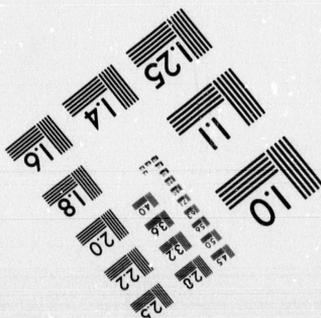
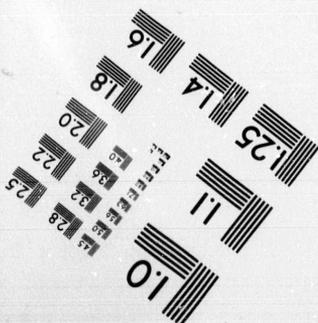
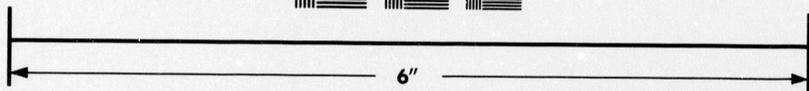
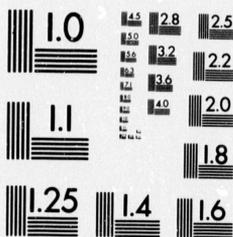


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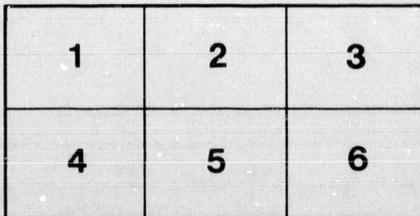
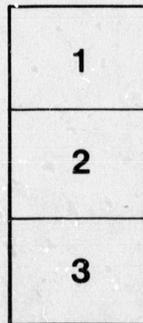
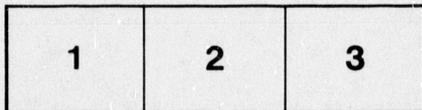
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TO COMMEMORATE THE VISIT OF THE MEMBERS OF THE
INTERNATIONAL MINING CONVENTION OF 1893
TO RADNOR FORGES. FEBRUARY 25, 1893.



THE CANADA IRON FURNACE COMPANY, Ltd.

Incorporated under Charter of the Dominion of Canada on the 29th November, 1889
with headquarters at Montreal.

AUTHORIZED CAPITAL, \$300,000, in 3,000 shares of \$100 each.

DIRECTORATE :

P. H. GRIFFIN, Buffalo, N. Y., President. G. E. DRUMMOND, Man.-Dir. and Treas.
T. J. DRUMMOND, Secretary.
JAMES T. MCCALL, Montreal. ROBERT SCHOTT, Sheffield, Eng.
General Superintendent, J. J. DRUMMOND, M.E., Radnor Forges, Que.,

SALES AGENTS :

DRUMMOND, MCCALL & Co.,
* * Montreal

GENERAL OFFICES :

NEW YORK LIFE BUILDING,
* * Montreal

PLANTS AT

RADNOR FORGES, Que.
GRANDES PILES, Que.

LA PECHE, Que.

THREE RIVERS, Que.
LAC-A-LA-TORTUE, Que.



