "	1940 to 1950	12276 " "
	Total	23017.5 million tons of ore

This amount is considerably larger than the whole of the iron ore supplies of the entire world, as at present known. And therefore, if the rate of increase remains the same as heretofore, it is absolutely impossible that in the year 1950 the smelting of iron ore can be carried on as it is now.

But long before this happens the large iron producing centers of the eastern States will feel the effect of the declining supplies; will feel also the effect of the higher prices of ore which will be demanded by the sellers; will feel the increase of the cost of carrying ore of much lower grade, and will also feel with equal intensity the much greater cost of smelting and fluxing material. In the face of this, are we to expect that the iron manufacturers will fold their hands and resignedly wait for the inevitable? I doubt it. Whence, however,will it be possible for these manufacturers to draw supplies of ore in order to postpone the day on which their own will be exhausted?

All the older ranges of Lake Superior have been very thoroughly prospected both with diamond drills and by other means, but of late years nothing has been discovered sufficient to make a perceptible addition to the present reserves that are in sight. No reliance can be placed on a supply from European countries, because the latter would not sell to an outside country the ores they still possess. It is far more likely that they would pass laws prohibiting the export of this most valuable commodity; following the policy of curtailing the exports which is practically operative in Sweden to-day. The same will also apply to the countries of Asia, because by that time the people of the whole world will have awakened to a full recognition of what is to their greatest advantage, and will do also what we are doing now.

Africa, so far, is an uncertain quantity, and by the time that continent would be able to furnish any iron ore, this metallic mineral will already be classed among the rare ones. Whence, then, can the deficiency be made up? The only possible source that I can see is Canada.

The province of Ontario alone contains immense deposits of ore, scattered over a very large area, sufficient to furnish a supply to the smelters both on this side and the other side of the International Boundary for many years to come. Although these ores to some extent consist of a low grade magnetite, it will not be long before the iron masters will be glad to get them at whatever price they are put upon the market.

Other classes of iron ore are also found in this Province: notably the large deposits of titaniferous iron ore situated both east and west of Port Arthur, which could be commercially utilized in the production of pig iron and ferro-titanium by means of the electrical furnace.

There are also large areas covered with deposits of jasper and high grade magnetite in a banded formation. These minerals, however, separate easily, and the iron could be used after magnetic separation. These deposits are found in a number of localities, but principally along the Kaministikwia river, Green Water lake and Hunter island. There are also in this district a number of pyrrhotite deposits, in which there is frequently intermixed enough magnetite to be worth mining and roasting as soon as the price of iron ores shall have reached a sufficient height. Then there is the Michipicoten iron range, that of Hutton township in the Nipissing district, and a great number of others of more or less importance spread throughout the eastern counties.

These deposits are all situated in the province of Ontario; but if an estimate were made of what is already known of the iron ore reserves throughout the whole Dominion, there can be little doubt that Canada would stand very high, if not first among the nations of the world as a prospective iron producing country.

It would naturally follow from this, that as soon as their own high grade iron ore supplies are on the wane, and more especially their reserves on the Lake Superior ranges, the United States will be compelled to look to Canada for their future supplies of iron ore.

The statistics quoted from the Engineering and Mining Journal have shown us that the United States exported 305,900 tons of iron ore; this amount, as we are told, going to Canadian smelters. This, however, is not the only ore which Canada imported, for, according to the report of the Canadian customs, 883,933 tons were imported into this country, from which 495,335 tons of pig iron were made, or an average of one ton of pig from 1.78 tons of ore.

Let us consider what this foreign ore costs us. Most of that which we imported was of bessemer grade, for which the price per ton was $5, and the expense involved in shipping it ran from 75c. to $1 per ton. Thus, on this raw material alone, we have expended over five million dollars. In this period, how many tons of pig iron did we smelt from our own ore? The Customs Department informs us that the Government has paid bounty on 86,523 tons of pig iron. Multiply this by 1.78 to arrive at the number of tons of ore smelted, and we find that for the production of that amount we have used 154,010 tons of ore.

Before enumerating and describing the various iron ore deposits of Thunder Bay and Rainy River districts, it has been deemed necessary to classify them in accordance with their elementary composition:—

Magnetite.
Magnetite (titaniferous).
Hematite.
Pyrrhotite.

Further, with a view of aiding clearness of exposition the principal features of the deposits and their locations have been placed under the following headings:—

(*a*) Situation (locality).
(*b*) Surveyed or unsurveyed territory.
(*c*) Owner.
(*d*) Physical features of land, including timber and water power.
(*e*) Size of ore deposits.
(*f*) Physical properties of ore.
(*g*) Analysis of ores.
(*h*) Experiments.
(*i*) Limestone deposits.
(*j*) Mining and metallurgical plants.

MATAWIN RANGE.

Magnetite.

To this class belong all those which occur in the oldest of our rocks, the Keewatin. They are found especially well developed in the most westerly portion of the province of Ontario, in the Thunder Bay and Rainy River districts. Firstly, there are those encountered along the shores of the Kaministikwia river and on both sides of it, south of Kaministikwia station. But of far greater importance are those contiguous to the Matawin river. I shall therefore, at least for the present, not take into consideration the first mentioned deposits, because it seems to me that on account of their very silicious nature and their isolated situation, they are of less importance than those along the Matawin, which are more massive and in which the individual deposits are more closely connected. Mention must also be made of those which lie in the same belt of chlorite schist, and are really a portion of the former, running westerly in a straight course. They terminate east of Green Water lake. The continuation of this is again found at the west side of the same lake and follows a south-westerly course from Hunter island into northern Minnesota.

For the present, however, I shall continue my description of those along the Matawin river, because they are the most massive, most interesting, and perhaps the largest deposits of magnetite of which we have any knowledge.

Situation.

These deposits are situated close to the Matawin river and to the Canadian Northern railway, being found both south and north of them, and are first met with west of the forty-seventh mile post (the miles being counted west from Port Arthur along the railway) to the fifty-first mile post, leaving it there and being found along the course of the river for four and one-half miles farther up its course. They are situated in the district of Thunder Bay, which is the most westerly but one of the districts of the province of Ontario.

Surveyed Territory.

The region in which these deposits occur is surveyed into different claims, which adjoin one another, and of which the surveyor's marks are W. and R., and the numbers, beginning at the extreme east and counting westward, are as follows:—

Location	W–211	with	320	acres
"	W–212	"	320	"
"	W–213	"	311	"
"	W–214	"	240	"
"	W–215	"	250	"
"	W–216	"	286	"
"	W–217	"	310	"
"	W–218	"	310	"
"	W–219	"	285	"
"	W–220	"	87	"
"	W–221	"	160	"
Location	W–222	with	160	acres
"	W–223	"	160	"
"	W–224	"	80	"
"	W–225	"	80	"
"	W–226	"	80	"
"	W–227	"	80	"
"	W–228	"	160	"
"	W–229	"	160	"
"	R–476	"	160	"
"	R–484	"	170	"

The locations enumerated here are those which I have closely examined, with the exception of a few, such as W–226 to 229, to which I only gave a cursory examination. Almost all of the other locations which are surveyed north of the Matawin were thoroughly gone over, but nothing was discovered to justify any special mention being made of them, excepting the two R–276 and R-484. On account of the low water in the creeks, which would not permit me to travel by canoe, I was compelled to postpone the examination of all the surveyed claims lying west of W–228. To have taken the overland route for that purpose would have occupied too much valuable time, which I was able to employ in other localities.

Owners and History.

All those locations which are marked with a "W" were applied for and surveyed in August of the year 1890, by the late James Hammond, of West Fort William. Later, Mr. Hammond interested Folger Bros., of Kingston, and through their efforts it ultimately became the property of the Matawin Iron Mining Co. which has disposed of the majority of its locations to Messrs. Mackenzie & Mann, while locations W–212, 213, 217, 224, 225, 227, 228, 229 have passed to the Crown. W–211 and 214 are held under lease, and

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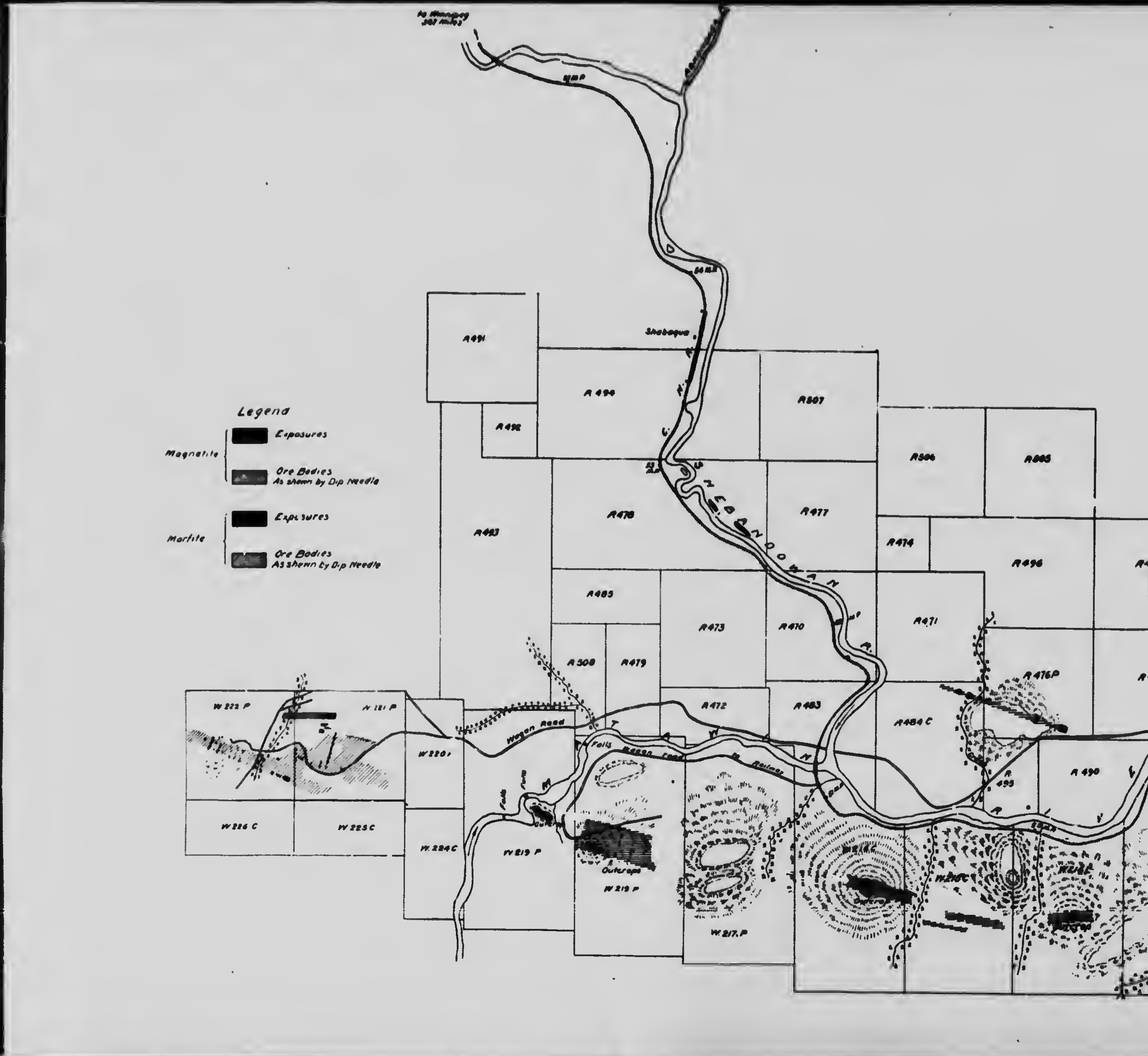
Legend
Magnetite
Exposures
Ore Bodies As shown by Dip Needle
Martite
Exposures
Ore Bodies As shown by Dip Needle
Shabaqua
Wagon Road
Falls
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R491
R494
R507
R492
R506
R505
R493
R478
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R474
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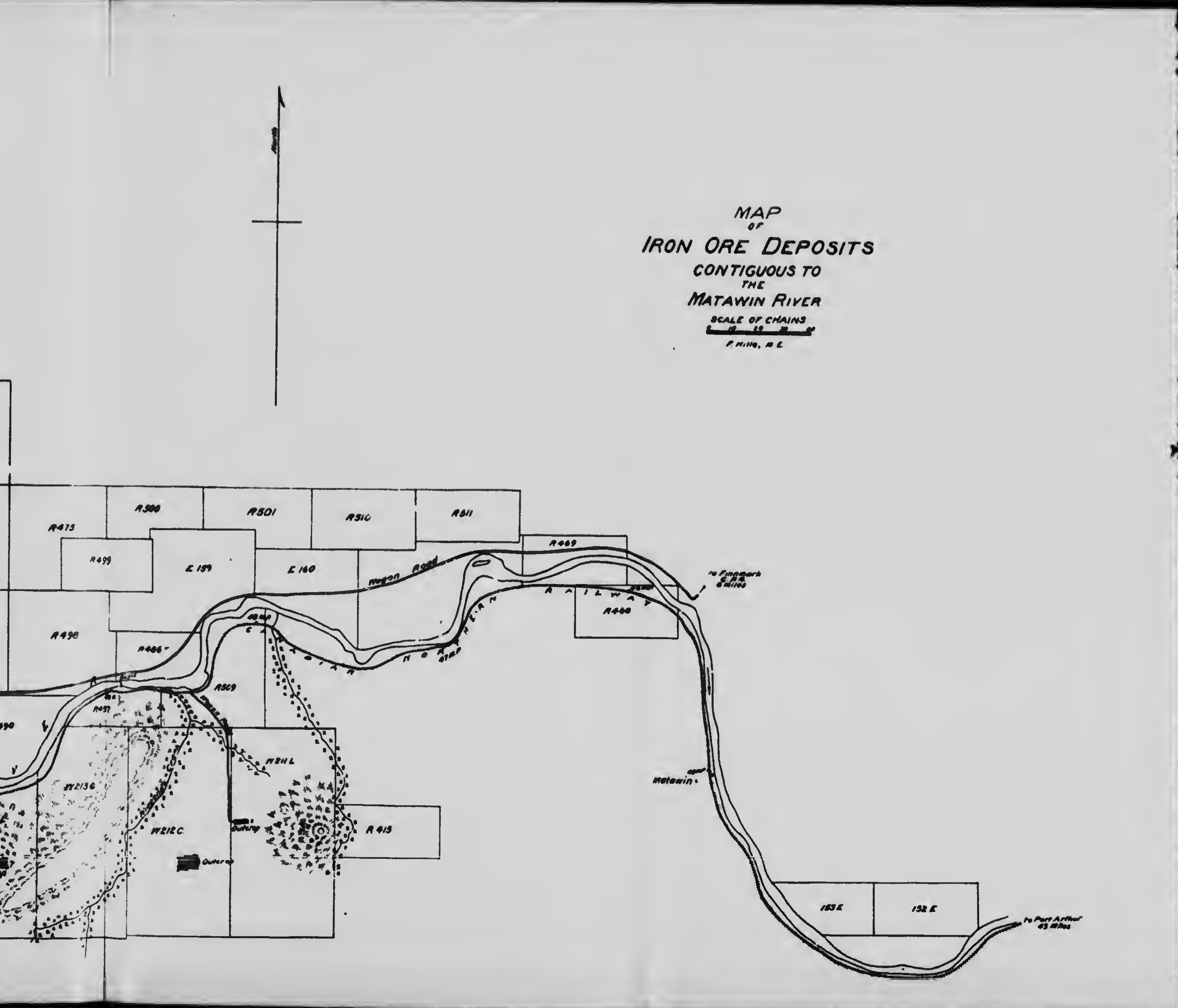

MAP
OF
IRON ORE DEPOSITS
CONTIGUOUS TO
THE
MATAWIN RIVER
SCALE OF CHAINS
R 500
R501
R510
R511
R475
R499
E 159
E 160
R469
R498
R509
R460
Wagon Road
Matawin
W212C
R 413
153 E
132 E
to Port Arthur
43 Miles

all other "W" locations are patented. In a map annexed the different locations are marked as follows:—

"P"—Patented. "L"—Leased. "C"—Still vested in the Crown.

The locations north of the river were surveyed for speculative purposes, and all except fourteen of them are patented. R–476 is owned by capitalists at Boston, Mass., and R–484 is still vested in the Crown.

Physical Features of the Matawin Range.

The topographical aspect of the territory in which the above mentioned locations are comprised is somewhat hilly, and the general slope of the region is toward the Matawin river, into which all the small streams empty. The highest elevation which came under my observation is on the survey line between R–415 and W–211, from which point a most beautiful panorama spreads out below us. This hill has an elevation of about fifteen hundred feet above sea level, being about three hundred feet above the Matawin river. Only a few little creeks wind their way northward through the lower portion of the land to unite their waters with those of the Matawin. The largest affluent of the latter river is the Shebandowan, which flows towards the south-east to Kashaboiwe and Shebandowan lakes. It comes from the north-west and loses its identity at the north line of location W–216 not far from the fifty-first mile post of the Canadian Northern railway. About a mile above the upper falls, the Matawin river leaves a wide, open and somewhat swampy country and flows through some narrow gorges into a small valley, through which it winds its way for nearly twenty miles to unite its yellowish waters with those of the Kaministikwia river, at a point about a quarter of a mile above the C.P.R. station of that name.

Water Power.

In the middle of location W–219 and at the north-west corner of W–128 the Matawin forms three falls, which, although they are not very high, would produce about 1,500 horse power, or possibly a little more if properly dammed, for which purpose the Upper Matawin river, with its wide, low banks would form an immense reservoir. To this subject I shall, however, return later.

Timber.

The country bordering the Matawin river, both north and south for a number of miles back, differs in its general character from the greater part of the district, it being very well wooded, although the kind and size of timber varies considerably at different points. Along the south bank of the river the timber consists principally of jack pine (*Pinus divaricata*) (*Banksiana*) from ten to one hundred years old, spruce, black and red (*Picea nigra and rubra*), intermixed with aspen (*Populus tremuloides*), commonly known as poplar, and white birch (*Betula populifolia alba*), also tamarac (*Larix Americana*) and sometimes white cedar (*Thuya Occidentalis alba*), which occur usually on the lower ground together with shrub alder (*Alnus glutinosa*) or shrub maple (*Acer spicatum*) and shrub hazel (*Corylus Americana*). The growth of the three latter shrubs is so thick in a number of localities that it is often impossible to travel the thickets without cutting a way with the axe.

On the north side of the river the timber varies from that of the south side, the land being principally studded with deciduous trees, such as aspen, birch and, in places, considerable quantities of elm (*Ulmus Americana alba* interspersed with jack pine and spruce. As we go farther back from the banks of the river the timber often becomes heavier, ranging from ten to twenty inches in diameter, and here also are found some isolated giant specimens of the red pine (*Pinus resinosa*) or white pine (*Pinus strabus*), the remaining witnesses of the once beautiful forests of this kind of tree, which covered the country.

Timber such as is mentioned above is found over a considerable area, and in sufficient quantities to furnish charcoal fuel for many years to come. That is to say, provided that the railway companies are compelled to equip all their locomotives with spark-arresters, and the section-men are taught to exercise more care when burning grass and decaying tree stumps in the vicinity of the road bed. During the first two weeks that I was in camp on the Matawin, I saw three fires originate in this manner which fortunately a heavy thunder shower extinguished before any serious damage was done.

Arable Land

The valleys between the hills often contain considerable areas of excellent farming land, the soil usually consisting, first, of a thick layer of leaf-mould, and below this a fine sandy loam. The growth of vegetation is very luxuriant, and, as an illustration of this, I have seen grass, clover, and even oats, spread there probably by lumber and construction camps, as high as three feet or even more.

Nature of the Ore deposits and Ore

Nearly the whole of the Matawin iron deposits consist of magnetite. Those, however, found on mining locations 221 and 222 have become oxidized in a somewhat high degree, being converted into hematitic ore called martite. It is rather a difficult question to settle whether this ore was at its origin formed as a ferrous-ferric oxide (Fe_3O_4) or was converted later into this form.

Both at the extreme eastern and western ends of the range the iron deposits have an extensively banded structure, jasper and iron alternating.

Very often the jasper bands are the thicker, and in places the formation consists even exclusively of jasper.

Beginning at W-211 and ending at W-233 the deposits, as far as I was able to examine them at this time, appeared to be very massive and of considerable extent both in length and width. They usually occupy the highest elevations of the hills, dipping with the formation at an angle of seventy-five degrees to the north, that is to say towards the river. North of the river there are some deposits of iron ore, which, although they have not the same extent laterally, show an ore of higher grade and somewhat banded with jasper. This ore is also magnetite.

On W-221 and 222, the largest deposits occur where they have been well exposed by stripping and trenching. The ore here is no longer a magnetite, being more highly oxidized and transformed into a martite.

It is quite possible that further exploration by magnetometric methods might reveal yet other iron deposits, in spite of the fact that I have repeatedly crossed the location both from south-east to north-west, and from north-east to south-west, and followed its boundary lines, and also followed up the common strike of the iron belt.

Notwithstanding this careful examination there might have been deposits of ore overlooked on account of the great difficulty encountered in traversing the thick underbrush, or crossing over fallen timbers at places where it is possible that some yet undiscovered deposits may exist. At the same time I was able during my trip to add several new iron ore beds to the number of those deposits which were already known and discovered, and to show that the limits of the latter are far more extensive than was formerly believed. In making these discoveries the only possible method was to resort constantly to the use of the dip-needle. The employment of this instrument was particularly advantageous, because, as I have repeatedly mentioned before, the greater portion of the ore consists of a magnetite, intermixed, heavily in some places and less heavily in others, with silica, or in banded formation, with bands of high grade magnetite alternating with red, blue, black, or gray jasper.

If these impurities can be economically separated from the iron ore the product should be an ore of at least fifty per cent metallic contents. As to the possibility of this I shall refer later.

At the above locations the magnetic qualities of the ore are usually not very strong, varying in proportion to the amount of impurities contained, there being a few spots, however, in which the needle stands vertical. On 221 and 222 the ore is naturally, from its high oxidation, only feebly magnetic. In all cases the north side of each deposit shows negative, and the south side positive attraction, according to the induction by terrestrial magnetism. This I shall notice later on as I come to the description of each individual deposit.

Treatment of the Ore

In experimenting with some of our silicious magnetites I produced concentrates varying in fineness, but before using these either in the blast furnace or electric furnace, they would have to be briquetted, or solidified in some way, in order to stand the burden and not choke the furnace. There are several methods of doing this effectively, and, I have no doubt, cheaply also. (1) By briquetting them dry or wet with a mixture of ten per cent of finely ground coking coal, after that, coking them in a suitable oven, by which process they become quite solid. That is to say, the particles of iron are held firmly together by the surrounding coke. (2) By a fritting process.

I will explain these two in detail. Several years ago, while looking for binding substances for the purpose of solidifying mineral concentrates, I experimented with a number of different materials, among them being coal, and at the end of my experiments I arrived at the mixture of 10% of finely ground coking coal, which I mixed intimately with the iron concentrated. I formed briquettes from this mixture and coked them in a muffle of an assay furnace, for various lengths of time, excluding the air and giving egress only to the volatile substances of the coal. At certain intervals I removed the briquettes from the muffle and invariably found a product very solidly fritted together. I again exposed these coked briquettes to the heat for a second time, with an air draft, by which means, while shrinking more, they became harder. After further trials I was able to produce briquettes of all degrees of hardness, and to bring the ore contained in them through all stages in the process of becoming metallic iron.

Briquettes of this kind present the advantage of easy reduction, the iron ore particles being intimately mixed with the carbon, and therefore it is unnecessary for the carbon gases of the furnace to force an entrance into the pores or cells of the ore in order to ensure complete reduction. Moreover the coke oven has practically carried out the work of the furnace by already expelling a proportion of the oxygen from the ore. The extent to which the oxygen is expelled will, of course, depend upon the length of time that is given to coking, the heat of the oven, the thickness of the briquettes. and the fineness of the ore used. Another advantage of this process is the elimination, not only of most of the sulphur from ores in which this element is contained, but also the water which is held in combination in them. The volatile substances of the coal contained in the briquettes will also help to provide heat in the coke ovens, and there is a further advantage of charging the already heated ore into the furnaces. I might also point out the possibility that exists of using these briquettes for a direct steel process. To summarize, the benefits that would be derived by this method of briquetting, are as follows:

(1) An easy, smooth and quick reduction.

(2) Economy in fuel, flux, and time, and the avoidance of overworking the furnace.

(3) The production of a purer iron.

(4) Purer gas in the furnace by the elimination of sulphur and water.

These advantages, which tend to economise the process of production are, however, partly offset by the cost of disintegrating and purifying the ore, mixing it with coal, briquetting and finally coking the briquettes. But I think if we strike the balance of our expense sheets we will find that the advantages and disadvantages are fairly evenly balanced, but the principal benefit derived will be found in the production of a superior quality of iron. Whether this is a sufficient incentive to encourage smelters that are compelled to use ores such as I described above, is a matter which must be considered from the standpoint of sound business principles.

The second process, by means of which a similar result might be obtained, without briquetting the concentrates, is the so-called fritting process. In this the fine ore, together with powdered coal, is fed into an inclined revolving kiln similar to a rotary cement kiln, through which the ore and coal travel onward and are exposed to a fire-blast. The coal is burned off and the particles of ore fused together solidly enough to stand the burden in the blast furnace. It is questionable whether this process is as advantageous as that first described, but it is undoubtedly somewhat simpler and it saves the necessity of briquetting the ore. On the other hand, there is the waste of that part of the coal which, together with the concentrates, is charged into the kiln, and the ore also takes up some of the ashes from the coal which is used in firing the kilns.

A Source for Coke.

While taking into consideration the fact that, as far as we know, coal is non-existent in this province, and further, that we are dependent as regards this fuel upon a supply from the United States, which might become a very serious feature to us at the most critical moment, I was led to direct my attention towards a new, or perhaps I had better say a perfected discovery, by means of which we can to some extent safeguard ourselves, and which would open up a source of wealth which has hardly been regarded by any of our commercial firms as such—I refer to peat-bogs, in which this province, and, in fact, most of the other provinces of Canada are immensely rich. In connection with this I have in mind the newly perfected Martin Ziegler peat coking process, by which air-dried peat can be converted into a coke, not only for metallurgical purposes, but also for use as a fuel for every description of heating (including, of course, household uses). What a boon the development of this discovery would be for localities such as ours, possessed of no coal supply and only a limited quantity of wood, can best be understood by those who have suffered as intensely from lack of fuel as have many of our western towns during the past winter.

I made an estimate of the possibility of utilising this new process as a factor in the conversion of our iron ores into raw iron, commonly known as pig iron, and I arrived at the conclusion that, as regards local enterprises, it would be undoubtedly more rational to make use of peat coke than to rely upon a raw material for the manufacture of coke, the certain delivery of which is liable to be affected by fortuitous circumstances. I give this as my opinion with less hesitation on account of the situation which our peat beds occupy in regard to our iron deposits, while the localities in which both are found are extremely favorable for the erection of smelters. Moreover, such an excellent quality of coke can be produced from peat that I consider it too important to be omitted from any discussion of our iron resources.

In making calculations as to the cost of the production of our iron ores, it will probably be of interest to give here a short description of this peat coke, of which a number of samples are in my possession. This coke, as manufactured by the Ziegler process, is not of a silver metallic lustre, like the Connellsville coke, but is almost jet black in color, of large cell structure, firm and with a metallic ring, like the Pennsylvania product. The outer surface of the bricks, in which form it is charged into the retorts, is almost as smooth as when it comes from the brick machines, while the interior still shows the original fibres of the peat coked and considerably contracted. The cracks in the coke show a glazed coating, which is probably an equivalent to the similar glaze seen in the Connellsville coke, produced by a deposit of hydro-carbons. Peat coke No. 1, in comparison with No. 2 or half-coke, is firmer, No. 1 being subjected to the coking process for a longer period. Is is this class of coke that finds its main use in metallurgy, in blast furnaces, or in similar work in which a fuel is required free from sulphur or phosphorus. It therefore in many instances takes the place of charcoal, and in consequence it realises, in Germany, a higher price than coal coke. The percentage of coke obtained from peat of good quality is about 33%, while that of coke No. 2 ranges from 50% to 60%. The caloric values of these cokes are 14,500 B.T.U. for No. 1, and 12,400 B.T.U. for No. 2. The cost of manufacturing these cokes in quantities of 18,000 tons per year is about $1.20 for No. 1, and probably a little over 70 cents per ton for No. 2. In larger quantities the price would be proportionately smaller. In these figures royalty is not included.

For purposes of comparison with Connellsville coke and charcoal, I give below a table showing the analyses of peat cokes Nos. 1 and 2 and charcoal and Connellsville coke.

	Peat-coke No. 1	Peat-coke No. 2 (half-coke)	Charcoal	Connellsville
C	87.8	73.9	87.	87.05
H	2.0	3.59	3.1	0.07
N	1.3	1.49	0.4	——
S	0.3	0.20	0.3	0.74
P	——	——	0.02	0.015
O	5.5	14.52	3.2	——
H_2O	——	3.80	3.	0.08
Ash	3.2*	2.50*	3.	10.60

The peat-coke analysed here is made from a good quality of German peat.

*In peat, as in coal, the quantity of ash will vary in different deposits.

From these analyses we can see that a good peat coke is of equal value to charcoal and of greater value than the best Connellsville coke, on account of the higher contents, in the latter, of sulphur and ash. Peat coke, therefore, is of greater utility, not only in blast furnace work for the smelting of raw iron, but also in electric furnaces or other ovens for the preparation of steel.

An important feature in the manufacture of this coke from peat is the saving of by-products, by means of which it is possible to reduce the cost of coking peat to the low prices given above. These by-products are:

(1) Peat-tar.
(2) Ammonium Sulphate.
(3) Lime Acetate.
(4) Methyl Alcohol.
(5) Gas.

Of these, the first four products can be sold and find a ready market; the last mentioned is used for firing the peat retorts, and the surplus can be utilized in running gas engines for the production of power. By using the gas under the retorts, which are operated continuously and not intermittently, as in other coke ovens, the peat being charged in the retorts at the top and drawn out at the bottom, the whole process is rendered very inexpensive.

This brief mention of the possibility of manufacturing coke from peat, and using it in smelting our ores, will probably be sufficient to call attention to the importance of investigating further our resources in this respect.

There is yet another source from which we may obtain fuel along the Matawin and Shebandowan rivers, on which reliance could be placed for a number of years to come, namely, charcoal made from the spruce, jack pine, birch, poplar and other trees, of which large forests are yet in existence These species of trees are about evenly distributed in quantity throughout the district, although, of course, the prevailing variety varies somewhat according to the locality.

The same peat coke ovens can be used for the conversion of these woods into charcoal as were used for the conversion of peat into coke, and this process also can be rendered economical by saving the by-products.

The question then arises, which fuel would be most economical and efficient for the smelting of iron ore.

Charcoal iron commands a higher price on the market than common coked pig, but peat coke, on account of its purity, is equal to charcoal, and the iron made with it ought to command a price equal to that made from charcoal. And therefore, thermically and chemically, the two fuels may be considered as being of equal value. But physically they are not. Charcoal cannot stand the same burden in the furnace, and for this reason charcoal furnaces cannot be built as high as coke furnaces, the result being a lower output.

To avoid too rapid a combustion of the charcoal a cold blast is used, or at the most a blast of very slightly heated air. On the other hand, a good coke can stand the weight of any burden, and combustion does not take place as rapidly as in the case of charcoal. A blast of hot air, therefore, increases the output.

It is on account of this difference in the physical properties of the two fuels that the economic value of them is not identical, and a good peat coke is at least a shade better in the comparison.

Lime.

Lime for fluxing is rather scarce, that is to say, limestone itself does not exist here; at least, it has never come under my observation; but marl is found, consisting of a soft and somewhat greyish-white carbonate of lime, carrying a considerable quantity of impurities, and being of a powdery nature when dry. When air-dry the composition of this marl is as follows:—

$CaCO_3$	71
Al_2O_3	24
SiO_2	1.6
$MgCO_3$	0.4
Fe_2O_3	0.5
Moisture	2.5

It is found here as a sediment in the beds of dried up lakes and only about twenty miles distant from Port Arthur.

Similar deposits are found forming the beds of lakes still existing as such, but these are not so conveniently situated as regards communication as the former.

As another source of lime supply we might take into consideration the large veins of calcite, twenty feet and more in width, which occur in the vicinity of Port Arthur harbor, on some islands in Lake Superior, close to the shore. These are not more than sixteen to twenty miles distant, and it would only require a journey of about two hours for a steam tug and scow to bring the calcite to the docks. There are also some large dumps of calcite near the Duluth extension of the Canadian Northern railway, the waste rock from the silver mining done in former years.

Besides these, an impure marl should not be overlooked, found among the Keweenawan rock series along Thunder cape. This consists of carbonate of lime, with more or less magnesia and ferric-oxide. I have unfortunately had no opportunity to collect samples of this marl, and cannot enumerate from memory its different constituents.

In the same regions occur large deposits of pure dolomite, of which I made a number of analyses years ago, finding it to contain an average of 55% carbonate of lime, and 45% carbonate of magnesia. As a flux for smelting purposes it is not improbable that this rock would be found to carry too large a proportion of magnesia, but even so, in case of necessity, it might be utilized with ores not containing too large an amount of silica.

During the season of navigation—from early spring till late in the fall—steamers come up from the east to take on cargoes of grain at Port Arthur and Fort William. There is no reason why these boats could not call at Kelly island and bring up limestone from there as ballast. This limestone is used in the Duluth furnaces and also in the lime kilns along the south shore of Lake Superior.

I think that what I have here mentioned may set at rest any apprehension that might be felt regarding the possibility of finding lime here, or securing it from elsewhere for use with our iron ores.

Water Power for Electrical Development.

Very few localities are so richly endowed with splendid water powers as the district in the heart of which Fort William and Port Arthur are situated. Within a radius of twenty miles from these cities there are the following water powers:—

(1) The Dog Lake Falls.
(2) The waters of the Kaministikwia river.
(3) The Kakabeka Falls on the same river.

These alone are capable of furnishing from eighty thousand to a hundred thousand horse power. In addition to this, sixty miles east of Port Arthur, we have the Nipigon river, along the course of which there can be developed not less than a hundred thousand horse power. There are also a number of minor falls which it would be useless to enumerate here, as those just mentioned give sufficient evidence of the abundance of water power in this vicinity, and, if properly developed, will furnish a sufficient supply of electricity for driving machinery of every description for the manufacture of ferro-alloys, or for any other metallurgical purpose.

Locality for Plants.

In considering the places in which the plants for utilizing these different raw materials should be located, the following questions should be taken up:

(1) Where is the best locality for the distribution of electrical power?
(2) Is the same locality suitable for the smelting of iron ore?
(3) Is it suitable for the coking of peat?
(4) Is it suitable for the shipping of the finished product?

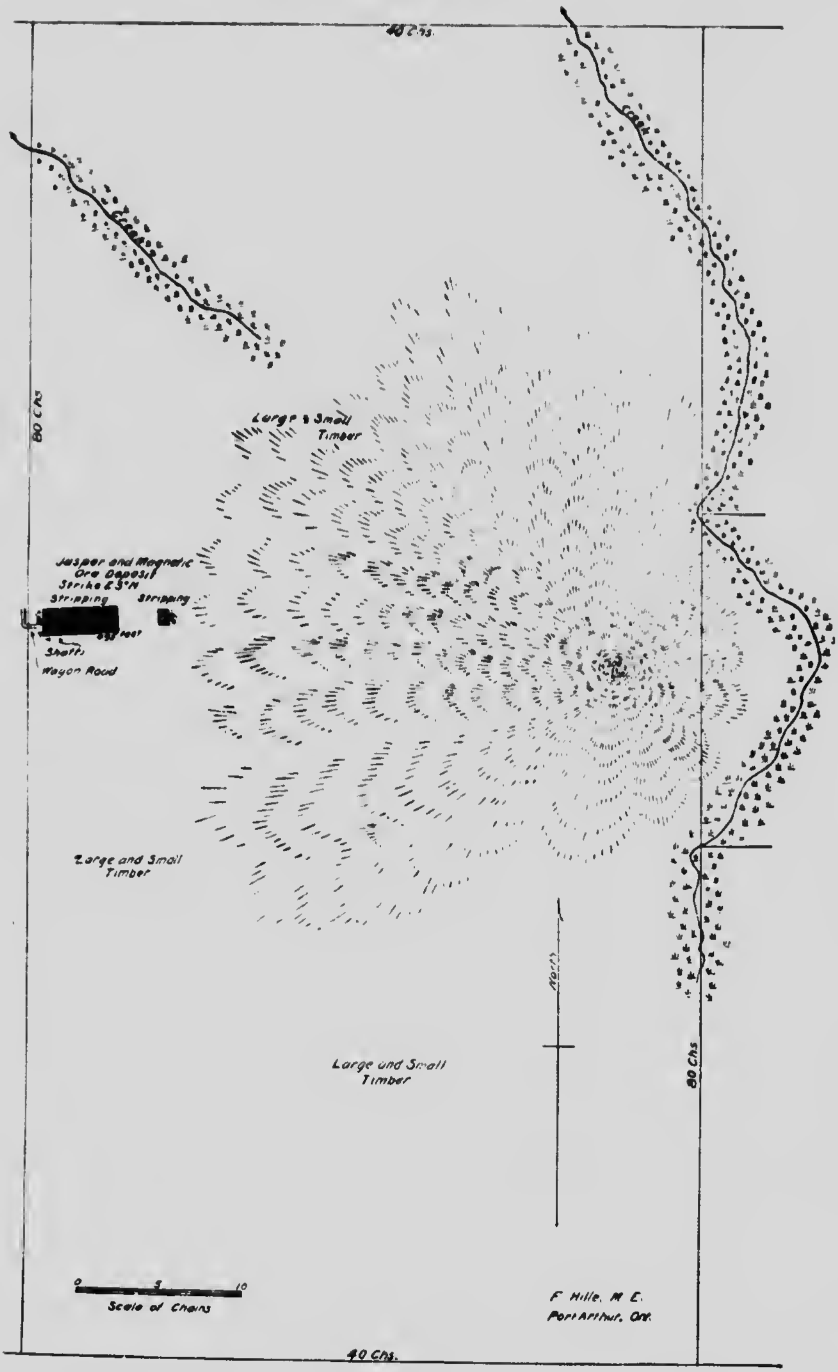
At the present time a low grade ore cannot stand heavy expense for transportation, especially if it has to be prepared first for the furnace. This latter operation, therefore, should be carried out in close proximity to the mine and the clean ore shipped to the furnace.

Coke will not admit of long transportation or much handling on account of the fines thereby produced. Machine peat offers a somewhat different proposition, being firm, and any fines that are produced consolidate in the coke oven. At the same time, peat will not stand the large and perhaps unnecessary expense which long distance transportation to coke ovens would involve.

Ore Deposits.

I come now to the description of the iron ore deposits along the Matawin and Shebandowan rivers, commencing at the extreme east, with location

Loc. 211.
320 Acres.



W-211, having an area of 320 acres. This claim is situated due south of the Matawin river. Following the old wagon road which leads to it and runs nearly north-west by south-east, we pass about four chains west of the north-west corner post. Proceeding twenty chains further south, parallel to the north-and-south survey line, the road turns sharply to the east, and travelling 60 feet farther we reach the dump of a shaft sunk in 1892 in a bed of jasper and magnetic iron. This shaft was discontinued at a depth of thirty-five feet on account of the great amount of jasper encountered in it, which made sinking slow and expensive. This work was undertaken on account of the owners discovering in these jasper beds some bands of high grade magnetite. This is the only outcrop showing on the surface, for at that time they had not succeeded in tracing and exp... ..g the continuation of the bed eastward; later on this was proved and practically laid bare by stripping. It can now be traced for a distance of 495 feet from west to east, being ninety-five feet in width at the west and forty-nine feet at the east end. I did not consider it worth while to take samples from along this deposit, nor from the shaft, as the ore is so extremely heavily banded with jasper of different colors and small quartz stringers, and so inextricably mixed with the rock formation of the district, that no sample of any value could have been obtained; indeed in most places it would have been almost impossible, with what tools we had at hand, to break pieces off the smoothly ground, polished surface.

This bed of jasper and iron, which at this point represents the iron formation, appears so far to be merely of petrographical and mineralogical interest on account of the wonderful forms which the jasper bands assume. The bands, formerly straight and unbroken both horizontally and vertically, are now seen broken up into fragments of every description, disconnected and mixed together as in a pudding stone. Sometimes portions of one band are found lying in a straight alignment, in another place they describe a curve, or even a circle; at other points, while retaining their old position, the bands are broken into pieces and the ends have shifted from each other a distance of one or two millimeters.

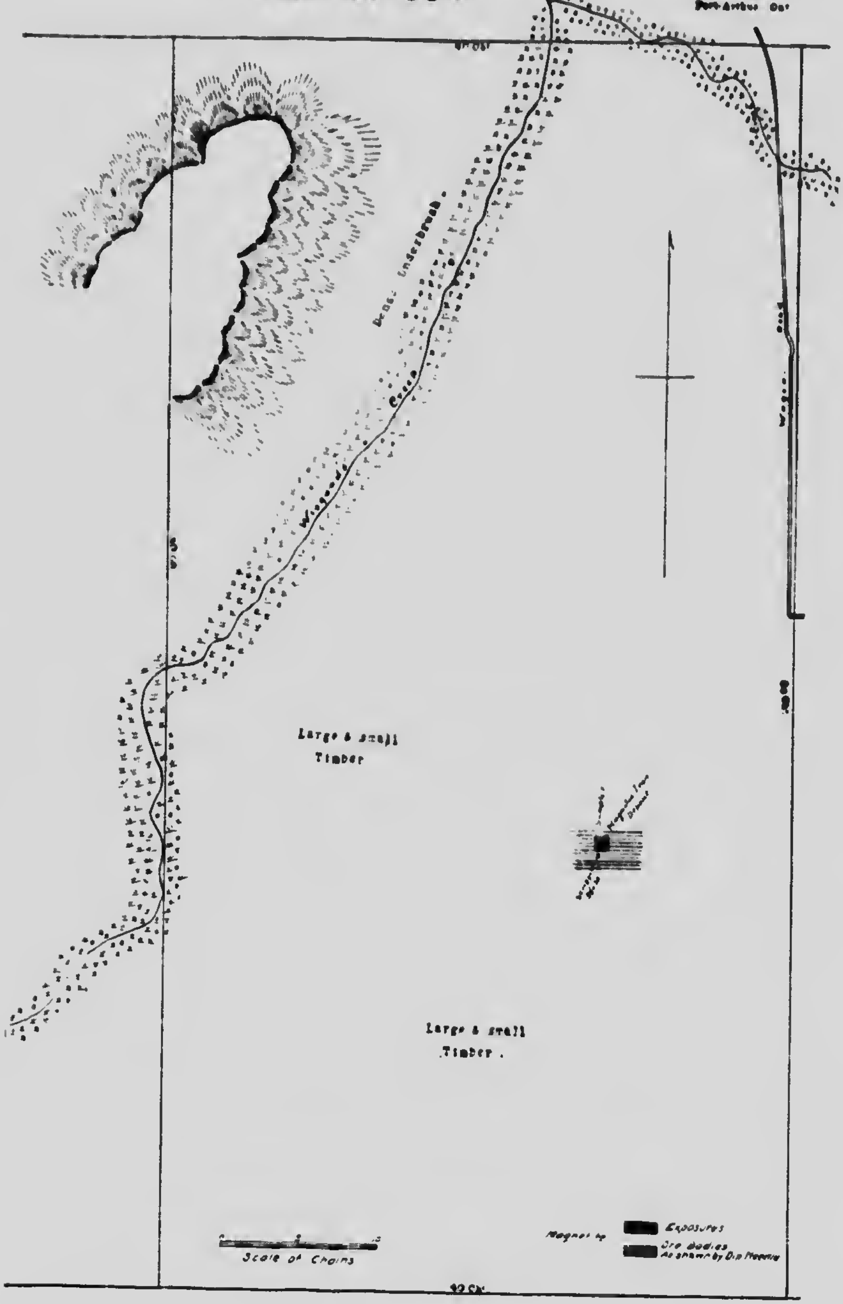
The country rock in which these jasper and iron beds occur is a chlorite schist, which is not well exposed, except at the eastern boundary of W-211 and R-415, where it forms a hill about 300 feet above the river, this being the highest point in that locality.

The best timber is on the south-east portion of this location—poplar, birch, jackpine and spruce, varying in diameter from four to eighteen inches, at the extreme eastern and also at the extreme western side. Two little creeks just touch the location, the land on which is in many places excellently adapted for agricultural purposes.

Location W-212.

The next location to be dealt with is W-212, with an area of 320 acres. Until my visit no iron deposits were known to occur on this claim. In fact, the deposit of W-211, which is situated very close to the boundary line, does

Loc. 212.
320 Acres.



not appear to continue into W–212, for after repeated trials I failed to detect a trace of iron, not even by the use of the dip-needle. But after a close prospecting with the latter in different directions I located a deposit at the south-eastern extremity, which I stripped as far as the overlying burden would permit, and exposed a small area, about sixty-six feet by thirty feet, of the deposit. This ore is different from that found on the former location; although silicious, it contains hardly any jasper bands. It is compact and massive and the admixture of silica could, after crushing, be taken out by magnetic separatic or by hydraulic classification, or by both used in conjunction. Sample No. 1 was taken as an average sample from the deposit, and by analysis gave :—

Sample No. 1

Fe	27.10%
Si	50.10%
Ph	0.16%
S	0.08%

It will be noticed that it is an ore of not high grade iron contents, but on account of its massiveness it could be mined cheaply, and as cheaply prepared for the furnace, if the works were built and conducted in the most economical manner. To this subject I shall return later on.

At the north-east part of the location very little timber has been left standing since the fire passed through some years ago; only a little scrubby jackpine about thirty to forty years old being left scattered through a growth of underbrush which is at times extremely dense. On the western and southern part good timber of various kinds is plentiful, and there are also considerable areas of fine soil for farming purposes. One of the largest creeks in the district crosses this location from south-west to north-east, coming in through the south portion of W-213, and uniting with a little creek which flows through W–211 a few chains north of the northern boundary line.

Location W–213.

This claim has an area of 311 acres and joins the last mentioned location to the west. I prospected it in vain for iron ore. This fact in itself must not be taken as proof that there is no iron ore on it, for a considerable portion of this location resembles the north-west part of W–212, being swampy and covered with a very dense underbrush, rendering thorough examination difficult and at times impossible. The Matawin river cuts through the north-west corner of the claim, and Weigands creek, with its affluent, through the south-east corner. The Canadian Northern railway runs alongside the Matawin river in close proximity to the north boundary of the location. In the center of the western part of this location there is still standing some good timber of different kinds, while on the north and south, small timber, principally poplar, is found, with dense underbrush of hazel, alder and shrub maple. Good land for agricultural purposes is to be found at the northern extremity of the claim.

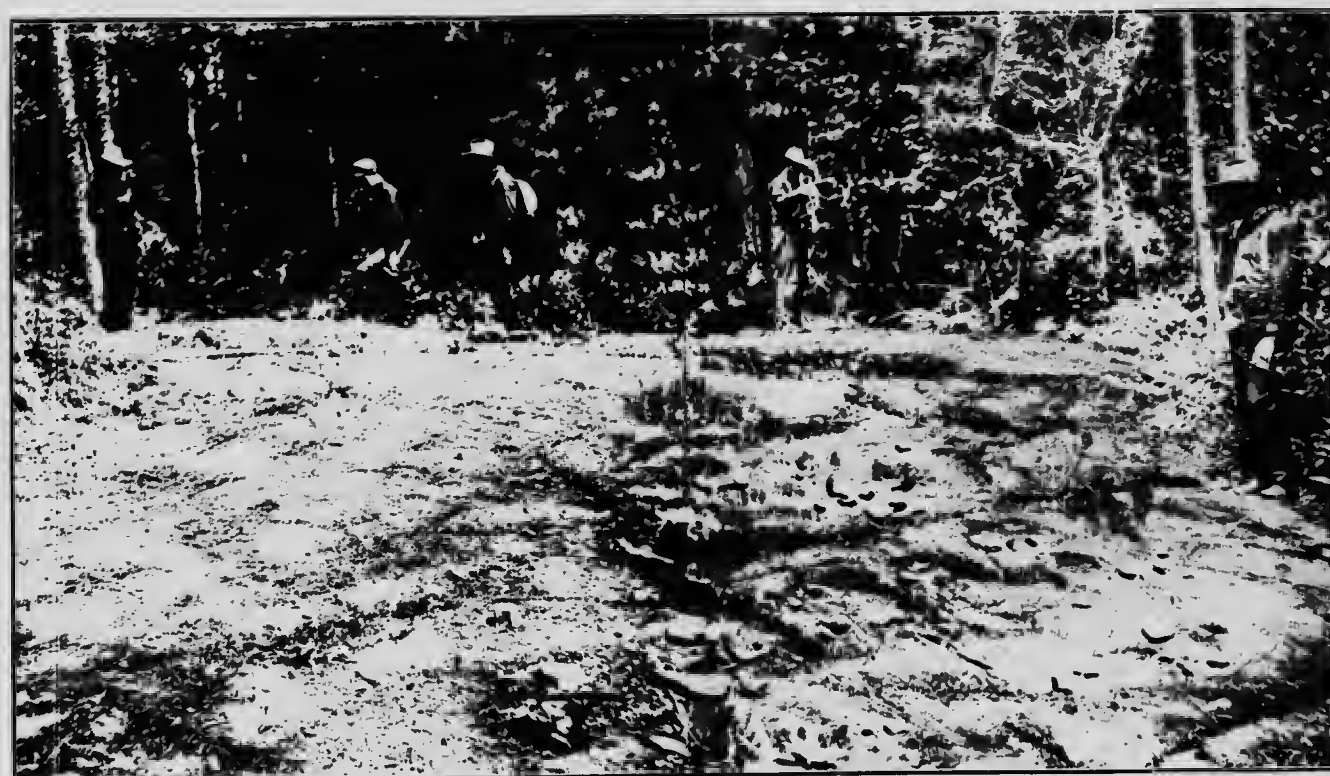
Location W-214.

This location, containing an area of 240 acres, adjoins W-213 on the east and the Matawin river to the north. The Canadian Northern railway runs parallel to the river throughout the whole width of the property from east to west for a distance of half a mile. Nearly in the middle of the location, and at the point of its highest elevation, there crops out a large deposit of magnetite. This has been stripped at three different places, and measures 309 feet in length and 213 feet in width. The correct strike of the deposit, as well as that of the adjoining rock, is so obliterated by the bending and twisting of the whole formation that it is difficult to recognise what was its former direction. But it seems that the trend of the rock formation, which is here also a chlorite schist, is now in a north-easterly direction, and judging by the strike common to many localities here, it has been shifted nearly seventeen degrees to the north. In this case the strike might be approximately determined by the direction in which the longest diameter of the deposit is taken, and also by the closeness of the rock north and south of it. This would give the deposit a strike east by five degrees north. This is in harmony with the fact that the general strikes of all the deposits of this country vary in any case only a few degrees from due east and west.

From this we may presume that the dip of the ore is northward, in conformity with that of the rock. The ore itself is very silicious, and at places is considerably banded with jasper; it has also incorporated in it a good deal of rock matter, in which respect it differs from the deposits of W-211. Otherwise it is very massive and dense, and the surface is so smooth that it was very difficult to take samples. I did not, therefore, do so, not for this reason alone, but also on account of the increase of the silica contents of the ore at the surface by the partial leaching out of the iron. This leaching progresses to a depth of two inches or more, and can be invariably observed in all deposits in that section of the country.

The magnetic attraction of the two places where it was first stripped shows a remarkable difference by the readings of the needle. At the first point of stripping it would appear as if the east end of the deposit were running out into several stringers. Of this, however, no indications appear at the surface, for it seems very compact over the whole width, and so also it seems for another 100 feet in an easterly direction, beyond the point of stripping, according to the indications given by the dip-needle. The repeated change from a positive to a negative reading would suggest that the deposit has been split up and divided into different parts.

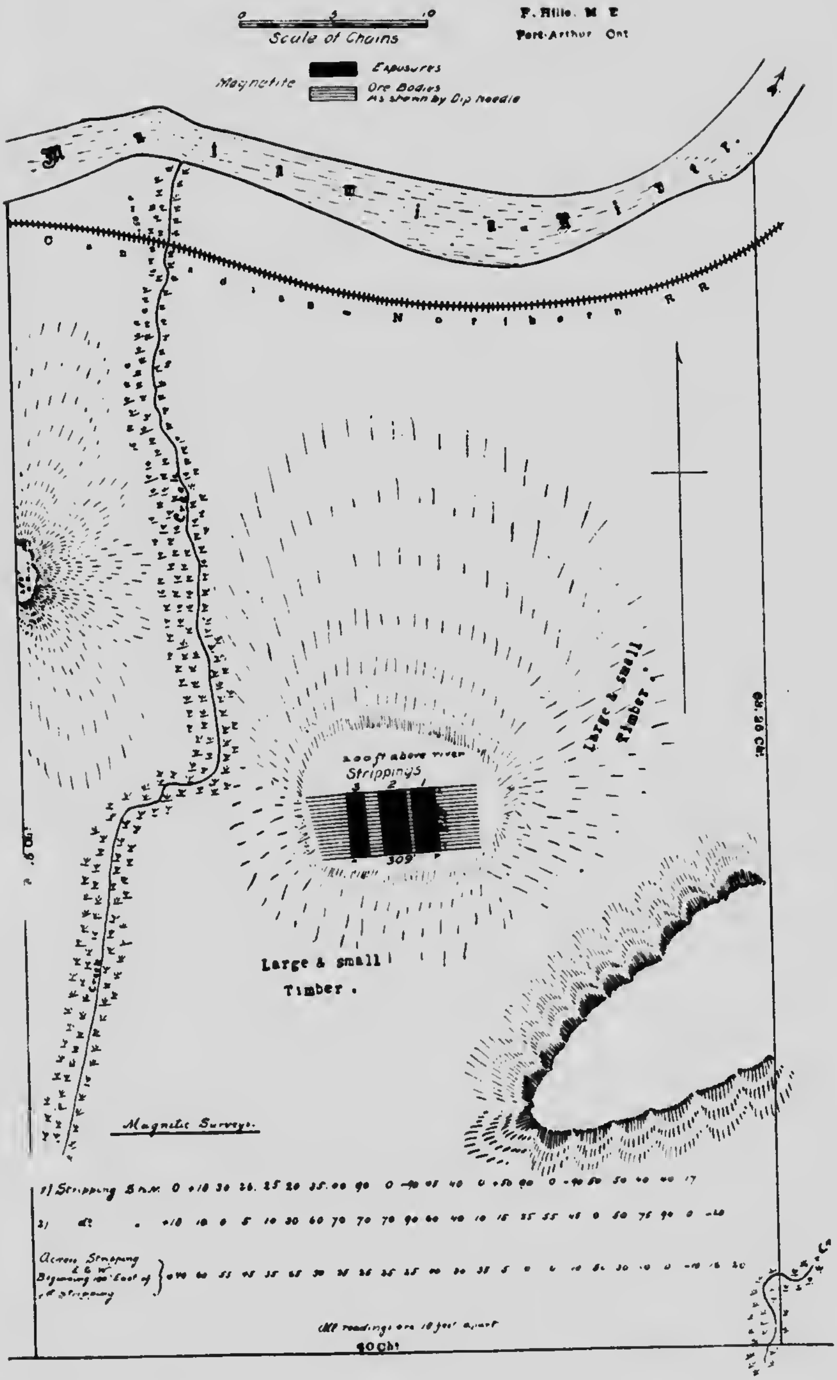
The second magnetic survey, made on the next portion of the vein which was stripped, showed less strongly the abnormal features of the first deposit. There is sometimes a variation in intensity as the survey reached the different pole readings of the former. In general, however, the normal status was



Part of Iron Deposit on W. 214, Matawin Iron Range

Loc. 214.

320 Acres.



maintained. The earth inductions were shown correctly, arriving, however, at the south pole reading somewhat later than was the case in the former deposit. All readings are taken ten feet apart, and each one commenced twenty feet south of the exposure. The third row of figures indicates the readings taken along the strike of the deposit, commencing at a point 100 feet east of the commencement of the first stripping, these readings being taken about twenty feet apart. There is nothing abnormal in these readings, with the exception, perhaps, of those at the extreme western limit, where negative readings occur for some distance, indicating probably an irregularity in the shape of the deposit. Further, we can notice that the length of the deposits is usually greater than the exposures would lead us to imagine.

The location is well wooded with the same variety of trees mentioned in connexion with other locations, and here also at one place timber is found as large as eighteen inches in diameter or more, while on a portion of it it is only from two to six inches, according to the greater or less damage done by fire in former years. But the area covered by large timber is considerably greater than that where the smaller trees predominate.

Only one small creek drains the location, flowing along its western side, where it follows a depression between the hill upon which the outcrop of the iron deposit is found and another hill on the boundary line between this and W-215.

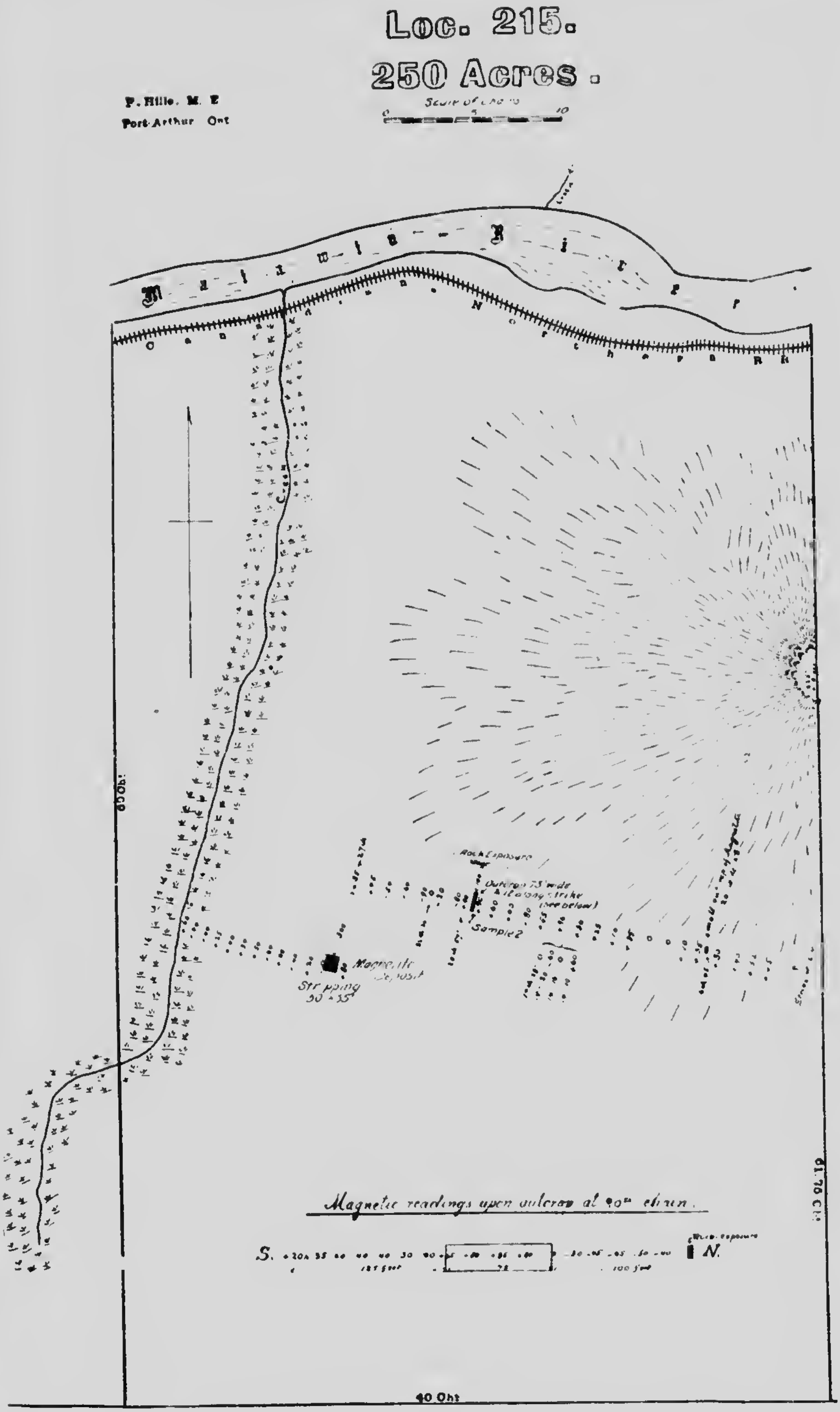
A great deal of the claim is covered with fine soil, sloping gradually down towards the Matawin river and the railway.

Location W-215.

The area of this claim is 250 acres, and it is situated due west of the last named. On the north-east side they are separated by a hill about 225 feet above the level of the river, which descends in a rather steep grade. Towards the south-east the slope is more gentle, while in a westerly direction nearly the same level is retained for about a quarter of a mile, when it again drops suddenly to the western survey line, forming there a hollow basin, from which a creek winds its way towards the Matawin river.

After this location had been thoroughly prospected with the dip-needle, a line of attraction was discovered west of the 36th chain, south of the north-east survey post, and this line was followed across the claim towards the western boundary line.

As will be noticed on the accompanying map, a reading of the dip-needle was taken every chain, and in this way, after traversing 441 feet, a small outcrop, showing about twenty feet of iron ore was discovered. At 1,320 feet a second exposure was found, which was stripped to a width of seventy-three feet and about ten feet along the strike of the deposit. Here sample No. 2 was taken. At 1,782 feet the country rock is encountered. I was led to search carefully close to this point on account of the restless behaviour of both compass and dip-needle, with the result that another deposit was found, which, after some stripping had been done, showed a width of fifty-five feet for a distance of



Loc. 215.
250 Acres.
F. Hille, M. E.
Port Arthur Ont
Scale of Chains
0 5 10
Canadian Northern R R
Rock Exposure
Outcrop 75' wide & 1 chain along strike (see below)
Sample 2
Magnetite Deposit
Stripping 30 × 35
80 Chs
40 Chs
Magnetic readings upon outcrop at 40th chain.
S.
N.

about fifteen feet along the strike. We did not, however, determine the entire lateral extent. I managed to trace it in a northerly direction towards the line of the adjoining location, W–216, as shown on the accompanying map. Near the creek all trace of it was lost, the dip-needle showing there only earth attraction. The sample mentioned above gave results as follows:—

Sample No. 2.

Iron	30.66%
Silica	47.86%
Phosphorus	0.11%
Sulphur	0.0[illegible]%

The iron contents of ore are not very high here, but by going deeper into the deposit, where the ore escapes the influence of the meteoric water, a somewhat higher quality will probably be found. Besides this, the greater portion of the impurities could be removed by magnetic separation alone, or by a combined process of washing and magnetic separation, as will be observed from the experiments made on the ore from W–216.

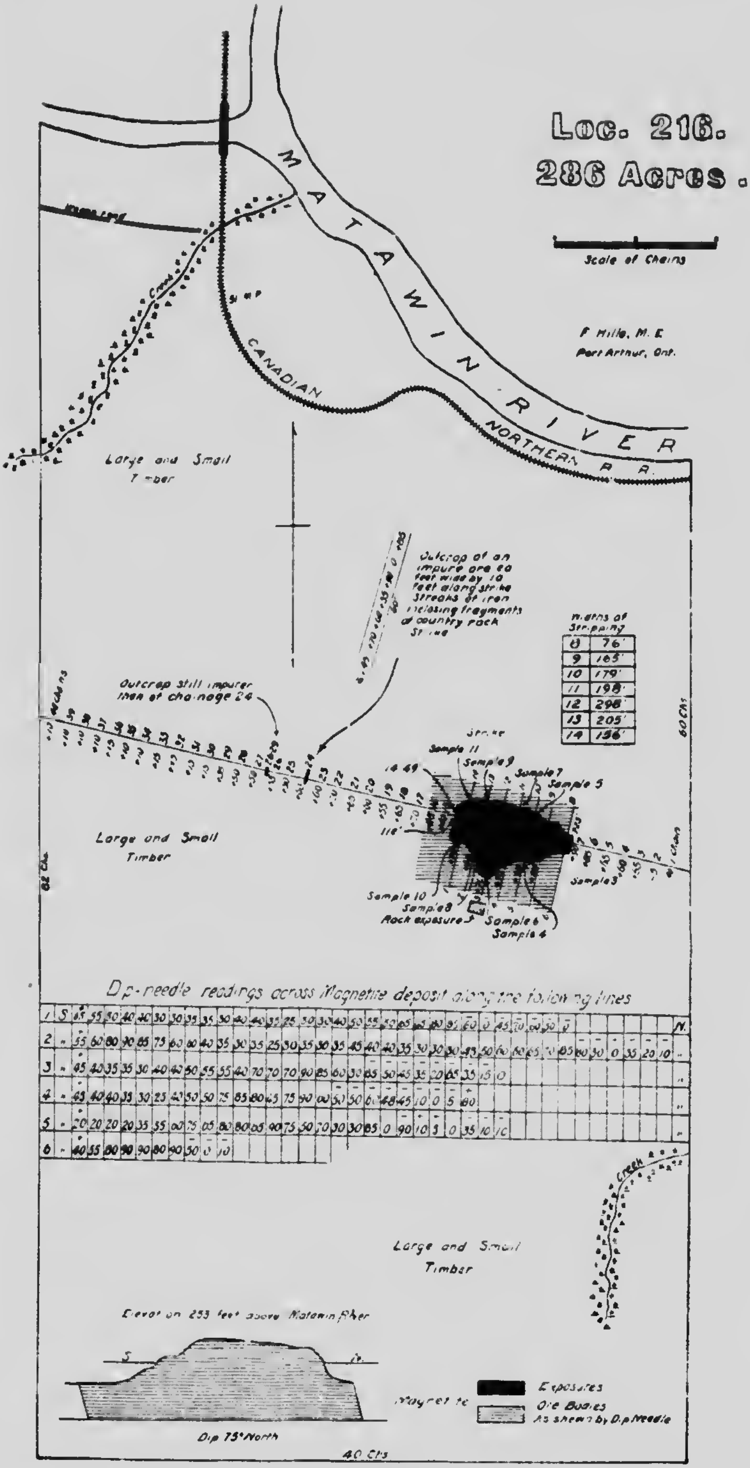
The location is fairly thickly overgrown with timber of the usual type, both small and large. As on the other locations, the railway passes through the northern portion, the Matawin river forming the northern boundary of W-215.

Location W–216.

This location contains 286 acres and adjoins W-215 to the east, being situated on the south side of the Matawin river where the Shebandowan river flows into it. The Canadian Northern railway traverses nearly the whole north part of the location, and after crossing the Matawin river it follows the Shebandowan river, paralleling the latter as closely as it did the former from its junction with the Kaministikwia. According to the railway mile post, this claim is fifty-one miles distant from Port Arthur. Close to the eastern boundary, on the very highest point on the location, there is exposed a very massive deposit of magnetite, standing out prominently above its surroundings in a large hog's-back, having a length of seven chains and twenty-six feet, and an average width of two chains and forty-seven feet. These figures, however, do not show the limit of the whole deposit in either width or length, as is clearly indicated by the magnetic survey lines on the map. According to the latter, we may expect to find its length to be over twenty-eight chains, and its width probably over six chains. Following the magnetic survey in a westerly direction, at a distance of twenty-four chains we come to another outcrop, about sixty feet wide by ten feet long. The surface ore is rather silicious. At twenty-six chains and twenty-nine feet we come to another exposure, which, however, is yet more silicious than the first. From here on the whole deposit seems to consist of this class of ore right into location W–217, where it becomes so impure that I do not consider it worth any attention.

Passing from the first described ore body, and going in an easterly direction, we find the character of the ore to be practically the same as that de-

Part of Iron Deposit on W 216, Matawin Iron Range.



Loc. 216.
286 Acres.
Scale of Chains
F Hille, M.E.
Port Arthur, Ont.
MATAWIN RIVER
CANADIAN NORTHERN R.R.
Large and Small Timber
Outcrop still impurer than at chainage 24
Widths of Stripping
Sample 11
Sample 9
Sample 7
Sample 5
Sample 3
Sample 10
Sample 8
Rock exposure
Sample 6
Sample 4
60 Chs
Large and Small Timber
Dip-needle readings across Magnetite deposit along the following lines
Creek
Large and Small Timber
Elevation 253 feet above Matawin River
Dip 75° North
40 Chs
Exposures
Magnetite
Ore Bodies
As shown by Dip Needle

scribed in the first deposit. Nine average samples were taken, four at each side and one at the eastern extremity; the results of these is given below:

SAMPLES

	Taken at the south side				Taken at the north side.			
	No. 3	No. 4	No. 6	No. 10	No. 5	No. 7	No. 9	No. 11
Iron.......	24 2	27.45	26.31	27.68	22.65	22.88	20.02	23.57
Silica......	51.50	49.60	50.66	46.68	52.26	51.34	54.86	51.46
Phosphorus.	0 12	0.14	0.09	0.11	0.11	0.11	0.11	0 12
Sulphur....	0.12	0 05	0 05	0.15	0 08	0 03	0.06	0.03

SAMPLE No. 8.

FeO.......	12.28%
Fe_2O_3.....	21.70 "
FeS_2......	0.33 "
MnO......	0.21 "
Al_2O_3......	7.93 "
CaO.......	0 87 "
MgO.......	2.65 "
P_2O_5......	0.32 "
SiO_2......	51.36 "
TiO_2	0.03 "
(H_2O, etc.)	1.35 "
Na_2O, K_2O etc.	0.97 "
(undetermined)	

Metallic Iron	24.73%
Sulphur........................	0.18 "
Phosphorus	0.14 "
Titanium	0 02 "
Manganese	0 16 "

I mentioned at the outset that the iron deposit comes to the surface at the highest point of the location, which is here 252 feet above the level of the river. The sketch given on the accompanying map will show the outlines above ground, and also the dip. A few chains south of the outcrop of the iron deposit the country rock become plainly visible. Here, as in every other place, this consists of a chlorite schist. The schist planes have a strike east by twelve degrees south, which is also the strike of the iron, which fills out large fissures in the rock.

The location is fairly well provided with large and small timber, especially on the north-east and south portions, the north-west corner being studded with small poplar and similar trees.

Experiment with Matawin Magnetite taken from the West End of Deposit on W-216.

Character of the Ore.—The ore consists of ferrous-ferric oxide in which silica is present, partly as a mechanical mixture in the form of quartz, and partly in chemical combination in the constituents of the chlorite schist, which is intermixed with the iron particles. The texture of the ore is granular, the diameter of the individual grains being not greater than a quarter of a millimeter. There is also found, intermixed with the magnetite grains, small particles of fine specular iron of a bright bluish steel colour, forming a small percentage of the whole.

In selecting the ore I tried to secure it as fresh and unaltered as possible, but, in spite of this, a certain amount of it showed in places some oxidation of the magnetite particles i[illegible] hydro-ferric oxide. Otherwise my choice was made of the most impure ore that I could collect from the deposit, my object being to give the processes that I was applying the severest test possible. The composition was as follows:—

Iron	24 16%
Silica	52 07 "
Phosphorus	0 14 "
Sulphur	0 06 "

My first experiment was with dry magnetic concentration after I had ground the ore to a fineness of from 40 to 200 mesh. Dry concentration did not prove successful, owing to the mechanical adherence of the fine, powdery gangue material to the particles of magnetic iron; even a brisk rattling or shaking motion was not sufficient to liberate them from the strong attraction in which they were held by the mass of the metallic grains, which were powerfully drawn together by the magnetic force.

My next trial was made by applying hydraulic classification followed by magnetic separation; by this method complete success was attained only when I used the ore in a powdered condition sufficiently fine to pass through a 200-mesh sieve.

My endeavors were next concentrated upon simplifying the process as much as possible, and in order to make the process as effective as possible, I abandoned hydraulic classification and constructed a machine by means of which the gangue matter would be separated from the iron particles by a process of washing, the latter being carried under a magnetic separation drum, by which they were picked up and deposited into their bin. The product from this process was as follows:—

Iron	66.50%
Silica	6.50%
Phosphorus	0.008%—0.022%
Sulphur	0.[illegible]

Had it not been for the hydro-ferric oxide in the ore, the concentrates would have shown up still better, but the results obtained I consider to be a great success. The tailings showed no iron grains, with the exception of some particles of brown ochre.

Fortunately the ores of the Matawin iron range are of only moderate hardness; had they been otherwise, the necessity for fine grinding would offer a serious obstacle to their utilization at the present time. I am convinced, however, that by employing a correct arrangement of the disintegrating machines and making a careful selection of the right kind, there ought to be found no difficulty in making an economic success of the treatment of these ores, or perhaps I had better modify this by saying a certain class of the Matawin ores. I make this modification because there are certain of them which are very hard, the iron being of a higher grade, and the impurities being present in the form of jasper bands; and again, there are others in which the magnetite particles are of a higher oxidation and therefore are not quite as amenable to concentration.

Location W-218.

The area of this location is 310 acres, and the iron ore deposit is prominently exposed on a hill 202 feet high, standing like a cliff about twenty-five feet above the surrounding country, and extending along the north slope of the hill for a considerable distance both east and west. In the latter direction it can be traced as far as the west boundary line of W-219, while to the east I was able to follow it for nearly twenty chains. Judging by the dip-needle, the actual length of the deposit seems to be even greater than this. The accompanying map of the location shows that the width of the deposit is also very considerable, being apparently about eleven chains, as far as it is possible to trace it, since, with the exception of two open cuts on the highest portion of the hill, no work has been done on the deposit.

The other exposures, or as I call them on the accompanying map, strippings, were made by myself, in order to verify from time to time the correctness of the readings of the dip needle. From several of these strippings I took samples for the purpose of finding out whether there are certain streaks of the deposit in which a different quality of ore exists. Wherever the ore is most solid, and this usually is the case toward the centre of the deposit, it appears to be cleaner, that is to say, has greater iron contents. This is undoubtedly the case where the pits are sunk, and the iron ore lying on the dump there looks extremely promising, and I see no good reason why there should not be places discovered where the iron is more concentrated, as is the case in other localities along this range. The general character of the ore is rather hard, dense, of bluish colour, and of moderate magnetic quality. The analyses made, seven in number, show the composition of the ore to be as follows:—

	No. 12	No. 13	No. 14	No. 15	No. 16	No. 18
	%	%	%	%	%	%
Iron	36.66	36.66	35.64	35.87	36.55	24.82
Silica	41.30	42.88	43.86	40.06	40.66	51.40
Sulphur	0.07	0.08	0.07	0.10	0.10	0.10
Phosphorus	0.12	0.11	0.12	0.15	0.14	0.17

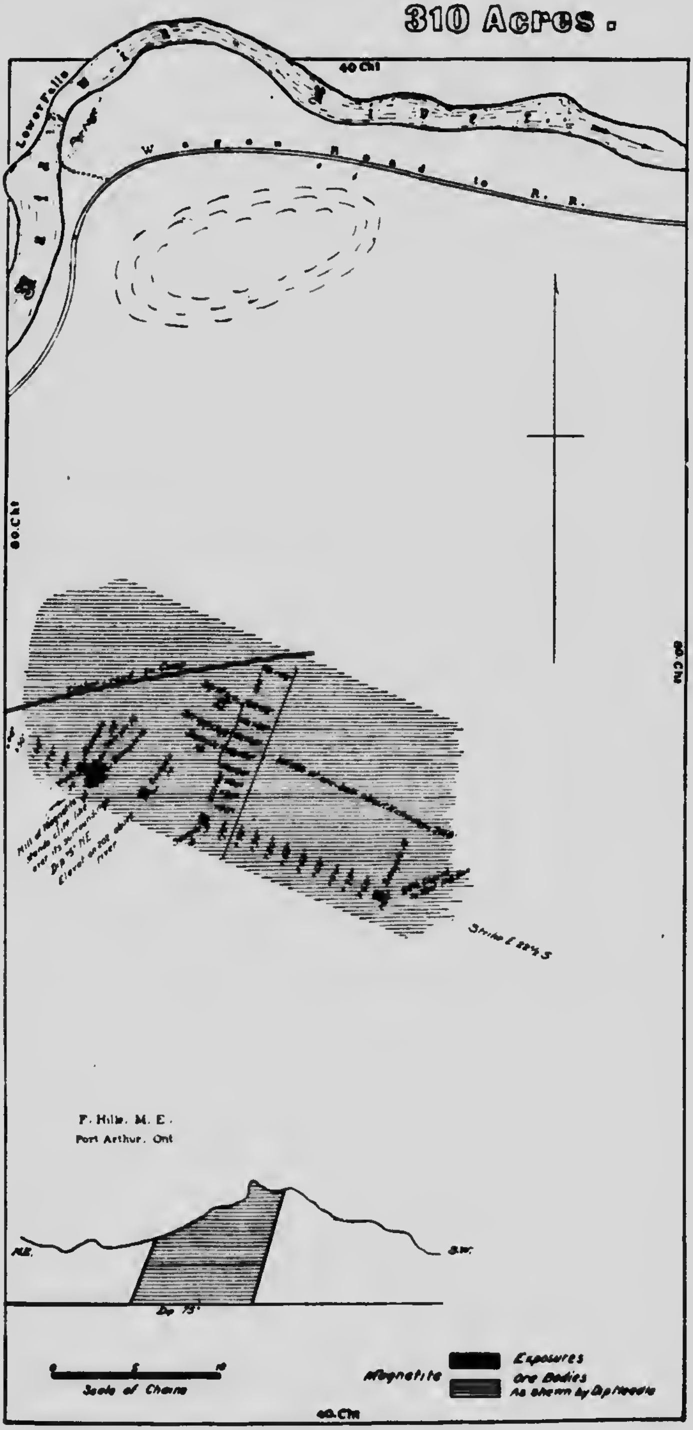
SAMPLE No. 17.

FeO	13.39%	CaO	1.27%	Metallic Iron	34.82%
Fe_2O_3	34.90 "	MgO	2.36 "	Sulphur	0.10 "
FeS_2	0.18 "	P_2O_5	0.32 "	Phosphorus	0.14 "
MnO	0.70 "	SiO_2	41.46 "	Manganese	0.54 "
Al_2O_3	3.10 "	TiO_2	Trace	Titanium	Trace
		$H_2O + CO_2$, etc.	2.87		

On account of the phenomenal size of this ore deposit and its favorable situation, it would only need to be quarried and sent down by means of

Iron Ore Cliff on W. 218, Matawin Iron Range.

Loc. 218.
310 Acres.



shoots into ore pockets, whence it could be dropped down into the ore buckets of an overhead cable tramway, being carried by gravitation one mile down the river, which is here 100 feet above the level of the Canadian Northern railway line; thence it could be shipped to Lake Superior, or wherever it is required. Or, in the event of it being found advisable to reduce the ore by electric smelting into pig iron on the spot, there are water falls here which would provide at least part of the power necessary, and if that were not sufficient the rest could be supplied by saving the gas from the burning of charcoal in closed continuous kilns. The gases from this could be made use of for driving motors for the production of electricity in the same manner as is done in connection with coke-by-product ovens. There is an abundance of wood for charcoal here to last for many years to come. Thousands of square miles of country are studded with timber of all the kinds that have already been enumerated, and most of this is still held by the Crown.

Taking into consideration the extremely cheap methods by which an almost inexhaustible ore supply can be mined, the inexpensive facilities for shipment to the railway, or the treatment of the ore in electrical furnaces, combined with the cheap production of electrical and other power—all these advantages should, to a great extent, offset the leanness of the ore, the cost of bringing it up to a higher grade, and the non-existence of limestone in the neighbourhood. The matter of limestone I have mentioned before, and I think I said enough to reassure anyone who intends erecting smelting works in this district.

I must digress here a little further to take up the subject of water power, which I alluded to briefly before. On location W-218 one only of the three falls is found, the other two are on the adjoining location, W-219. Before giving the results of my measurements (see plan) and the amount of horse power calculated therefrom, I might mention that last summer was extremely hot and dry, and that, in consequence, the waters in the creeks and rivers were lower than I have ever seen during the nearly twenty years of experience that I have had in this country. The rocks in the falls, which are usually submerged, were exposed to view, which can be seen by the photographs accompanying this report. Had the rainfall of last summer been normal, I believe that my register would have shown three to four times the amount of horse power which I actually measured. The figures were :—

The Upper Falls	93¾ H.P.
The Middle Falls	165½ H.P.
The Lower Falls	79¼ H.P.
Total	338½ H.P.

A few weeks later, after some showers of rain, I again measured the falls, when my result was :

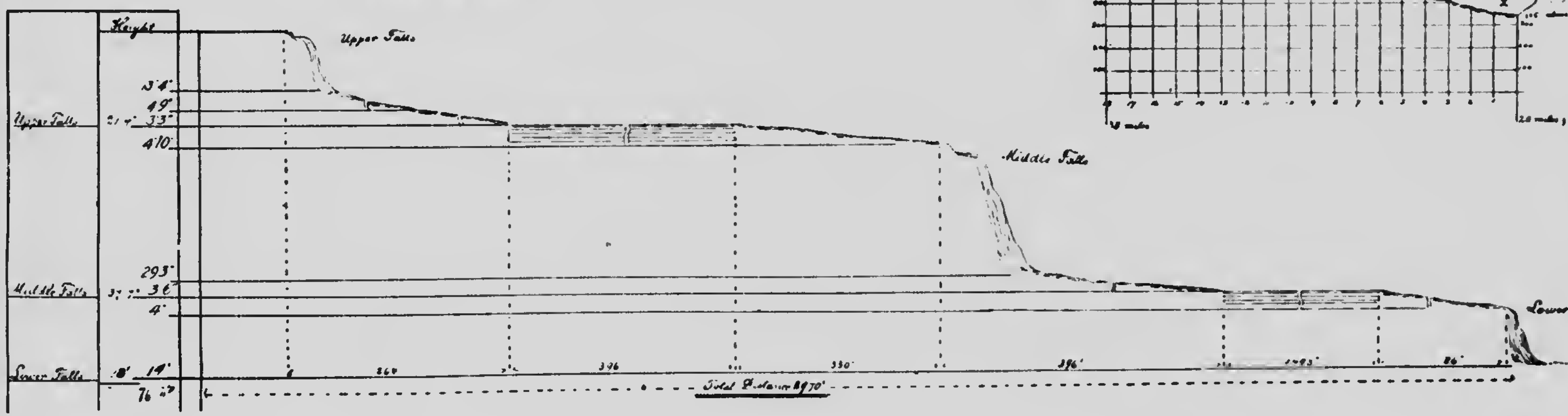
The Upper Falls	286 H.P.
The Middle Falls	461 H.P.
The Lower Falls	221 H.P.
	968 H.P.

Middle Fall, Matawin River.

Lower Fall, Matawin River.

Profile

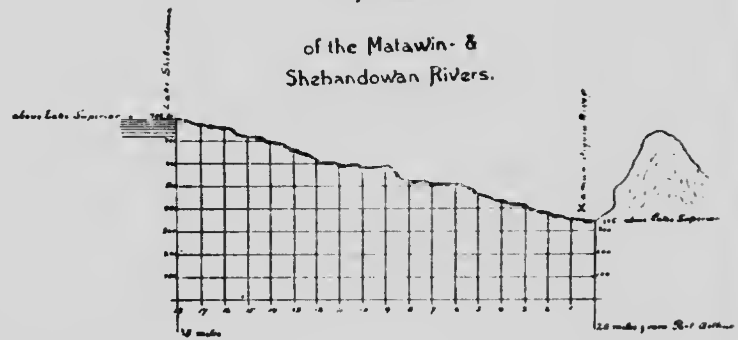
of the Matawin River between its Falls.



F. Hille. M B.
Port Arthur. Ont.

Profile

of the Matawin- & Shebandowan Rivers.



Even the figures given in the latter table seem to me far short of the reality, when looking at the height of the water marks on the rocks along the shores of the river, intensified by the pollen of the willows, alder and hazel bushes. These bushes flower here in May, at a time when most of the snow is melted, and last year in April all the snow and ice on the lakes and rivers, as well as the snow in the green bush, had disappeared. We had a very late and mild winter and early spring weather throughout March, although this was followed at the beginning of April by some severe weather, which closed navigation at Fort William and Port Arthur harbors and the little inland lakes for a week; still the principal source of the spring flood, the snow, had already gone, and was supplemented by only an exceedingly scanty rainfall. When, therefore, the season for the flowering of these plants arrived, the snow waters had already left the rivers, and the marks on the rocks will indicate the usual height of the Matawin river. This was three feet above the water gauge at the time of my taking the first measurements. This shows that the normal height of the river is much greater, and even my second measurement did not represent the usual figures during an average season.

At the same time we learn from the weather conditions of last year that we should at all times be prepared for the unusual to happen, such as the meteorological phenomena of last year.

As suggested before, such extraordinary conditions can be alleviated by damming the river and maintaining by that means a steady flow and volume of water throughout the year. The most suitable place for this purpose would be at the upper falls, where a dam from twenty to thirty feet high could be built, which would create a reservoir many miles in extent, since the river flows for nearly thirteen miles through a low and generally swampy country, while on both sides of the falls, or in the immediate vicinity of them, the banks rise to a height of thirty or forty feet, at the most convenient point for a dam thirty feet high by 150 feet long, and the timber for this work can be found close at hand.

In this connexion I might mention that while I was in camp at Shabaqua station, I measured the fall of the Shebandowan river from my camp to the Shebandowan river bridge. The distance was 6,600 feet, and the head of water about 88 feet. I calculated from this that horse power could be developed to the extent of 4,670. I am certain that in a season when the rainfall is normal this amount would be trebled. And even as it is, I could have increased it had I added the measurement of water in the Oskondiga to that of the Shebandowan. This stream can be seen on the map at a point where the Shebandowan river makes a sharp bend to the north-west, about 1⅛ miles north of the Shabaqua station. The Shebandowan river boasts of the best reservoir imaginable in the lake of the same name, and also in the Kashaboiwe lake, the former being over twenty miles, and the latter nine miles in length, and both of them can easily be dammed. I must now return from this digression to the iron deposits.

About six years ago one or two diamond drill holes were sunk in the most westerly portion of the deposit on W-218. I was, however, unable to secure the information that I required as to the records of the holes. I can only speak from recollection when I say that they went down about 1,000 feet, at an angle of forty-five degrees, and that it appeared to me that they had placed the drill too near the western margin of the deposit. As regards the development work that has been done on this location, I found nothing more than the two workings shown on the accompanying map. One of these is a small pit at the western base of the cliff. From this sample No. 17 was taken. The other work consists of the shooting out of a piece fifteen feet by ten feet from the north side of the cliff, samples Nos. 15 and 16 coming from this. I followed the strike of this deposit, which is east by twenty-two and one-half degrees south, for nearly a quarter of a mile, and verified the existence of ore by stripping such places as would permit of it without taking up too much time and labor. At 157 feet I caused the first stripping to be done, taking therefrom sample No. 14. At a point 256 feet farther east a second stripping was made and sample No. 13 taken. At 726 feet the last stripping was made along the strike of the deposit and then sampled, sample No. 12 coming from here.

Although the dip-needle shows some indications of the continuation of the iron ore still further, I stopped here, and, cross-cutting the deposit, passed in a northerly direction from the point of the second stripping, as is shown on the map. At 213 feet I made an opening at a place where the dip-needle gave a high reading. Sixty-six feet farther on I took sample No. 18. The next four strippings were made each sixty-six ft. apart, and the last one with an interval of 152 feet, and this brought me as far as the wagon road leading to the camps. In this manner I proved the width of the deposit to be about eleven chains, that is 726 feet. I found no difficulty in taking the extent of the dip westward, following it with a dip-needle right into the adjoining location, W-219, where in several places it is very prominently exposed. By adding the length of the deposit towards the west boundary to the length of W-219, the total length of the cliff westward appears to be 1782 feet; by including that portion east of the cliff, the total length is 3,351 feet, with a width of 726 feet. Perhaps I ought also to remark on the depth of the deposit, which must be very great, going down with the steeply tilted rock formation, which in that particular locality is especially wide, somewhat over three miles. However, it is not a matter of very much consequence to the present generation whether this deposit is 4,000 or 12,000 feet in thickness, since the deposits of the Matawin range are in any case sufficient to outlast the present generation of the people of Canada, and their children.

The country rock in which the iron is found is the same as usual, viz., chlorite schist, which is visible a few chains south of the cliff and at nearly the same height, and dipping like the former to the north-east and probably at the same angle.

The north wall of the iron ore deposit is not very well exposed, but it cannot lie very far from the wagon road, where the grade of the iron ore is getting more lean, and where a few chains to the north-east some small knolls reveal the presence of the country rock. Like all the other deposits along the Matawin range, this one follows the strike of the foliation of the schist in a course west by twenty-two and one-half degrees north. The dip is the same as that of the enclosing rock, being somewhat steeper towards the south, where it is seventy-five degrees to the north-east, while at the north margin the dip appears to be ten degrees less. It will be noticed that the iron formation stands out rather strongly above its surroundings, being harder than the country rock. At the foot of the hill, along the river, a wagon road leads down the railway track not far from the confluence of the Shebandowan river and the Matawin, this road being only a mile and a quarter in length.

Location W–219.

This has an area of 285 acres, and my remarks about the iron deposits of the adjoining location, W–218, and the ore contained in it, apply equally to that of W–219; the deposit is the same, being an extension of the former. The ore is perhaps a trifle more lean, generally speaking, at least the majority of it is not of quite the same grade as that found close to the cliff and at some other places along the eastward strike. The iron ore shows up along a ravine south of the old camps, and yet more prominently along a little knoll near the centre of the location, where it is exposed to a width of 132 feet, and a length of 594 feet. The strike of the deposit is in the direction of the middle falls on the Matawin river, but it seems to stop not far from the south bank of the river, and only the schist can be found at that point. Samples No. 19 and 20 are taken from the little hill, the first from the south part and the last from the northern part (for analyses see below). No work of any kind has been done on the location itself, but it is from this point that all the other work in the neighbourhood has been carried on, sixteen and six years ago, at which times this camp was a centre of considerable activity. The old buildings have now nearly yielded to the teeth of time.

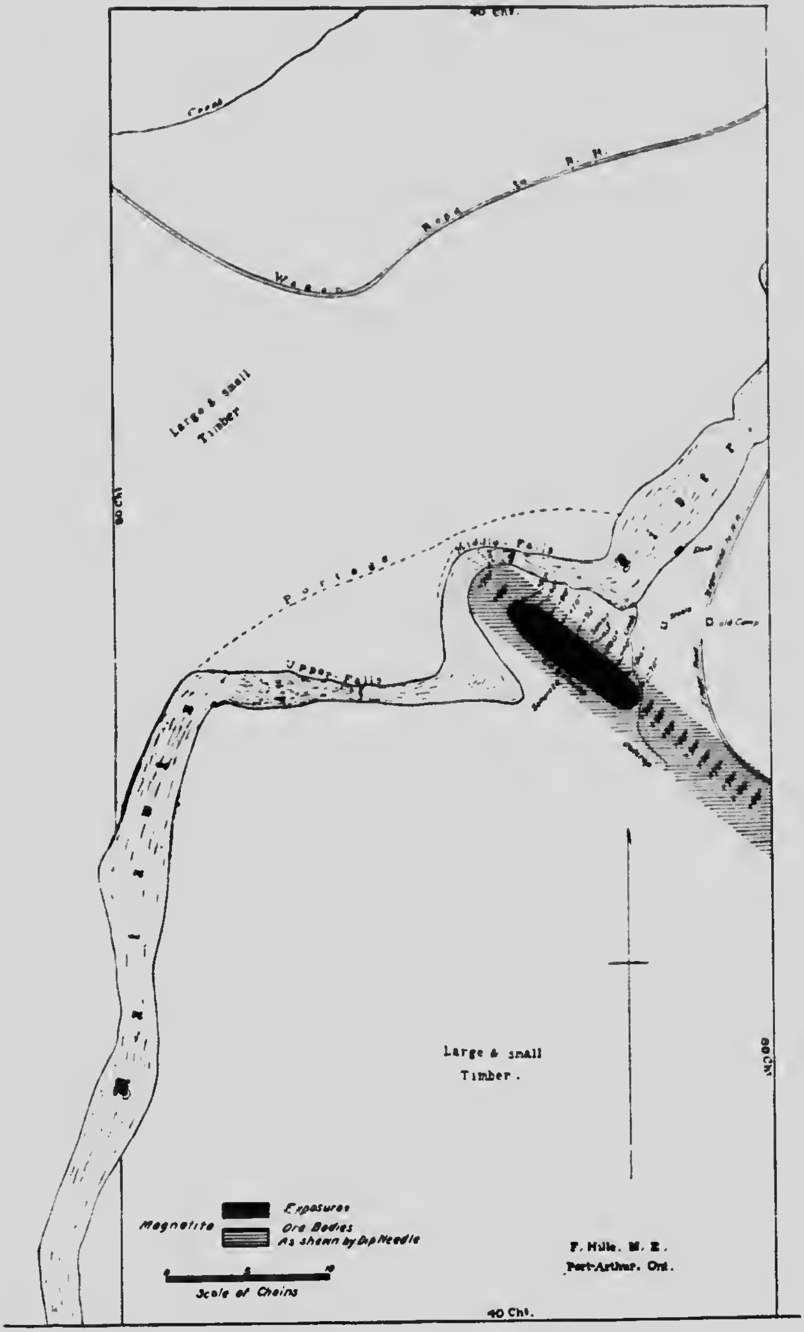
The Matawin river, which divides the claim into two parts, forms two falls here, which I have called the upper and the middle falls. This I fully described in my description of W–218. On the northern portion of the claim a wagon road crosses it, which was formerly the means of communication between Finmark, a station on the C.P.R., and this location, south and west of the Matawin river, ending at W–222. At a later period the road south of the river was substituted for the former, being somewhat shorter and avoiding the necessity of crossing the river.

Considerable timber, and some of a fair size, is found on this location.

ANALYSES OF SAMPLES.

	No. 19.	No. 20.
Iron	37.40%	41.66%
Silica	42.20%	40.36%
Phosphorus	0.13%	0.17%
Sulphur	0.04%	0.04%

Loc. 219.
235 Acres.



Locations W-221 and W-222.

These locations have an area of 160 acres each and are separated by some lots from those just described, but I was unable to find indications of minerals on those intervening, sufficient to justify me in giving them any mention here. I will therefore proceed to deal with W-221 and W-222 and take both of them together, as they have in common the iron ore deposits which occur there.

These two locations are without doubt the most worthy of attention on the whole range, although as we have seen, some of the ore bodies on the locations before described are of phenomenal size, yet those which we have now consider are of still greater extent, especially as regards the width of the iron ore bodies. They are still further remarkable in that most of the ore has been changed from a magnetite into a martite, that is, into hematitic ore.

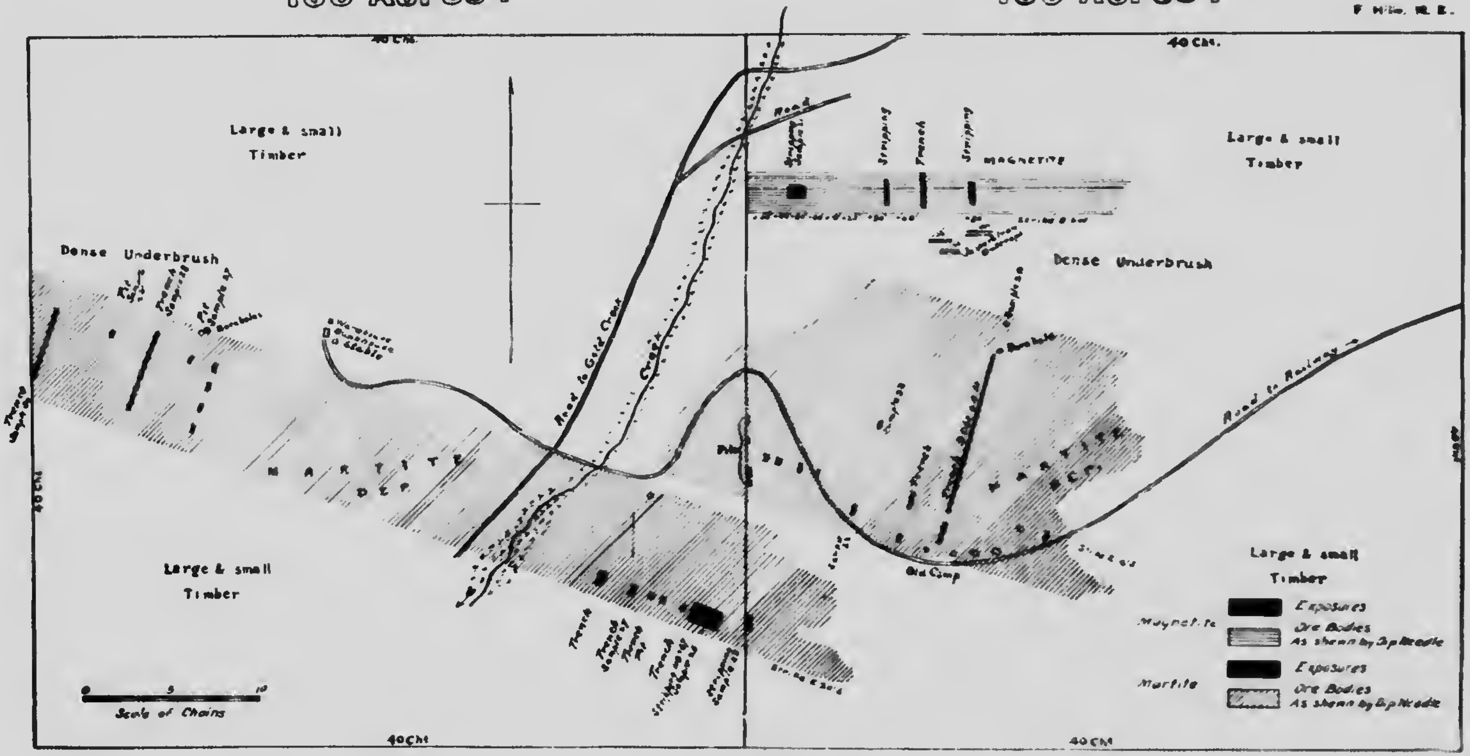
Each of the locations is forty chains square, with an area of 160 acres, and a central [illegible] crosses through the centre of them, with a course nearly [illegible] west. In the middle of each location, this elevation is cut by deep [illegible] the deepest depression being where the creek and wagon road wend their way northward. The highest points are marked by iron deposits, which [illegible] shown their greater resistance to the forces of erosion. Towards the north the land descends into low ground, consisting of a somewhat swampy muskeg, overgrown partly with black spruce or a mixture of poplar, tamarac and red spruce. In some places this timber is upwards of 18 inches in diameter, but in others only from four to six inches. The larger trees are found mostly near the middle of the claims, but there is enough timber to furnish wood suitable for mining and other purposes.

Two roads lead into these claims, one from the north-east, and the other also from an easterly direction, but entering the location to the south of the first and near the middle portion of location W-221. This second road has been the longest in use and was principally utilized when W-221 was prospected for iron about sixteen years ago. The more northerly one was cut out several years later at the time when work was commenced on W-222; later on it was widened in some places to as much as 100 feet, to carry a heavier traffic to and from a number of gold mining locations to the south. In some places these roads are in excellent condition; in others they are practically useless for present purposes and are in need of thorough repair.

These locations lie from two and one-half to three miles distant from the line of the railway. The nearest point at which one could strike the line would be at the Canadian Northern bridge over the Matawin river, while the nearest railway station is Shabaqua, about two and one-half miles farther on. An easy grade for a spur line to the C.N.R. could be found in to the locations in question, but probably the most convenient method for carrying the ore would be by means of an ærial tramway, in case any of the ore deposits should be brought into active operation. The most favorable point on the

Loc. 222.
160 Acres.

Loc. 221.
160 Acres.



railway for the erection of ore pockets would be fifty-one miles from Port Arthur, or Lake Superior.

The iron ore deposits themselves are not only of very considerable extent, but also of special interest in as much as they are no longer true magnetite, but have become more highly oxydized and changed into a sesquioxide of iron, known as martite, which has a hematitic character, of a dark reddish color and a red streak, but has still retained a feeble degree of magnetism, which may be taken to prove that it still contains a certain amount of ferrous oxide. Analysis No. 29 shows this to be the case. Pure magnetite contains 69% ferric oxide and 30% ferrous oxide, while an ore of the composition shown in analysis No. 29 contains 80.79% ferric oxide, and only 19.22% ferrous oxide.

Judging by the diamond drill cores which I found near the old camp on W-222, this process of oxidation must have penetrated to a considerable depth, there being a much greater number of cores of the reddish martite than there were of the dark bluish and black magnetite.

To proceed now to the description of the deposits as they occur on W-221 and 222, a glance at the map will show that the deposits, especially on W-221, are of phenomenal size. Commencing at the north portion of this location, we find, about the eighth chain from the north-west corner post, a deposit striking nearly due east, with a width, as far as could be determined, of 126 feet, and in length, as traced by the dip-needle, 784 feet. This deposit is the only one which shows pure magnetite on the surface, which at its western extremity is massive and silicious, containing also some bands of jasper. Sample No. 21 will give an idea of its principal constituents. Towards the eastern limit it is very much banded with red and black jasper, which is especially noticeable in a large trench, and where the ore body is stripped, as well as in some isolated beds a few chains south. I endeavored to take some photographic pictures of these, but on account of the denseness of the surrounding bush it was impossible to take a really good photograph. The accompanying map shows the places where work has been done on this deposit.

Following along the same survey line farther south, on arriving at the nineteenth chain the dip-needle gives indications of the neighbourhood of another deposit, which can be traced to the twenty-sixth chain for a distance of about 462 feet At twenty-three chains and twenty-six feet I cut out a picket line in order to trace the deposit eastward, and succeeded in doing this for seventeen chains and forty-one feet, or 1,163 feet. I cross-cut the deposit twice, first at a point forty-five feet beyond the sixth chain, and found that I could trace a width there of 396 feet, at least this was the distance which I could strip it, or over which I found outcrops. Samples Nos. 22 and 23 are taken from this point.

I made another cross-cut forty-nine feet beyond the eleventh chain, and there found it to be 888 feet wide, and encountered the schists on each side of it. Considerable trenching has been done here, and two drill holes were put down at some time in the early nineties, but no record of the results is now available. Sample No. 24 is taken out of a pit close to the contact with the schist. At this point the strike of both the ore and rock is east by sixteen degrees south.

Again taking up the survey line, at the thirty-fourth chain we come across another stripping forty-nine feet in width from south to north. The ore is somewhat lean and partly banded with jasper. I took from this sample No. 25.

This deposit, which has a width approximately indicated on the map, has a strike of four degrees more southerly than that of the former, reading east by twenty degrees south.

On account of the dense underbrush and heavy windfalls in the southern portion of this location, I did not trace this deposit very far to the south-east. Instead of this I followed it on to location W-222, where more work had been done. In the first 547 feet stripping and pit sinking has been done at different places, and the number and extent of these may be seen in the accompanying map. From this place samples Nos. 26 and 27 were taken.

About five chains to the north a diamond drill hole was put into the deposit, but with what result I could not learn. The whole width of the deposit seems to me to be about 460 feet. At about nine chains from the survey line the depression commences between the two hills on W-221 and 222, and here the deposit is heavily covered with soil and boulders, and for about twenty-five and one-half chains no outcrop of ore could be discovered. Its presence, however, is very plainly indicate by the dip-needle. On reaching a distance of thirty-four chains and twenty-five feet, which brings us nearly to the top of the hill, we come to a pit six feet by six, sunk in the deposit to a depth of ten feet. As in every other place, the ore here is extremely massive, and in the bottom of the pit it appears to be of a higher grade than at the surface. Going 150 feet farther west we arrive at a trench two feet in width, which is dug right across the deposit to as great a distance as could conveniently be done, that is to say, until the covering of soil and boulders became too deep. The length of this trench is 314 feet, but whether this represents the full width of the deposit I was unable to verify, as it would have taken too much time to cut out a line owing to the heavy windfall and underbrush, which interfered considerably with the progress of my work, especially on these two locations. At any point where I could break off samples of this extremely hard and smooth ore, I did so and combined them to make up sample No. 28. West from this trench, and 150 feet distant from it, we came across a pit irregularly shaped and six feet deep, from which sample No. 29 is taken. The last place we examined where work had been done was near the west boundary, consisting of a trench not quite so long as that just described, as the ore body on the west slope of the hill is more heavily overlaid with drift material and humus. Sample No. 30 was taken here.

This brings us to the line of W-222, and the deposit of iron ore strikes into the adjoining location, W-223. Before leaving the description of this deposit, however, I must note that the owners endeavored to put three diamond drill holes into the deposit, two of which were almost at the north margin, one at an angle of forty-five degrees pointing towards the south-west, and the other at an angle of fifty degrees. It is extremely questionable whether the direction of the latter hole is exactly correct. It is evident, if we judge by the standpipe still in place and the many feet of country rock in the core boxes, that they must have drilled into the north wall of the deposit and struck iron ore with only a few feet of the last lengths. The third hole, which is near the south-west portion of the location, as I mentioned above, was put down in 1891, and the two former about six years ago. About five chains east of these borings stood the camps, consisting of a sleeping house, warehouse and stable. Although some large clearings have been made by cutting timber for fuel for the diamond drill boiler, etc., there is still a large quantity of standing timber of good size all over these two locations.

ANALYSES.

LOCATION W-221.

Samples	No. 21 %	No. 22 %	No. 23 %	No. 24 %	No. 25 %
Iron	36.40	33.94	35.84	31.36	38.64
Silica	43.84	45.92	45.78	46.24	43.96
Phosphorus	0.16	0.16	0.13	0.13	0.16
Sulphur	0.06	0.05	0.10	0.11	0.06

LOCATION W-222.

Samples	No. 26 %	No. 27 %	No. 28 %	No. 30 %	Core (blk) %	Core (red) %
Iron	35.01	39.12	37.98	32.03	35.96	35.28
Silica	44.90	38.23	41.15	46.33	43.00	43.24
Phosphorus	0.13	0.14	0.14	0.12	0.14	0.12
Sulphur	0.06	0.05	0.06	0.06	0.06	0.09

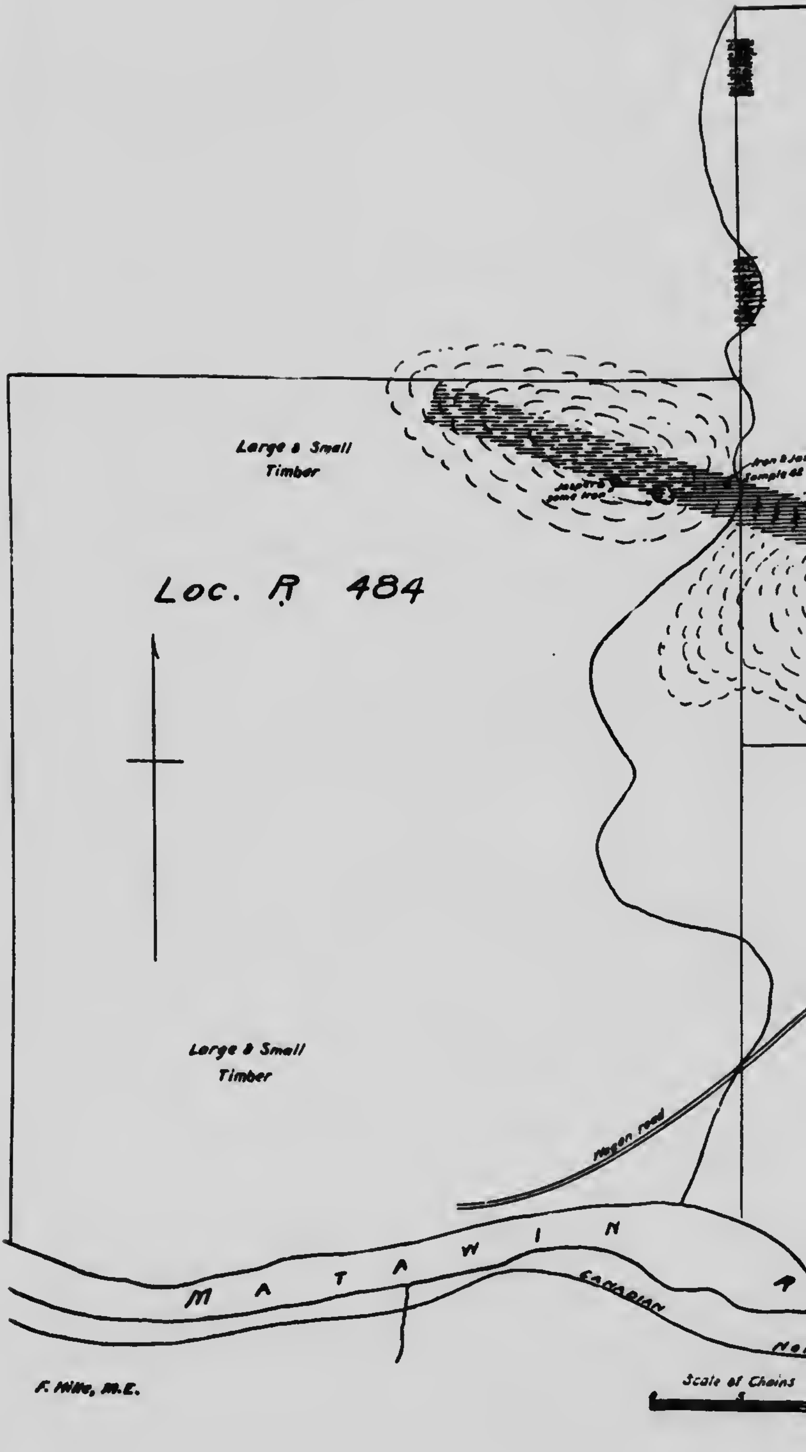
SAMPLE No. 29.

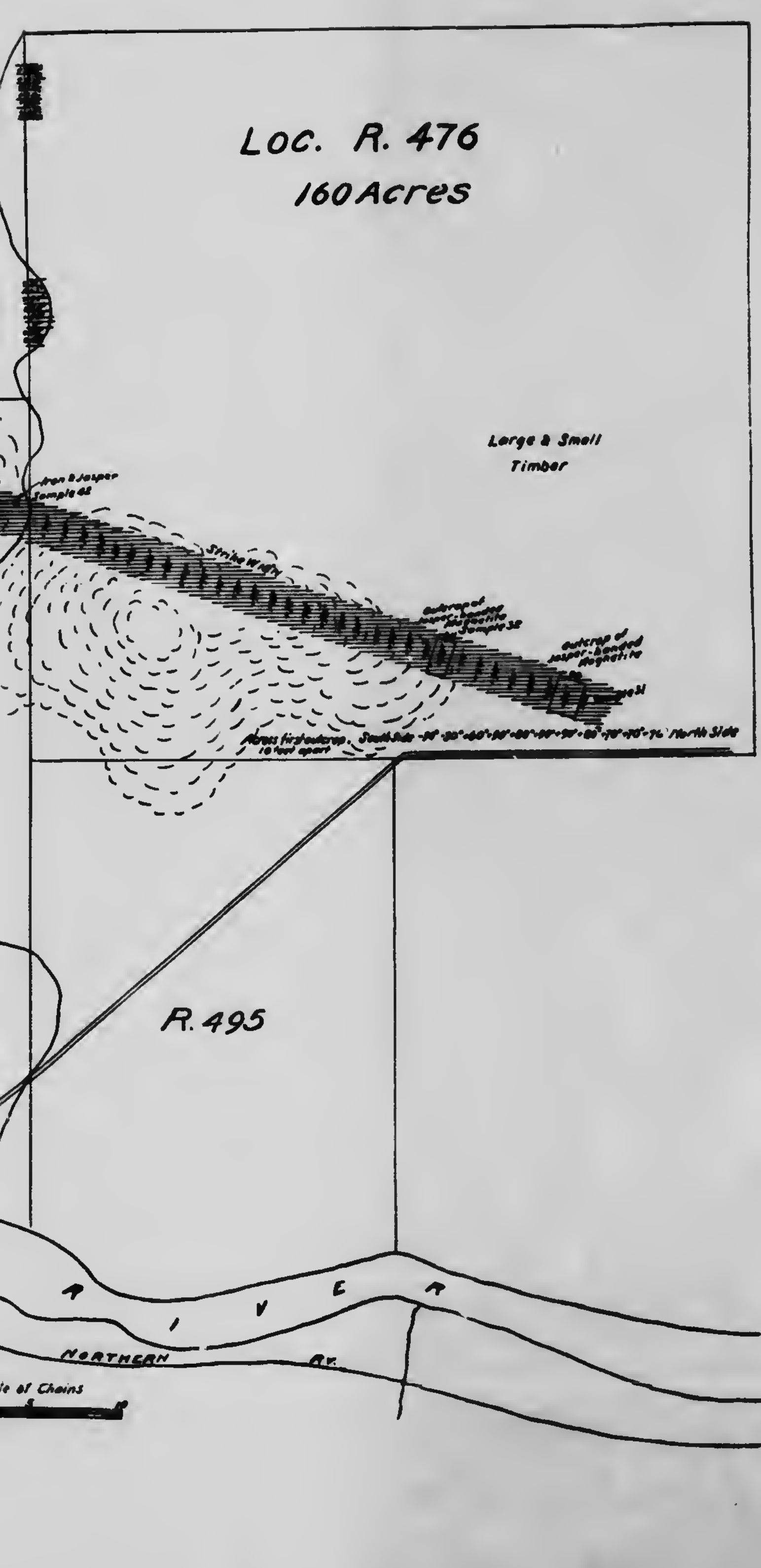
FeO	8.82%	Metallic Iron	32.83%
Fe_2O_3	37.10 "	Phosphorus	0.12 "
FeS_2	0.09 "	Sulphur	0.05 "
MnO	—	Titanium	Trace
Al_2O_3	3.58 "		
CaO	1.16 "		
MgO	2.12 "		
P_2O_5	0.27 "		
SiO_2	44 90 "		
TiO_2	Trace		
(H_2O, (etc.,)	1 80 "		

Locations R–476 and 484.

We must now retrace our steps and cross over to the north bank of the Matawin river, where there are a few locations worthy of consideration,


F. Hills, M.E.


Large & Small
Timber
Loc. R 484
Large & Small
Timber
Wagon road
M A T A W I N
R
CANADIAN
F. Hille, M.E.
Scale of Chains
5



Loc. R. 476
160 Acres
Large & Small
Timber
Iron & Jasper
Sample 42
Outcrop of
Jasper-banded
Magnetite
North Side
R. 495
R I V E R
NORTHERN
RY.

especially locations R–476 and R–484, which I combine here in my description, since the iron deposits are common to them both.

Commencing at the eastern part of location R–476, we observe, as is shown in the accompanying map, that at a point about ten chains from the south-east corner post there crops out a deposit of magnetite. This differs somewhat from those with whose descriptions we have become familiar in the preceding pages. The iron is more separated from the silica, the latter appearing as jasper bands, which include different sized bands of high grade iron ore. Only a very small portion of the deposit, however, is exposed to view, and not until the whole has been completely freed from the overlying drift can we express an opinion as to whether this deposit has places on the surface where little or no jasper will be found mixed with the iron.

Reference to the high readings of the dip-needle would almost lead us to believe that there are localities where iron is the more predominant of the two minerals of the deposits. Not only do those readings of the dip-needle show a very high average for over 132 feet across the deposit, but also for nearly twenty-six chains (1,716 feet) along its strike to the north-west. The deposit crosses the west boundary line at about the twelfth chain from the south-west corner post. Another deposit must also cross the same line nine chains farther north, having a width of about four chains, for here also the needle shows high readings. It is at present uncertain whether this indicates a second deposit having no connexion with the first, or whether this is a branch of the former. In my opinion the latter seems to be the most probable, from indications given by the needle close to the middle of the first mentioned deposit. Owing to the very dense undergrowth and windfalls at the foot of the hill I was unable to confirm this.

I found two small outcrops on R–476, which I enlarged to some extent in order to acquire a better idea of the character of the deposit. One, 132 feet wide by 99 feet long, was near the eastern end, and the other was about seven and one-half chains farther to the north-west. Both these outcrops I sampled; from the first one is taken sample No. 31, and from the latter sample No. 32. From the most northerly deposit I was unable to take any samples owing to its heavy covering.

I experimented with the ore from this deposit, attempting to eliminate the jasper particles by magnetic separation, taking the run-of-mine ore containing iron 51.48%, silica 25.95%, phosphorus 0.25%, sulphur 0.04%, crushed to a fineness of one-tenth of an inch, and secured the product that analysed :

Iron, 57.88%; silica, 18.68%; phosphorus, 0.14%; sulphur, 0.03%.

I was able by this process to reduce the silica 7.27%; the separation, however, would have been more complete had the ore been finer ground.

I mentioned above that the same iron deposit is common to both R–476 and R–484. On tracing it through I found that it crossed the boundary line at the twelfth chain from the south-west corner post of the first named location, entering the latter about four chains south of its north-east corner post, leaving it again about sixteen chains west of the same post. About 100 feet from its point of entrance into R-484 I discovered on the slope of a hill a little higher than the rest a small outcrop, in which the ore was about the same as that at its eastern extremity, containing, perhaps, more jasper. I took a sample from this (No. 42), picking out the best ore. A few chains north-west from here a number of jasper beds are visible on the surface at the highest elevation of the hill. The bands of iron between them are very small and of little value. These bands can be traced for one and a half miles into R-478.

The hills on these two locations are about 250 feet above the river, offering a beautiful view to the north, where a wide valley spreads out before our feet, well wooded with the timber common to this country, poplar, however, predominating, and growing sometimes beautifully straight and healthy, of a considerable height and often eighteen to twenty inches in thickness. The same can also be said of the older growth of jackpine and spruce. Where younger poplars and jackpine are standing, they were largely damaged two years ago by ice, such a weight of which incrusted the trees in that year that they broke or bent, thus forming almost impenetrable, tangled thickets on the ground.

The soil on this location is very good, consisting of a fine sandy clay of the same nature as that found everywhere along the Matawin river.

ANALYSES OF SAMPLES TAKEN FROM THE DEPOSITS OF R-476 :

	Sample No. 31	No. 32.
Iron	58.68%	38.90%
Silica	18.54 "	44.00 "
Phosphorus	0.21 "	0.13 "
Sulphur	0.03 "	0.03 "

R-484.—Sample No. 42.

Iron	60.63%
Silica	15.26 "
Phosphorus	0.18 "
Sulphur	0.05 "

This concludes the description of the iron deposits contiguous to the Matawin river. It is not at all improbable that a number of other deposits of the same nature occur throughout this district, but to prospect every location and every locality would envolve an expenditure of more time than I considered to be at my disposal.

MAGNETIC IRON ORE DEPOSITS OF THE ATIKOKAN RIVER.

These deposits were discovered in 1882 by an Indian trapper named "Jim" Shogonosh, who revealed his find to his employer, Mr. G. McLaurin, of Savanne. Mr. McLaurin in turn brought them to the attention of Messrs. McKellar Bros., of Fort William, who applied for and acquired from the Government what is now known as Mining Locations E. 10 and 11.

From the time of their discovery these deposits have been known as the Atikokan Iron Range. The term, however, is a misnomer, as the deposits do not, in the sense applicable to pure iron ores found elsewhere, constitute an iron range; and it would be equally appropriate to use this designation in describing any deposit where the gossans of a decomposed ferruginous rock or of iron-bearing minerals have become changed into iron ore at the surface.

The Atikokan mineral area consists of a series of norite dikes containing pyrrhotite and magnetite in lenses. Such dikes are not an infrequent occurrence in this country; as I can instance those near Schreiber, Kaministikwia, Green Water lake, and a number of others in the Thunder Bay and Rainy River districts.

General Physical Features. [1]

The name Atikokan is derived from the Indian name Aticosepi and means Caribou river; it was given that little stream which has its source in Crooked Pine lake, a lake of about ten miles long and from one-half to two miles wide, and which flows in a course almost due east and west, forming at certain intervals a number of large expansions, found on the accompanying map and named Magnetic lake, Whiskey Jack lake and Sabawe lake. Between the two former the river forms two falls, and between the two latter lakes one fall, but neither is more than ten feet high and hence incapable of furnishing any considerable power for industrial purposes. Fourteen miles farther west, the Atikokan loses its identity by joining its waters with those of the larger Seine river, which forms there a lake-like expansion named Steeprock lake.

For many years the Atikokan, the Seine river and a chain of lakes formed one of the principal canoe routes into the Rainy lake and Lake of the Woods regions, but since the Canadian Northern railway follows this course very closely, the old mode of travelling is now little in vogue.

The whole Atikokan country was formerly covered by a dense forest. Even ten years ago beautiful pine timber could still be seen overgrowing a considerable area, but when, ten and eight years ago, fires swept this region, it freed it so thoroughly of timber, and even of soil, as to leave the rocks bare, except in some of the lower, marshy spots.

The general character of the country north of the river is rugged and broken, with a gentle ascent northward. Several chains of hills traverse it in a trend nearly east and west, especially that part between the Atikokan and the Seine river; while south of the Atikokan the land slopes gently to the south and south-west, forming here a more undulating, rocky plain of rough, sharp-edged, barren rocks.

The highest elevation is near Magnetic lake, which is between 1,200 and 1,400 feet above sea level, although the individual hills are seldom more than 150 to 200 feet in height.

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[1] Quotation from my paper on the Atikokan nickeliferous pyrrhotite deposits. Proceedings, Canadian Mining Institute, Vol. IX, page 285.

It has already been mentioned that the Canadian Northern railway, which coming from the south-east and striking Crooked Pine lake between this lake and Elbow lake, follows the height of land for some distance, reaches the Atikokan in the neighbourhood of Whiskey Jack lake, and then parallels the waters of this and the Seine river towards Rainy lake.

Gabbro or Norite.

The rock which interests us principally in this locality is a gabbro, as well or better called norite, as it is identical with the Sudbury rock now usually given that name, and which occurs along the Atikokan river in a succession of dikes.

The principal mass of this rock is very much altered, and were it not for some apophyses somewhat distinct from the main body, it would be difficult to collect fresh, unaltered specimens by which it would be possible to recognize the true character of the rock. By these samples we can easily distinguish that it consists of orthorhombic pyroxene, either hypersthene or enstatite, plagioclase, with here and there some quartz, magnetite granules and pyrrhotite or pyrite. A considerable portion of the pyroxene is altered into light green and creamy, fibrous and scaly masses of serpentine (bastite).

The quartz, where observed, is a very transparent or subtranslucent, bluish glassy variety. This quartz is (in the opinion of the author) not a very common occurrence in the Sudbury norite, but it has been noticed in the gabbro of this region very frequently, sometimes in large phenocrysts, accompanying not rarely the massive pyrrhotite.

Pyrrhotite and magnetite are represented in considerable quantity in this rock, the latter mineral unusually so.

We can observe that the rock has suffered considerable pressure, so much so, that it has, especially at the surface, the aspect of a ferruginous schist with planes standing almost vertical. The surface of the rock, when little magnetite is present, has a greyish green or brownish color, but in places, especially at the farthest eastern outcrop, it has a brown black color.

Unlike the Sudbury occurrence, our pyrrhotite deposits show at the surface very little chalcopyrite; in the unaltered portion it is found more frequently, though the percentage is far less here than in the Sudbury formation, and the question as to whether it will increase with depth has yet to be settled by further underground development.

Nickel is contained in the Atikokan deposits in no small quantity, otherwise we would not find that part dissolved out of the surface ore filling the little fissures of the rock in the form of genthite.

The most important exposure of these gabbro or norite dikes is east of Sabawe lake on location E–10 and 11, which has a length of about 3,500 feet by 284 feet wide at the place of the greatest width, but narrows, east as well as west, into a width of a few feet. Next we come to that on 400–402 west of Sabawe lake, which is smaller in size, being about 2,000 feet long, neither does it rise to the same height as the former, which is, at the north and south line of E-10 and 11, about 150 feet above the river; nor does it possess the same width or show the same mineralization at the surface, although the diamond drill proved that the sulphurets are as abundant here as in other places.

The length of these dike outcrops is nearly twelve miles from Magnetic lake to south of Steep Rock lake in an almost east and west line.

It was mentioned before that there are also a number of smaller apophyses of the same rock lying north of the river, but they are a negligable quantity on account of their insignificant size, being from one to two feet in width.

Origin of the Atikokan Ore Deposits.

I must repeat here that the Atikokan ore deposits are almost a counterpart of the Sudbury nickeliferous pyrrhotite deposits, with this difference, that the latter usually do not contain as great a quantity of magnetite lenses, with the exception, perhaps, of one or two instances.

Upon the occasion of my first visit to the Atikokan, which was made in the early nineties, I recognized correctly their nature, not being misled by the heavy hydroferric oxide covering, nor even by the outcrop of some lenses of magnetite. When at a later date, repeated diamond drill operations were conducted on these deposits, I received indisputable proof of my determination, which was to this effect, that the rock masses standing out so prominently above their surroundings were nothing more than gabbro dikes.[1]

A certain portion of the surface of these dikes is covered with a thick layer of iron ore, sometimes extremely pure and apparently consisting of dark brown limonite and magnetite in varying proportion, this being produced by a decomposition of the sulphurets and of the magnetite.

Tests made of this material gave results high in iron, low in silica and phosphorus, and even in sulphur and nickel. The absence of nickel in harmful quantities may be explained by the leaching process that has continued for so long a period of time. The nickel has usually accumulated in the small fissures of the rock in the form of genthite. A few tests made of this material in my laboratory showed:—

	1	2	3
Iron	62.4%	66.5%	67.2%
Silica	7.1%	3.2%	2.1%
Phosphorus	0.02%	0.015%	0.036%
Sulphur	Trace	0.01%	0.07%
Nickel	Trace	Trace	Trace
Titanium	Trace	Trace	Trace
Magnesia	0.34%	Not det.	Not det.
Lime	0.13%	——	——

[1] Vide my paper on the Iron Ore Deposits of Western Ontario, and their Genesis, C. M. I. Proceedings, Vol. V, page 56, et seq., and my paper on the Atikokan Nickeliferous Pyrrhotite Deposits and their Origin, Proc. Vol. IX, page 10.

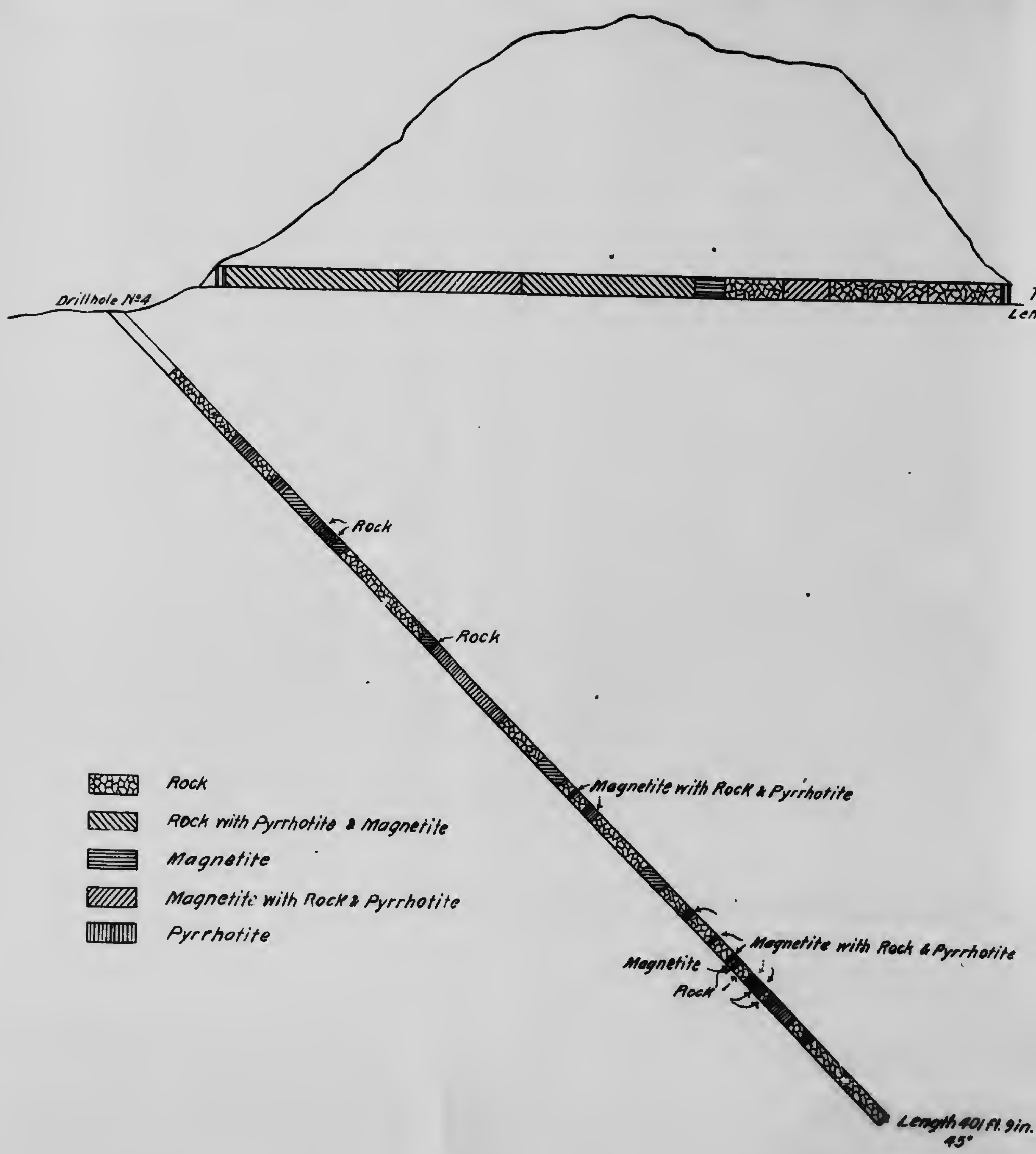
Tests made of seemingly unaltered pyrrhotite specimens for nickel gave unsatisfactory results; nothing different was to be expected, as the leaching process of this ore had been going on to considerable depth. This process can be produced artificially in the laboratory. The mode of procedure would have to be as follows:—Place a sound piece of pyrrhotite over an evaporating dish partly filled with water; soon you will observe how the water-vapor commences to disintegrate the specimen and how the green sulphate of nickel collects at the surface. Bring now water in contact with this salt and it will dissolve. Evaporate the water, and a residue of green sulphate of nickel will be found in the dish.

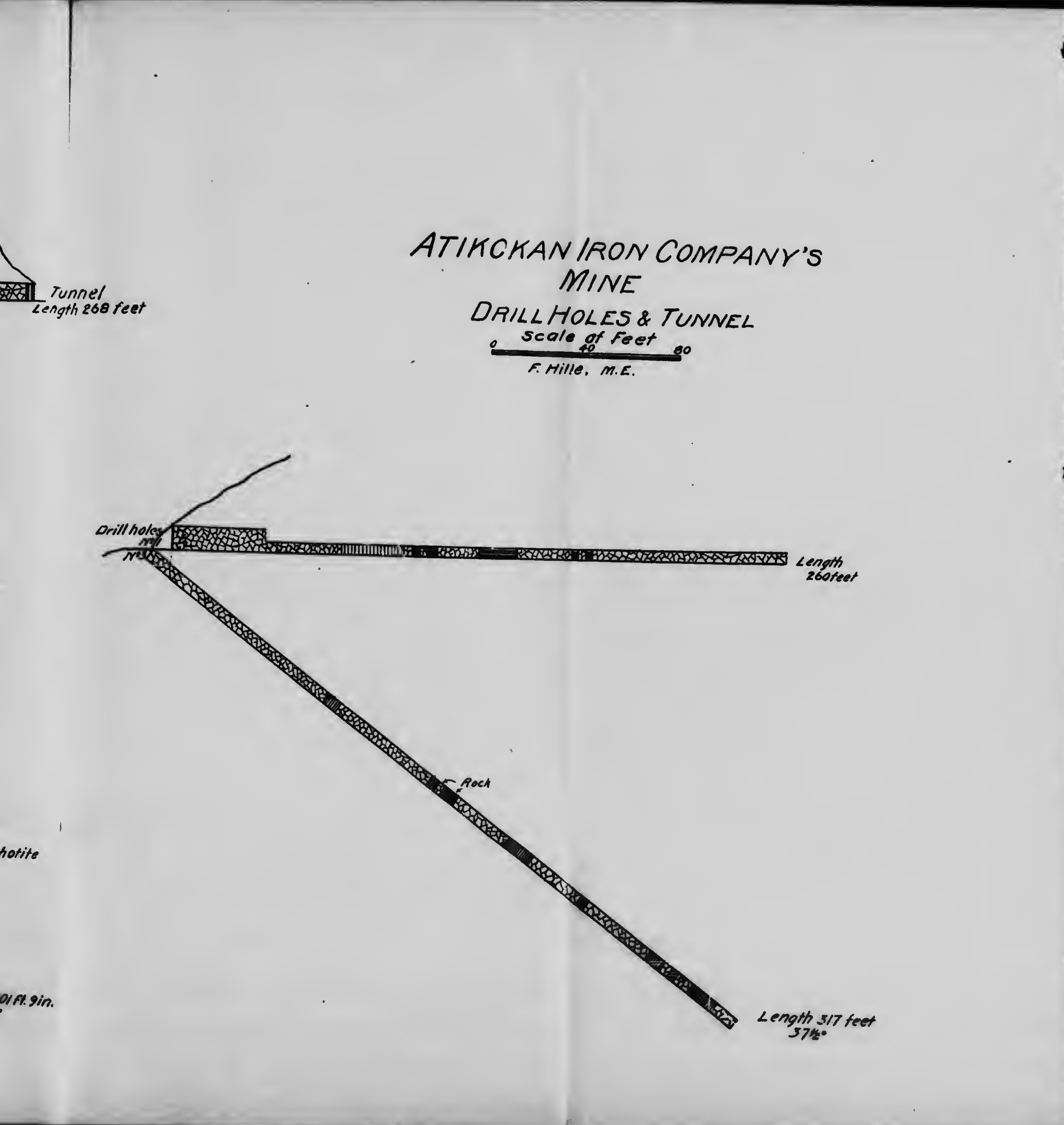
Diamond drill cores from a depth of 200 to 300 feet tested for nickel gave from one to two per cent of that metal, according to the mixture of the sample with rock or magnetite. These tests proved amply that the nickel occurred in the same manner as in the Sudbury deposits.

Copper, usually a companion of the nickel in the latter ores, has so far not been found in any appreciable quantity, only here and there at places; whether this metal will be discovered at greater depth it is impossible to determine, owing to the insufficient amount of development work so far done. At the surface it seems to be absent from pyrrhotite deposits in the district. I have tested quite a number of samples of the drill cores, with a result varying according to the part of the core from which they were taken, and according to whether they contained a greater or less quantity of rock matter, or whether the mineral which predominated was pyrrhotite or magnetite. All these samples contained a certain percentage of nickel, but they also contained a much larger percentage of phosphorus than those taken from the surface, the percentage of nickel varying according to the amount of sulphurets, from 1 to 2%. The quantity of sulphur naturally depended upon the proportion of sulphurets to the other constituents. Phosphorus was usually present in quantity above the bessemer limit; the average of it being somewhere near 0.1%. The great difference found in the quantity of this element contained in ore from the surface and that taken from a depth of 200 to 300 feet may be ascribed to the process of leaching, which acted most intensely on the surface ore. Of titanium I only discovered traces. Calcium, magnesium and aluminium are, of course, always present.

Development Work Done.

Considerable prospecting has been done on some of these dikes, especially on that one which lies east of Sabawe lake, while those that lie west of this location have been tested by diamond drill, hand drill and powder. However, for the present I will confine my description of this work to that done on R-400 and 401, and E-10 and 11. The latter two were formerly known as the McKellar property and now as the Atikokan Iron Company's mine. Here the most prominent dike occurs, which for years has been repeatedly in the public eye as an Iron Range, as I mentioned at the commencement of this paper.


Drillhole No 4
Rock
Rock
Magnetite with Rock & Pyrrhotite
Magnetite with Rock & Pyrrhotite
Magnetite
Rock
Length 401 Ft. 9in.
45°
Rock
Rock with Pyrrhotite & Magnetite
Magnetite
Magnetite with Rock & Pyrrhotite
Pyrrhotite


ATIKOKAN IRON COMPANY'S
MINE
DRILL HOLES & TUNNEL
Scale of Feet
0 40 80
F. Hille, M.E.
Tunnel
Length 268 feet
Drill holes
No 1
No 2
Length
260 feet
Rock
Length 317 feet
37½°

Development on E-10 and 11.

The first work done on this location consisted of a trench cut across the dike at almost its widest part, a few yards west of the survey line between the two locations. This work was done in 1887 with the object of discovering whether the iron ore, which is seen cropping out on the surface, has width and depth. I took two samples here—No. 35 from the south side, at a point where we might expect to find the upward extension of the ore lens in the tunnel, which shows there a width of forty feet. Sample No. 36 is taken from the north part above the eight ft. and sixteen ft. lenses in the tunnels.

The exact width and length of the ore body at the place where the latter sample is taken could not be accurately determined, on account of the heavy drift covering. The lens of ore from which sample No. 35 comes is at that point about twenty-four feet in width, thinning out at a point about twenty feet to the west, and also at a point about 146 feet to the east. Analyses of these two samples, made in the laboratory of the Superintendent of Mines, gave results as follows:—

	No. 35	No. 36
Iron. . .	58.24%	62.16%
Silica . .	11.76%	11.70%
Phosphorus.	0.25%	0.17%
Sulphur .	1.21%	0.15%

In 1900 an irregular tunnel about five by six feet and 284 feet long was driven through the hill, under the direction of a Mr. Hunter, of Duluth, Minn., exactly below the trench just mentioned above, and about 100 feet below the top of the hill. The accompanying plan will give an idea of what this tunnel revealed. I can add here some analyses of ore that came from the tunnel, and were made several years ago in my own laboratory.

From one sample the returns were:—

Iron. . . .	58.116%
Phosphorus.	0.078%
Sulphur. .	1.90%

Second sample gave:-

Iron. . .	59.03%
Phospherus.	0.092%
Sulphur. .	0.58%

To this I can add the analyses from ore taken from the dump in front of the tunnel, mined by the present Company during the process of widening the south entrance of the tunnel. These samples are numbered 33 and 34, the first being taken from the west side and the latter from the east side of the dump, the tests being made at Ottawa.

FeO	27.51
Fe_2O	46.85
FeS_2.	3.45
Mn	—
Al_2O_3 .	1.01
CaO .	4.12
MgO.	4.06
P_2O_5 . .	0.62
SiO_2	11.58
TiO_2	none
(H_2O etc.)	0.52

	No. 33	No. 34.
Metallic Iron	55.80%	55.10%
Phosphorus	0.27%	0.50%
Sulphur.	1.84%	2.29%
Titanium	none	none
Silica. . .	11.58%	12.61%

In the same year that this tunnel was completed two trenches were cut into the dike (for the situation of these see map). One of these trenches is 122 feet east of the center survey line and is about four feet wide. From this I took sample No. 37. The other trench is 331 feet from the line. The above sample was tested at Ottawa with the following result:—

	No. 37
Iron. . .	67.49%
Silica	5.86%
Phosphorus.	0.05%
Sulphur. .	0.11%

In addition to the prospecting work mentioned here, other improvements have been made at the mine. In a straight line from the mouth of the tunnel a trestle has been erected sixty-four and one-half feet long by sixteen feet wide, bridging over a railway track. On this trestle is installed a Gates crusher six and one-third by eight feet high, a bucket elevator and a steel sheet trommel three and one-half by sixteen feet long. To the side of this, about thirteen and one-half feet west of the crusher, is housed an engine for the purpose of operating the machinery. This whole instalment is made for the following purposes: the ore to be mined will be taken by tramcar out from the tunnel and dumped into the crusher; the broken ore falling into a hopper below, thence being elevated into the trommel, from which the sized ore drops into railway cars to be transferred to the roaster and blast furnace at Port Arthur.

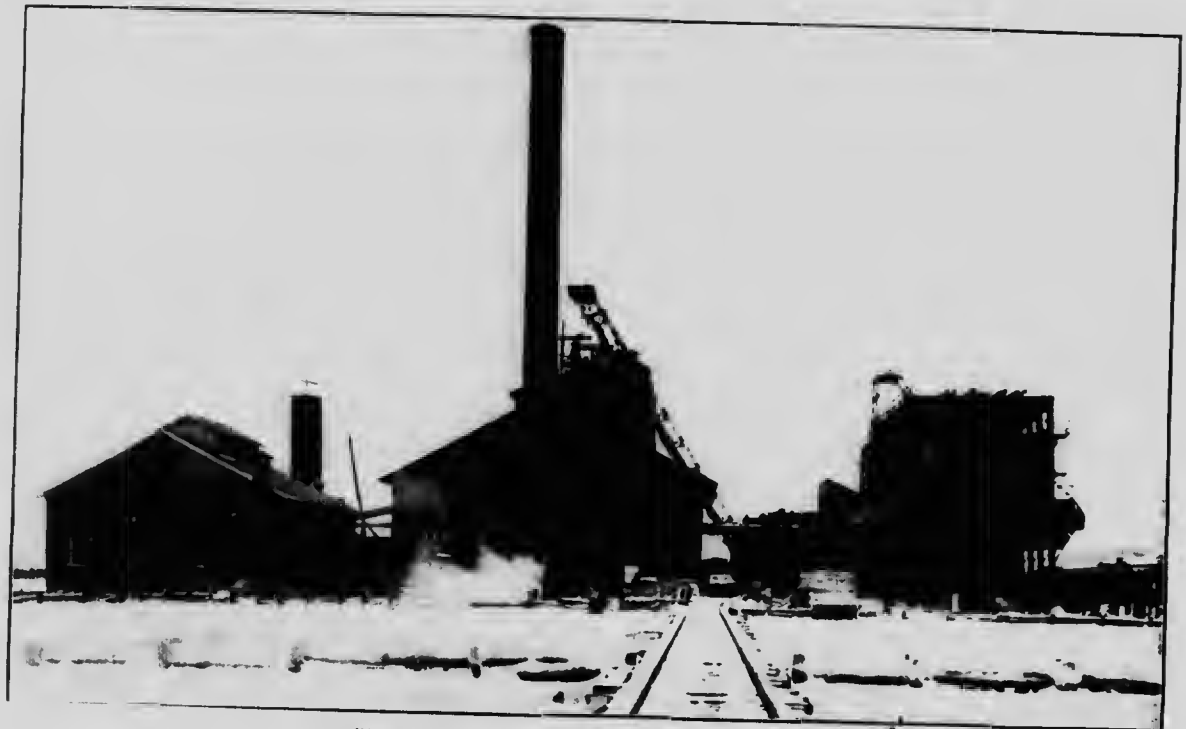
On account of the installation of only one set of machines at the mine, it would be necessary to keep a very considerable supply of mined ore ahead; otherwise any accident that interfered with mining would cause cessation of operation at the blast furnace.

South of the trestle is situated the power house, seventy feet long by forty feet wide, divided into two parts, the western part containing the engine, and the eastern the boilers, with an iron tube stack 115 feet high outside the building.

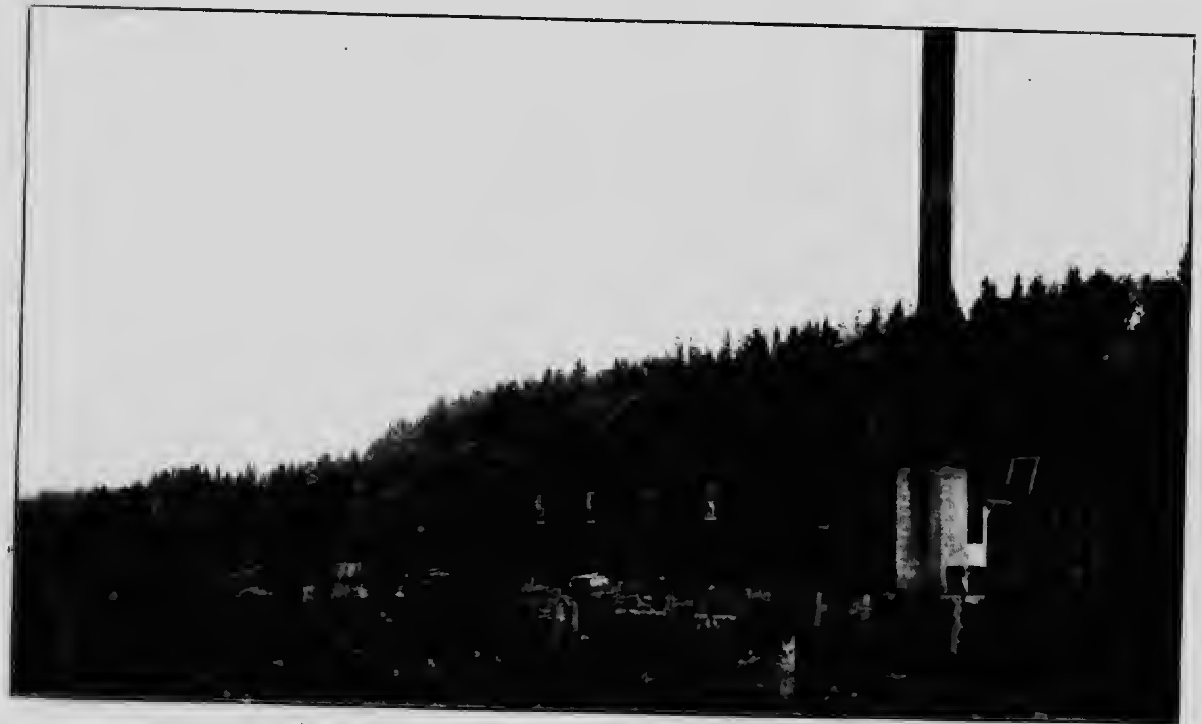
At the time that I visited the mine the machinery had not all been placed in the building. This, as far as I can learn, will be done this summer and the railway track will also be completed—it being at that time only about half finished.

Fifty feet west of the power house stands the blacksmith shop, and at intervals of fifty feet farther, the wash and dressing house for the miners, and the warehouse, each of these buildings being of frame construction, twenty feet deep and forty feet long, fronting towards the hill. The sleeping house, ninety-five feet by twenty-five feet, and the dining house, eighty-seven feet by twenty-seven feet, with two annexes each twenty-six and one-half by twenty-seven feet, had to be built beyond the limits of the two locations, in close proximity to the river, on account of the wet nature of the land near the other buildings.

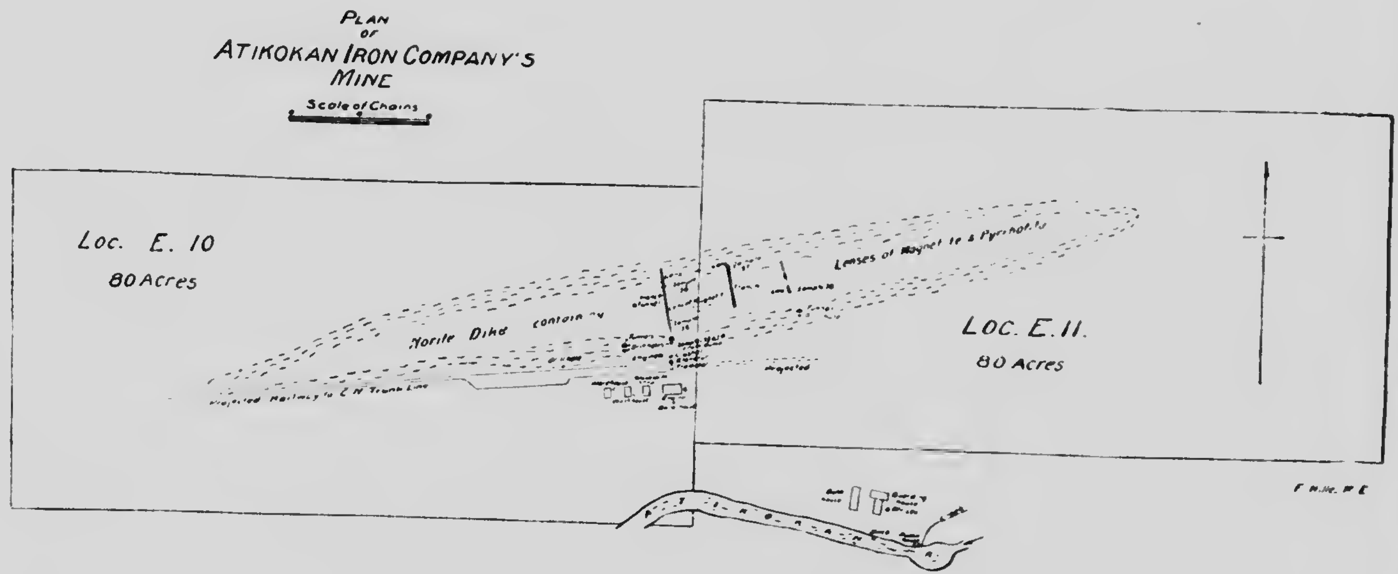
In close proximity to them, at a point where a little creek enters the Atikokan river, a small pump is installed in a pumphouse to supply the



Blast Furnace, Atikokan Iron Company, Port Arthur.



Atikokan Irc" Company's Mine, showing Tunnel at Extreme Right.


PLAN OF
ATIKOKAN IRON COMPANY'S
MINE
Scale of Chains
Loc. E. 10
80 Acres
Norite Dike containing
Lenses of Magnetite & Pyrrhotite
Projected Railway to C N Trunk Line
Loc. E. 11.
80 Acres

buildings with water for cooking and washing. The entire arrangement of machinery, houses, etc., is extremely good, the machines being conveniently situated for efficient work; the housing for the miners being practical and comfortable. At present, the railway not yet being completed, communication between the main line of the Canadian Northern railway and the mine is maintained by canoes from a point on the railway where Sabawe lake empties into the Atikokan river.

In connection with this mine I might mention the blast furnace in Port Arthur, which is under the management of the same company. It is situated near the southern end of the city and is connected with the Pittsburg Coal Company's docks, from which it receives its fuel for coking, the coke being produced in the common beehive ovens, of which they intend to have one hundred.

The blast furnace is a modern structure with a capacity of 100 tons of pig iron per day. The accompanying photographs will give an idea of its situation and arrangement.

I do not think that a detailed description of the furnaces need be incorporated in this report. The bibliography of iron metallurgy, including furnace construction, is so great that those who desire information on the subject can secure it much better by means of standard works than from a report on such establishments, which would necessarily be incomplete.

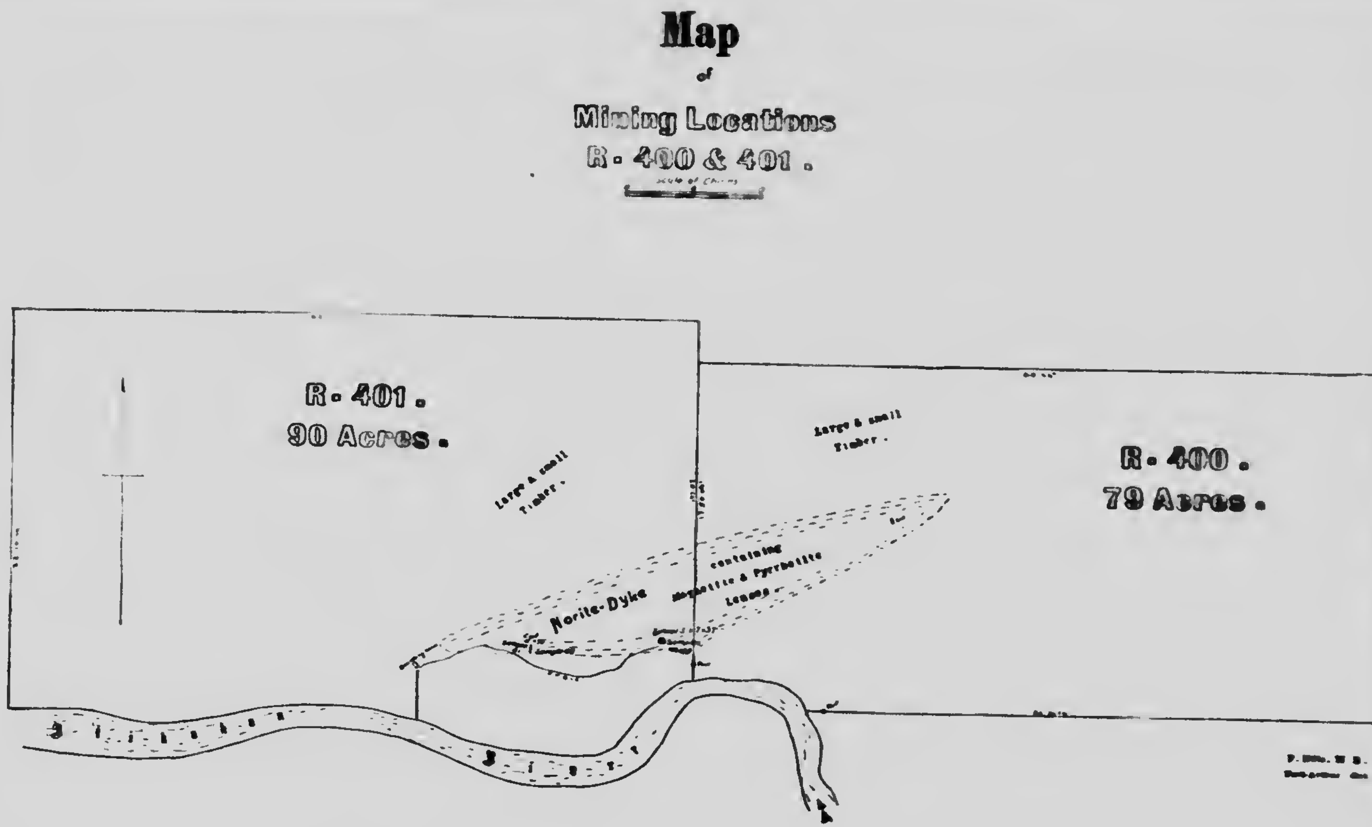
Locations R-400 *and* 401.

I now come to the other two locations situated along the Atikokan river which I examined last fall, viz., R-400 and 401. The first named is situated about ninety chains due west of Sabawe lake, but by canoe route down the river the distance is nearly doubled. As the accompanying map will show, both locations are bounded by the Atikokan river; R-400 on the south-west corner and R-401 along the whole extent of the south side.

The two claims are traversed from east to west by a dike of the same description as that described on E-10 and 11. The strike is also the same, east by sixteen degrees north. Its longest diameter is twenty chains thirty feet, while the total width can hardly be estimated at present, the north side of the dike being still covered by drift material.

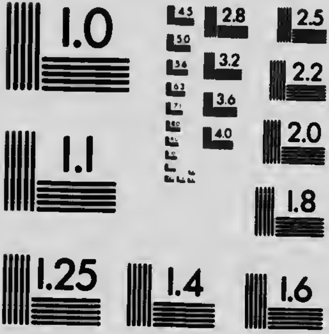
On landing from the canoe near the south-west corner post of R-401, we ascend the hill for about eighty feet, then, turning sharply to the west, travel 117 feet, and there find a tunnel five feet wide, seven feet high and thirty-one feet long. This tunnel is driven into the dike to ascertain the continuation of a magnetite deposit which was first observed on the top of the dike some fifty feet higher up.

The mineralized portion of the tunnel commences about six feet from the entrance and consists of lenses of magnetite mixed with pyrrhotite, pyrrhotite and rock, or pyrrhotite mixed with both magnetite and rock. Here I took


Map
of
Mining Locations
R. 400 & 401.
R. 401.
90 Acres.
Large & small
Timber.
R. 400.
79 Acres.
Norite-Dyke
containing
Magnetite & Pyrrhotite
Lenses.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



two samples, No. 38 representing that portion of the ore six feet from the entrance to a point seventeen feet from the face of the tunnel, while No. 39 represents the ore for the remaining fourteen feet to the face.

No. 38.

Iron	47.48%
Silica	17.53 "
Phosphorus	0.04 "
Sulphur	4.47 "

No. 39.

FeO	31.18%
Fe_2O_3	52.37 "
FeS_2	2.26 "
MnO	—
Al_2O_3	1.30 "
CaO	1.45 "
MgO	1.71 "
P_2O_5	0.18 "
SiO_2	7.33 "
TiO_2	0.16 "
(H_2O etc.)	1.84 "

Metallic Iron	62.02%
Phosphorus	0.08 "
Sulphur	1.26 "
Titanium	0.10 "

At the time of my examination of this location a number of miners sent in by the United States Steel Corporation were prospecting in the tunnel, and also at different places on the location, east as well as west of this point. For example, twelve chains and thirteen feet east from the survey line these men had stripped a small place where there was an outcrop of magnetite on the surface. Their work was not far enough advanced for me to take samples. Had I done so, however, I do not think that the results would have differed much from those that were taken in the tunnel, or from a rock cut which I found eight chains fifty feet west from the survey line that divides the locations.

This cut is fifty feet long by two and one-half feet wide, trending from north to south, and the first fourteen and one-half feet from the southern extremity contains magnetite, pyrrhotite and a certain proportion of rock. The next twenty-nine feet consist of rock, pyrrhotite and a little iron, and the last six feet are in fairly good magnetite. Two samples were taken here, Nos. 40 and 41, the former from the first fourteen and one-half feet and the latter from the last twenty-nine feet, leaving the middle, which was principally rock matter, untouched.

	No. 40.	No. 41.
Iron	62.58%	56.28%
Silica	6.90 "	12.56 "
Phosphorus	0.03 "	0.03 "
Sulphur	2.26 "	2.56 "

This is the principal work done on these locations, which have revealed nothing essentially different from the ore deposits of locations E 10 and 11. Here, as on the other locations, the minerals appear in lenses, limited in extent both in length and width, in which, at times one, and at times the other mineral predominates.

If the sulphur in this magnetite had occurred in a different form, as a pyrite or marcasite, and the magnetite were not so dense and in lenses only, it would be possible to use it to advantage after roasting it in continuous kilns, a process which is followed at several places in Pennsylvania. In order, however, to insure success, there must be no increase of copper, which I have recently found at several places, as depth increases, neither should there be any increase in phosphorus, which appears to contaminate the ore to a larger extent in the interior of the dike. This difficulty, however, can be modified by mixing the ore with a silicious ore low in phosphorus, such as Mesabi or Gogebic, or for a time with those found in the neighbourhood of Loon lake, should it be determined that the latter are sufficiently free from that undesirable element.

A few hundred feet south-west of the western extremity of the dike is a small camp, consisting of a cooking and eating house, both built of logs and situated 213 feet from the river, while tents formed provisional sleeping apartments.

The nearest railway station of the Canadian Northern railway is Hematite, about two miles away from the point where the railway communication with these claims is established. Timber for purposes of fuel and mining is plentiful in this district.

Hematites.

I must now take up another class of ore, namely, the red anhydric ferric-oxide, expressed by the chemical formula Fe_2O_3 (sesquioxide of iron), to which is given the mineralogical name Hematite, meaning bloodstone, the name being derived from the Greek word *aima* (blood).

This ore is found on this northern continent in large deposits, more especially on the south and south-west shore of Lake Superior, where it is mined in millions of tons every year and carried by a large fleet of steamers to eastern ports. The ore occurs in a rock formation which is known by different names in different localities; by us it is called the Animikie series. This series is as extensively developed here as in any other locality in the vicinity of Lake Superior, and consists of bands of pure carbonate of iron, of silicious iron carbonates, of iron silicate, and cherty silica with bands of jasper.

It appears that the Animikie rocks are identical with the Mesabi and also with the iron-bearing rocks of all other Lake Superior iron ranges.

I must now describe the distribution of these rocks on this side of the international boundary line.

The extreme margin of the Animikie is always found where the older rocks reach an altitude of from 1,400 to 1,600 feet above sea level, a fact which can be readily observed at many places in this district. We therefore find their eastern margin near the following islands : Victoria, Jarvis, Spar, Thompson and Pie islands, in Lake Superior; thence it extends northward toward Thunder cape, reaching as far as about the north line of the township of McTavish. Their margin is found towards the north, near the middle portion of the township of McGregor, thence traversing part of Gorham, McIntyre, Oliver, Conmee, Marks and Strange townships north of Whitefish river. Thence it goes south-westerly to the line of the Port Arthur, Duluth and Western railway as far as Gun Flint lake, and from here, south-east along the international boundary to Lake Superior.

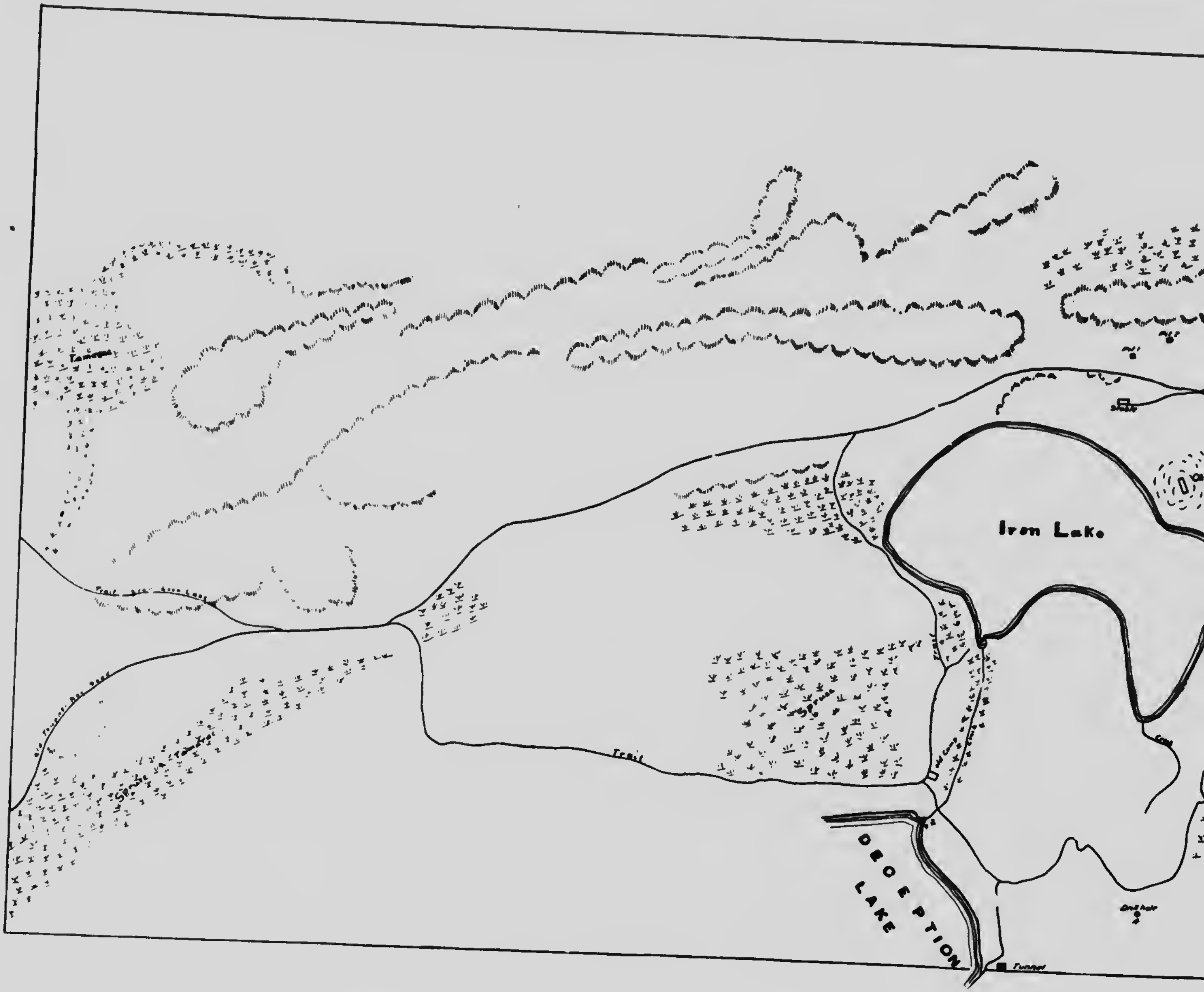
Wherever, near the northern margin, the iron-bearing rocks have been eroded, we can still follow it by the thin layers of magnetic iron resting in shallow depressions of the granite.

The area upon which the Animikie rocks were laid down is 100 miles from east to west, and about twenty-five miles at its greatest width, which is on a line extending from Kakabeka falls to Big Trout bay.

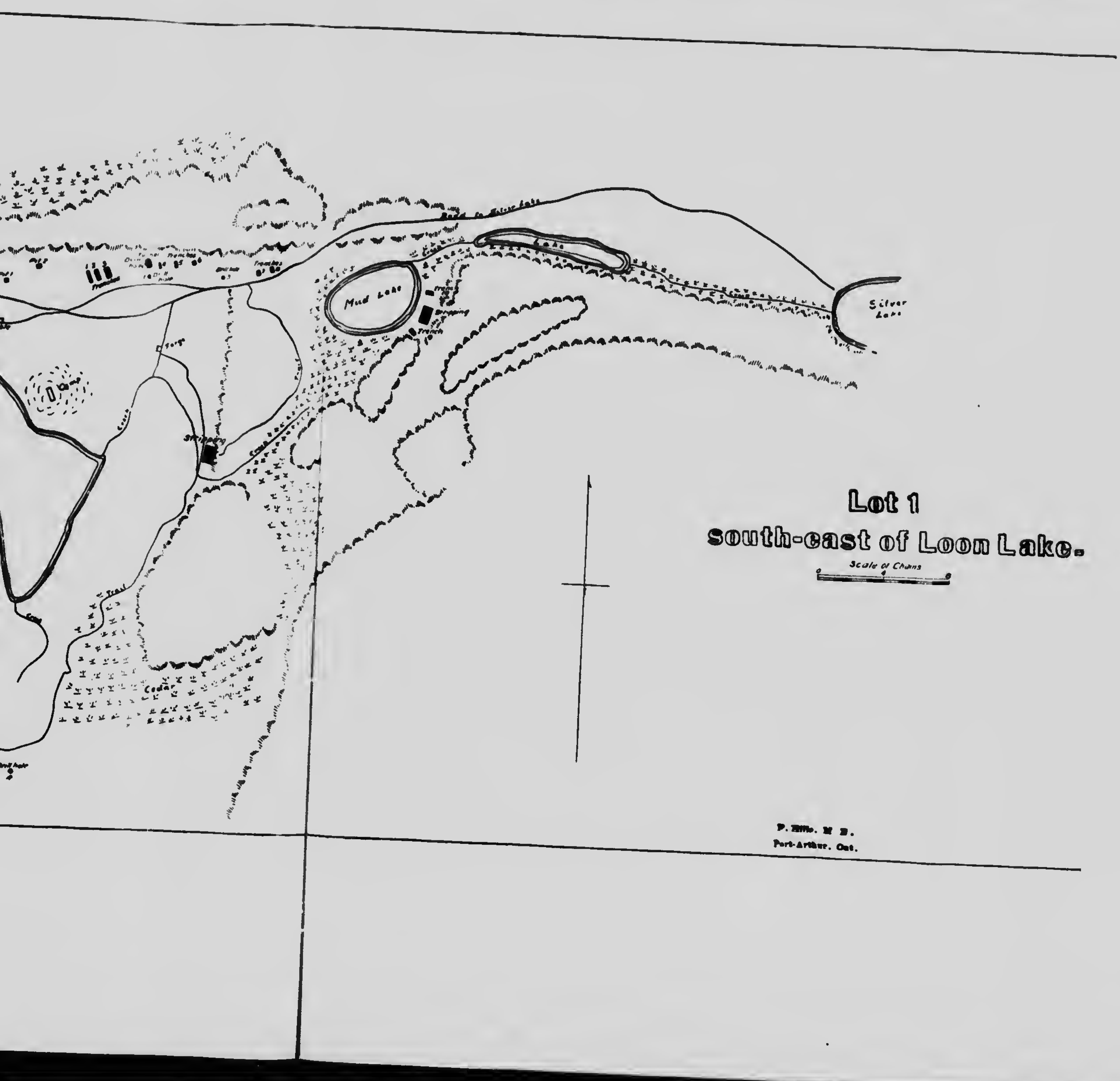
Of the above area only a very small portion was examined last summer. The region to the south and west will be gone over more closely next summer. Of the several localities along the line of the Port Arthur, Duluth and Western railway, I can only at present say that very promising results were obtained three or four years ago with diamond drills, and that the Arrow lake and Arrow river regions of that part of the range situated in Blake, Crooks, and Pardee townships are equally promising. The area which I examined early last summer is that in the vicinity of Loon lake, about twenty-five miles east of Port Arthur. For several years a certain amount of prospecting and development work was done on a few locations which were acquired from the Government, during the time when prospecting for silver was at its height. This was about thirty-three years ago, and even at that early date hematite was found in several places, among which I may make special mention of Lot 1, half a mile west of Silver lake. Iron, however, was not the object of their search; silver was not discovered, and indications of iron were not followed up. At a later period, fourteen or fifteen years ago, a party from Detroit and Buffalo tried their luck in this region, but soon gave it up. Nothing further was done until three years ago, when Mr. Flaherty, of Port Arthur, continued prospecting on Lot 1, and Messrs. Wiley Bros., of Port Arthur, Mr. McConnell, of Ottawa, and others, prospected on the north-east quarter of section 9, concession 8, and the south-east quarter of section 8, concession 8, respectively.

As regards the physical features of the country south of Loon lake, we find the surface to be somewhat hilly and broken, and at every turn we can notice the intensity of the glacial action. The land slopes southward toward Lake Superior, and, owing to the trend of the glaciers, which was nearly at right angles to that slope, little basins and narrow valleys have been produced, which not only afforded basins for the accumulation of water, and formed channels for rivers and creeks, but also proved to possess a certain degree of importance to iron ore deposits by opening up and loosening the strata of the iron-bearing rock.

The land is very poorly wooded. Almost everywhere the heavier timber has been destroyed by fire. It is only here and there, and more especially upon the swampy land, that we can see groves of black and red spruce, interspersed with cedar, tamarac and birch, still standing.

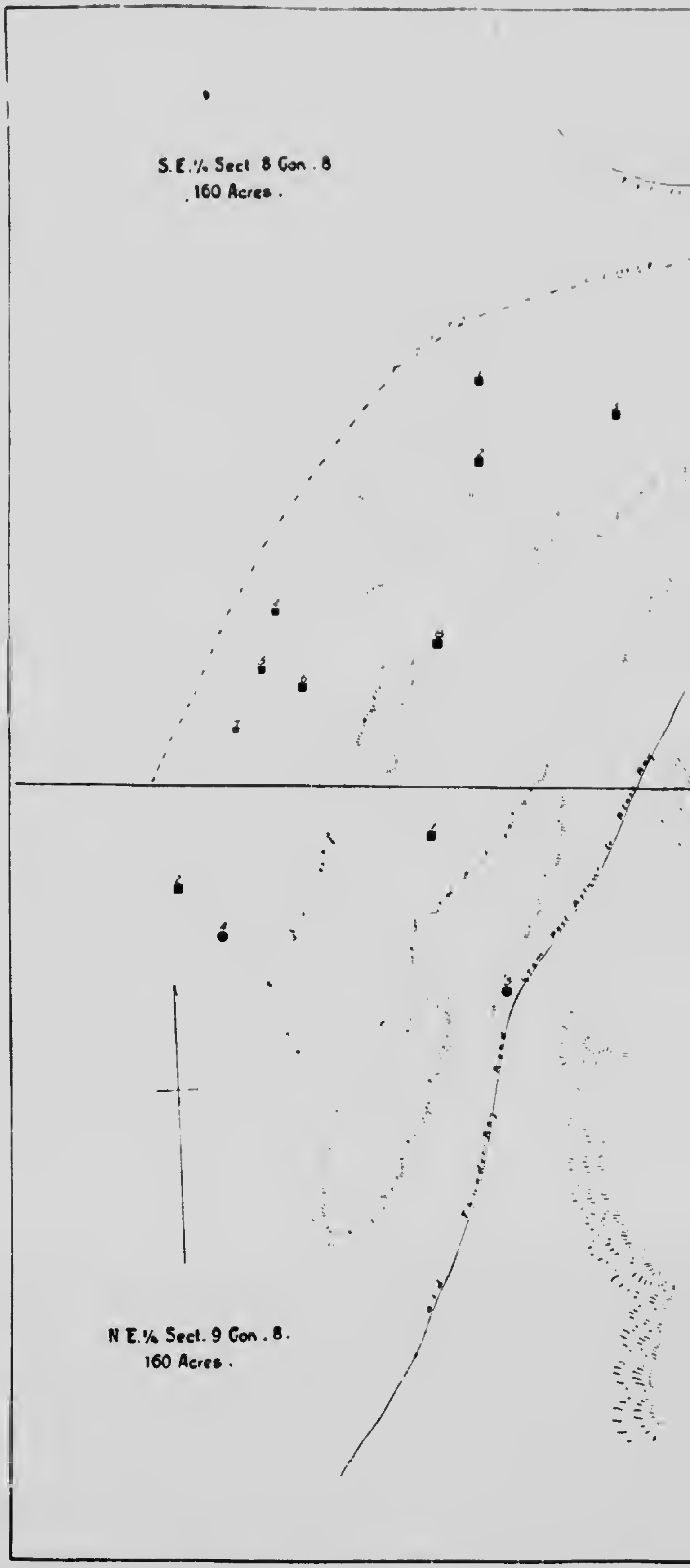


Iron Lake
DECEPTION LAKE
Trail
Tunnel

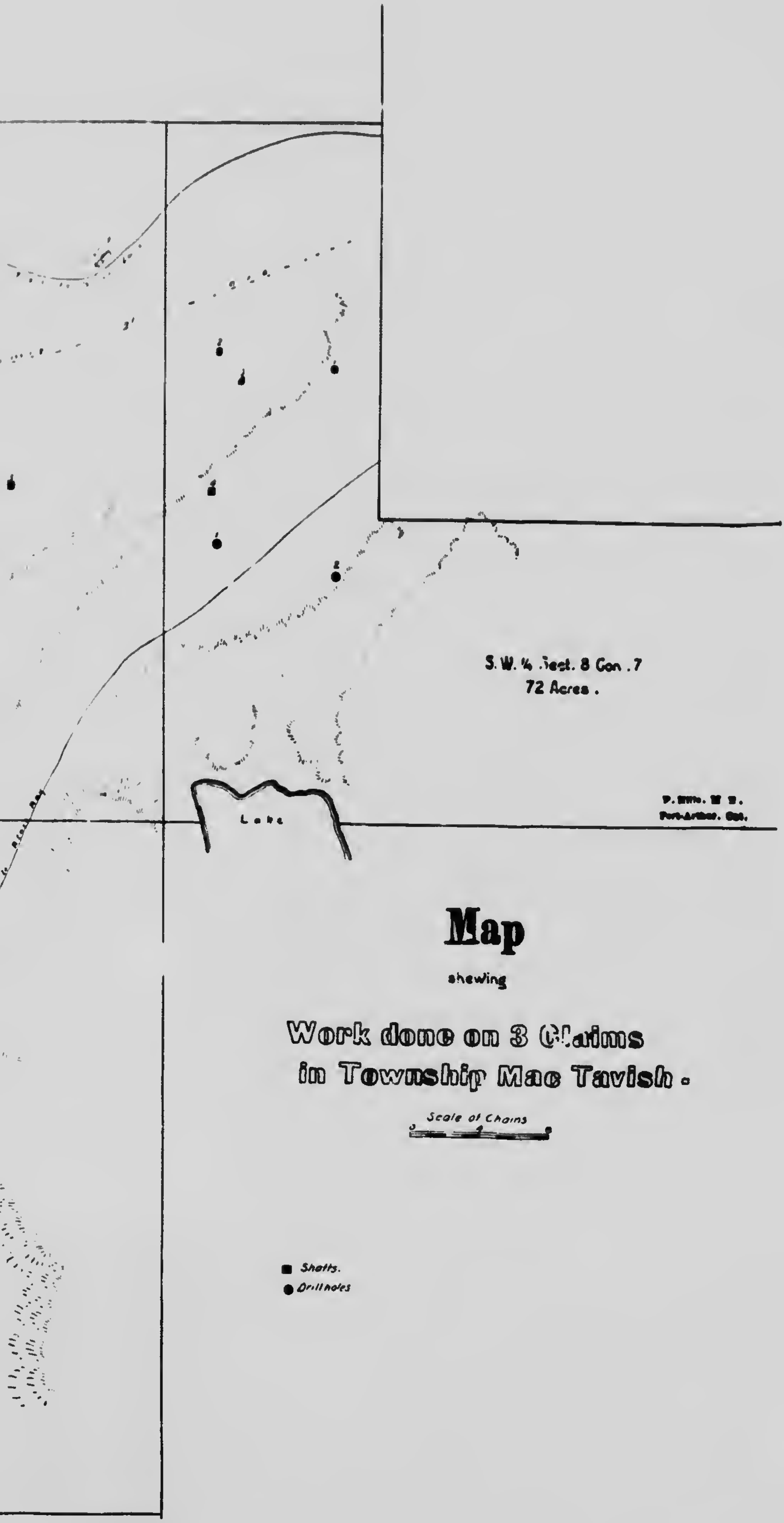


Lot 1
south-east of Loon Lake.
Scale of Chains
Mud Lake
Lake
Silver Lake
Stripping
Forge
Cedar
Trail
Port-Arthur, Ont.

spersed with [illegible],



S.E.¼ Sect 8 Gon. 8
160 Acres.
N E.¼ Sect. 9 Gon. 8.
160 Acres.



S.W. ¼ Sect. 8 Con. 7
72 Acres.
Lake
Map
shewing
Work done on 3 Claims
in Township Mac Tavish.
Scale of Chains
Shafts.
Drillholes

I mentioned before that the margin of the Animikie rocks is usually found according to the elevation of the granite on which they are laid down, and if the granites reach a height of 1,400 to 1,600 feet they then thinned out to nothing. This fact is plainly observed at the locations which I examined. Upon the ridge of a little hill south of Loon lake, on the south-west quarter of section 8, con. 7, and the south-east quarter of section 8, con. 8, they thin out and disappear altogether, but become gradually thicker in a southerly direction, especially so in a little basin which terminates on the north-east quarter of section 9, con. 8, and the north-west quarter of the same section.

The thickness of the Animikie depends on whether they rest in the trough or whether they lie on the flat sloping surface of the Laurentian granite. Near Blende river, I think, they are found in about the same thickness as farther west, north of the Thunder Bay mine, where they are well exposed and measure about 200 feet. The thickness here mentioned refers only to the occurrence of the Animikie on the north shore of Lake Superior. To the south, toward Blake, Crooks and Pardee townships, towards Gun Flint lake the conditions are entirely different, the Animikie reaching a thickness of 3,000 feet at some places in that district. Dr. Selwyn, former director of the Geological Survey, estimated the thickness of these rocks to be from 10,000 to 12,000 feet; this, however, I consider to be an over-estimate.

In a few places where diamond drill holes and shafts have been put down we find that the depth of these rocks is as follows:—

(1) A diamond drill hole 25 miles east of Whitefish lake......1,200 feet
(2) A shaft four miles east of the same lake.................... 700 "
(3) Several diamond drill holes north-west of the same lake .... 600 "
(4) A diamond drill hole near Iron Range lake................1,000 "

All these holes were put down close to the north margin of this formation, and, I might add, nearly everyone of them yielded good indications of the occurrence of hematite ore.

What I have said about the thickness of the iron-bearing rocks to the south of Loon lake sheds light also on the deposits of hematite ore that have been discovered in that vicinity. The shallowness of the formation has also tended to produce shallow layers of iron ore of insignificant commercial value. But, on the other hand, they possess considerable academic value for us in that they form an excellent indication of what we may hope to discover in the Animikie series.

It is probably only a question of time, and also of exploration, for us to find ore in our rocks in quantities as great as on the Mesabi. I can see no reason why this should not be the case, since the geological and petrographical conditions are identical, and we have the added advantage of the greater thickness of the Animikie series. It is surely incredible that an imaginary boundary line should have placed a limit on the deposits of hematitic ore, produced through natural phenomena which were in activity in our district as well as in that a few miles away from us. But it is far more likely that the fact of little or no development work having yet been done here has so far prevented their discovery.

Locations Examined.

(1). South-west quarter of section 8, con. 7, containing 72 acres.

On this location four shafts and pits and two diamond drill holes have been put down, of which pit 1 is shallow and was partly caved in, the dump showing no iron ore. Pit No. 2 is eleven and one-half feet down. At a depth of about six feet it shows a few feet of very silicious ore of irregular width. The bottom of the pit consists of a shelf of trap, and on top of this is a layer from one to one and one-half feet in thickness of quartz conglomerate.

Shaft No. 3 is twenty-two feet deep, and had four feet of water in it, the bottom eight feet consisting of unaltered ferruginous chert, the next eight feet of silicious hematite, and the balance of it, chert and soil. Sample No. 44 was taken from here, and on analysis showed as follows:—

Iron	26.51%
Silica	34.78 "
Phosphorus	0.04 "
Sulphur	0.06 "

Shaft No.4 was nearly full of water. The result of analysis of sample No. 45 taken from the deposit was as follows:—

Iron	26.28%
Silica	29.50 "
Phosphorus	0.05 "
Sulphur	0.14 "

Of the two diamond drill holes which have been put down on these locations I could obtain no records. The accompanying map shows the correct situation of the workings.

(2). South-east quarter, section 8, con. 8, containing 140 acres.

The work done on this location consists of eight pits and shafts.

Pit No. 1 is eleven feet in depth, containing only a few feet of very silicious ore, of which no sample was taken.

Shaft No. 2 is twenty-five feet deep, and contained eight feet of water. The ore is silicious, sample No. 46 being taken from the dump, which gave results as follows:—

Iron	24.74%
Silica	34.56 "
Phosphorus	0.09 "
Sulphur	.08 "

Shaft No. 3 is twenty feet deep, and at the time of my visit had fifteen feet of water in it. The ore on the dump was too silicious to make it worth while taking samples.

The same can be said of the ore from shafts Nos. 4, 5, 6 and 7

Shaft No. 8 is twenty-four feet deep, and contained six feet of water. The ore is silicious, sample No. 47 being taken from the dump. The following analysis will show the grade of ore:—

Iron	31.24%
Silica	30.86 "
Phosphorus	0.08 "
Sulphur	0.06 "

(3). North-east quarter of section 9, con. 8, area 160 acres.

Shaft No. 1, twenty-eight feet deep, with nine feet of water in the shaft. The ore is silicious, sample No. 48 coming from the dump, and the contents of the ore being as follows :—

Iron	40.20%
Silica	44.76 "
Phosphorus	0.06 "
Sulphur	0.04 "

Shaft No. 2 is sixteen feet deep, eight feet of water in the shaft, and the ore on the dump was too silicious for sampling.

Two drill holes have been put down on this location, of which I obtained no record.

Location No. 4.

Lot 1, *Area* 240 *acres.*

It was on this location that the first work was done thirty-three years ago, by prospectors in search of silver, who discovered the hematite in some trenches and also in a tunnel on the north part of the location. The old dumps are still visible upon which they had carefully collected the ore taken out of the workings. They were encouraged to do this work by the presence of a few stringers of calcite, which at the time was always considered to be a good indication of the occurrence of silver.

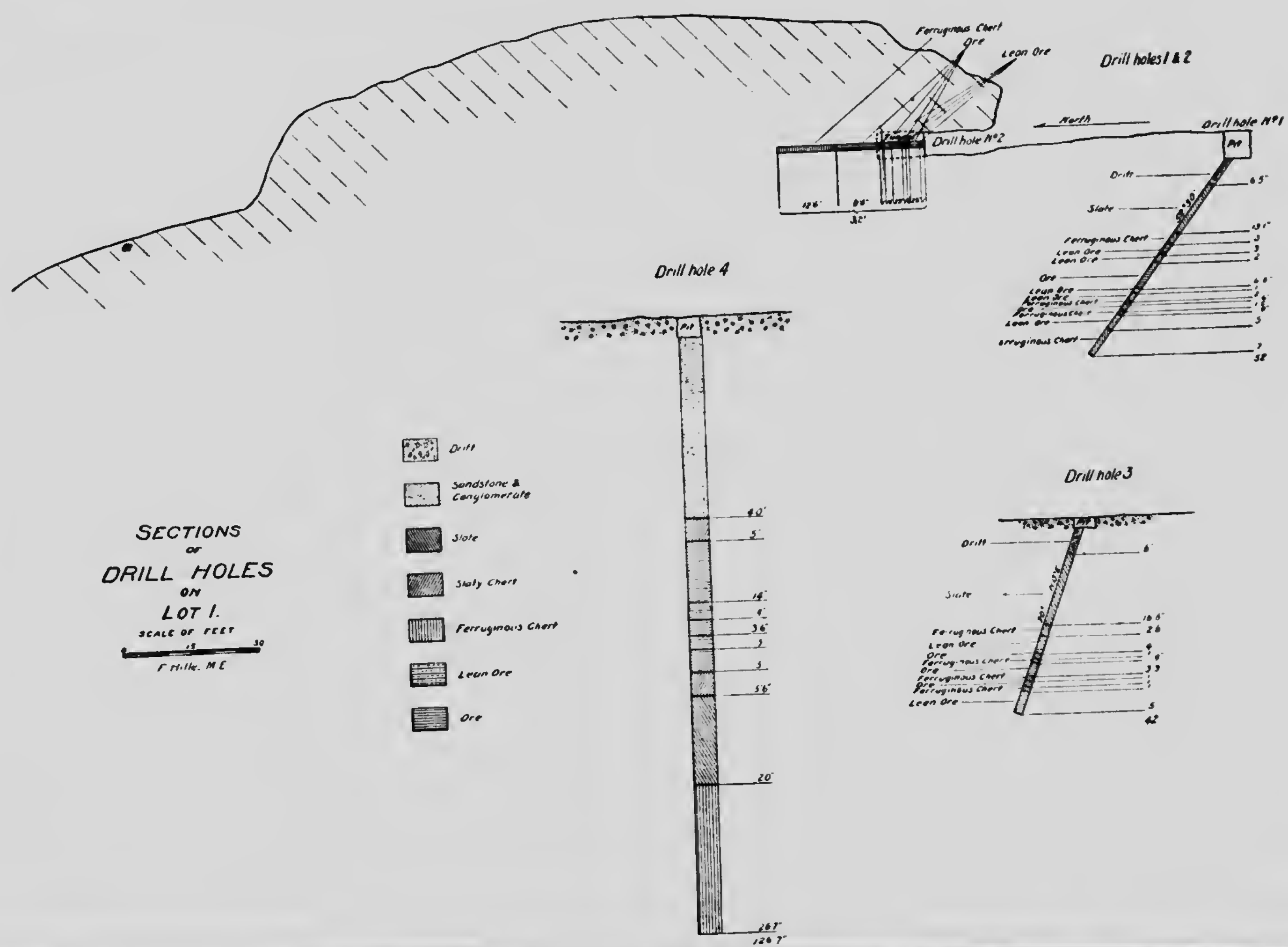
The rock stratum on lot 1 differs somewhat from that on the location above mentioned, as it has undergone considerable disturbance. Considerable prospecting work has been done, consisting of stripping, trenching, tunnelling and diamond drilling, and there is no doubt that this work has resulted in exposing ore in larger quantities and of better quality on this location than on the others. Here, as in the above mentioned location, the ore rests partly in the basin and partly on the little hills which surround it like an amphitheatre; the greater part of it, however, is low grade. There is also some ore considerably better, especially that which is found in the tunnel.

The description that follows of the different workings will show what quantity and quality of ore there is. On an elevation near the middle of the location stands a log house, used by the prospectors and miners, from which a very good view is offered of not only the immediate neighborhood, but also of the country in the farther distance.

The old Thunder Bay road, which starts at Port Arthur and ends on the shores of Black bay, crosses lot 1.

Should the present owners of this location, the Canadian Bessemer Ore Co., be fortunate enough to find large deposits of merchantable ore, it will be possible to find a very easy grade for a spur track to a point on Blende river, a distance of only three miles, and from that point it could be shipped either to Port Arthur or any other destination required.

Following the trail that leads from Loon lake to Silver lake, at a point sixty chains from the western boundary line, we reach the first work done on the location, which is marked on the accompanying map as pit No. 1.


SECTIONS OF DRILL HOLES ON LOT I.
SCALE OF FEET
F. Hille, M.E.
Drill holes 1 & 2
North
Drill hole No. 1
Drill hole No. 2
Ferruginous Chert
Ore
Lean Ore
Drill hole 3
Drill hole 4
Drift
Sandstone & Conglomerate
Slate
Slaty Chert
Ferruginous Chert
Lean Ore
Ore

This pit is seven and one-half by six feet in diameter and fourteen and one-half feet deep, but was filled with water; sample No. 49 was taken from the dump; contents as follows:—

Iron	56.74%
Silica	17.70 "
Phosphorus	0.06 "
Sulphur	0.07 "

We next come to pit No. 2, eight by eleven feet in diameter and eight feet deep, which was partly caved in and is filled with water. Trench No. 2, seven by four feet and fourteen feet long, contains an impure silicious ore, both soft and hard, resting against the slope of a hillock thirty feet high. I was unable to sample the trench; I therefore took sample No. 50 from the dump. An analysis of this resulted as follows :—

Iron	40.61%
Silica	29.90 "
Phosphorus	0.07 "
Sulphur	0.07 "

Trench No. 3 is situated thirty-six feet from the former, the diameter being about the same; sample No. 51 was taken from it. In front of this trench is an old dump which dates from the time of the silver prospecting. The ore, when tested, gave results as follows :—

Iron	27.64%
Silica	55.83 "
Phosphorus	0.09 "
Sulphur	0.08 "

The tunnel is fifty feet east of trench No. 3. Its dimensions are five by six feet and twenty-four feet seven inches in length. The rock and iron ore dip thirty-five and one-half degrees to the south-east. The breast of the tunnel consists of streaks of iron ore, some of high and some of low grade, interspersed with a few stringers of calcite, between which is often found a dark blue iron ore which has every appearance of being manganiferous. Sample No. 53 is made up of a few specimens of this iron, while sample No. 52 gives an average of the whole tunnel. Two diamond drill holes were put into the ore body, one horizontally at the breast of the tunnel and the other twenty-seven feet in front of the first at an angle 52° 30′, of which the accompanying plan will give an idea. The ore encountered in the drill holes will be found noted on the plan.

With regard to the iron contents of this ore I have no record, but I am informed that it is practically the same as the ore found in the tunnel:

No. 52.

FeO	2.01%
Fe_2O_3	25.88 "
FeS_2	0.24 "
MnO	0.29 "
Al_2O_3	0.90 "
MgO	4.06 "
MgO	2.13 "
P_2O_5	0.13 "
SiO_2	61.04 "
H_2O&CO_2	3.72 "

Metallic Iron	19.68%
Sulphur	0.13 "
Phosphorus	0.06 "
Manganese	0.22 "

SAMPLE No. 53.

Iron	
Silica	0.16%
Manganese	
Phosphorus	
Sulphur	

Trench No. 4 is eighteen feet long, four feet wide and four feet deep, and the quality of the ore in this trench is the same as in the tunnel.

Trench No. 5, sixty-eight feet from the tunnel, is shallow, ten feet of ore being exposed, the southerly four feet being of a quality similar to that found in the tunnel. The north six feet is silicious; sample No. 54 was taken here. When tested it gave results as follows:—

No. 54.

Iron	47.94%
Silica	24.96 "
Phosphorus	0.06 "
Sulphur	0.06 "

Diamond drill hole No. 3 was placed seventy-seven feet from the trench just mentioned, in a corner where the ridge takes a sharp angle to the south. The record from this hole will be found on the accompanying plan, which was kindly furnished me, as well as the other two plans, by Mr. R. Flaherty, of Port Arthur. The quality of the ore found, according to information given to me, is the same as the general average of that on this location.

Trenches Nos. 7 and 8, four by five feet, resemble shallow pits and contain some lean ore. At this point on turning to the south we arrive at the foot of a small but steep ridge about sixty feet high, on which is a stripping twenty feet wide and sixty-six feet long. The ore here is a lean silicious iron, which still shows the narrow bands of the ferruginous chert, into which it is merging at the different sides of the stripping. The two accompanying photographs show the whole width, and from these it will also be noticed that the rock and iron at the north end is tilted, while at the southern end it still remains in its original flat position. I took two samples here, No. 55 from the north side and No. 56 from the south side. When tested they gave results as follows:—

	Sample 55.	Sample 56.
Iron	35.19%	33.28%
Silica	43.59 "	44.13 "
Phosphorus	0.11 "	0.06 "
Sulphur	0.21 "	0.34 "

Trench No. 10, two feet wide and ten feet long, is east of Mud lake. The ore as exposed is of a low grade. Stripping No. 2, thirty-five by forty feet and seventy-two feet long, is near the south-east shore of Mud lake, and shows a very silicious fine grain iron ore intermixed with ferruginous chert and some jasper. No sample of this ore was taken. It would probably average from twenty-five to thirty per cent. iron.

Going farther south, about two chains south of the trail and eight chains east of Deception lake, we find diamond drill hole No. 4. The ore encountered in this drill hole was plainly of the same quality as that usually found in the neighborhood.

Tunnel No. 2 is the last working on lot 1, and is situated close to the south line near the shore of Deception lake. It commences at a point twenty-five feet above the water, is sixteen feet deep and its diameter is five by six feet. The face of the tunnel shows four feet of cherty ore, with small stringers of jasper.

Exploring from this point to the south and west of Deception lake, I found more shallow pits, which, however, contained nothing that would be of any commercial value. The same may be said of that ore lying west of Loon lake, in which in recent years a number of locations were surveyed, but where nothing attractive has been discovered.

It will be noticed that in nearly all the work on the location just described some ore has been found, not usually of high grade, as has been shown by the analyses, nor of any great thickness. The horizontal extent, however, although interrupted here and there, gives promise of the possibility of mining perhaps a few hundred thousand tons of low grade ore, which would be useful only as a mixture with ore of a high grade in which the silica contents are extremely low.

To improve the quality of this ore by means of water or dry concentration, or by sorting, may be regarded as out of the question. At the same time, if it can be mined cheaply enough and reasonable railway charges can be obtained for its transportation to points close by, for purposes of smelting, then it is quite possible that the owners can make some use of it. If this cannot be done we must accept the occurrence of this ore in the manner that I mentioned earlier, as being a most favorable indication of what might be found in other localities along the Animikie iron range.

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