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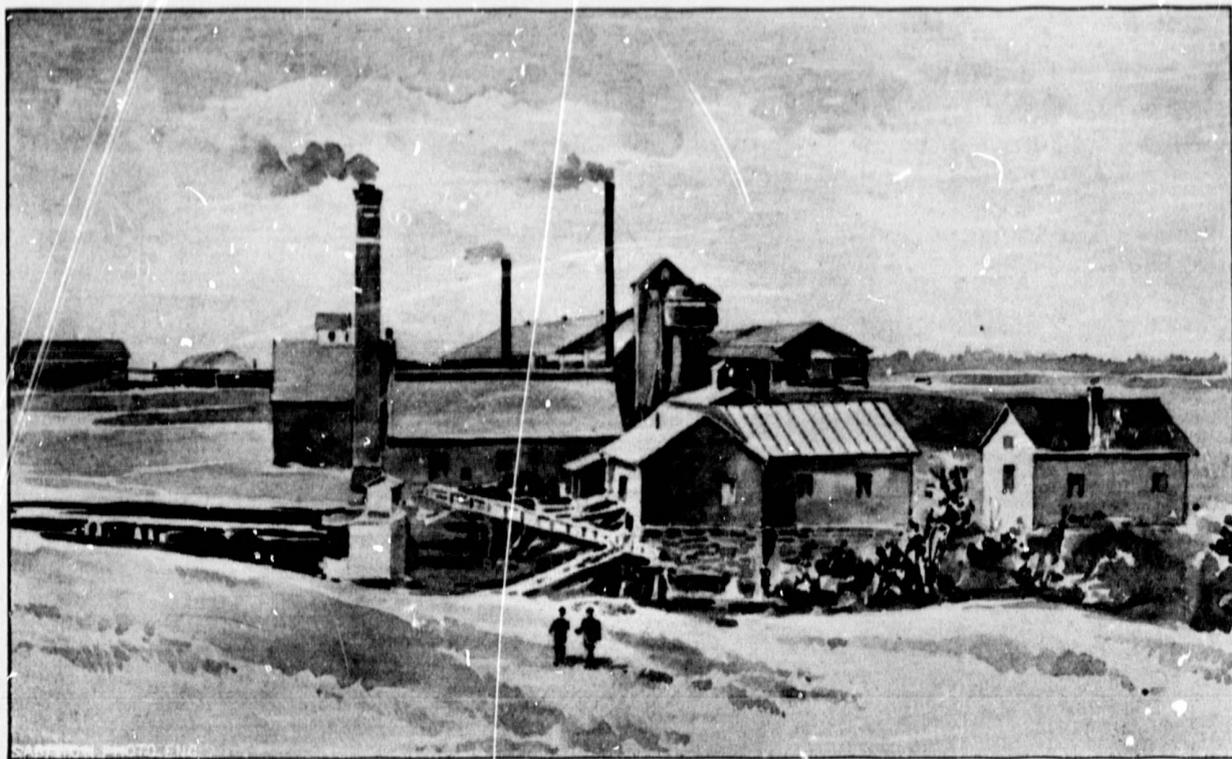
PREFACE.

In issuing this "Souvenir," to mark the visit to Radnor Forges of the American and Canadian Mining Engineers, I have deemed it not out of place to include a brief sketch of the Iron industry of the district from its inception, during the reign of Louis Quatorze, down to the present day.

In my researches with this end in view I came across a number of old legends associated with the old St. Maurice Forges, some of which are still firmly believed by the simple-minded folk of the parishes. I thought it well to include a few of these old stories in the hope that they might prove as interesting to others as they did to myself.

To enter even the border land of the Laurentide country and overlook its beauty of mountain and lake and river, its wealth of game and fish, seems scarcely right, and so, too, I have included "Among the Laurentides," and "Memories," the latter penned under the pines of this paradise of sportsmen and lovers of Nature.

Geo. E. Hammond



RADNOR FORGES.

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THE CANADA IRON FURNACE CO., LTD.

THE Company was formed in 1889 for the purpose of acquiring the iron interests of the district of St. Maurice, including Iron Works at Radnor Forges, together with all accessories, such as a village of sixty workmen's cottages, limestone quarry, perfected water power, clay pits, railway line, bridges, sidings, and other valuable property ; also car wheel shop, and shipping dock situated on the River St. Lawrence at Three Rivers, Que. ; property forming site for permanent battery of charcoal kilns, together with water power on the River St. Maurice, at Grandes Piles, Que. ; Ore deposits of Lac-a-la-Tortue, together with ore rights, over 100,000 acres of ore bearing lands and lakes at other points in the district of St. Maurice and vicinity.

After operating the antiquated stone stack at Radnor Forges (capacity $4\frac{1}{2}$ tons per day) for some two years, in an experimental way, the Company proceeded to develop the entire property, systematizing the collection of ore and wood, by establishing ore depots, wood camps, charcoal kilns, etc., at the most desirable points throughout the territory controlled by them, and finally building at Radnor a modern blast furnace plant, complete in all necessary details, and capable of producing every day from 40 to 50 tons of high class charcoal iron.

The furnace is splendidly situated in the very centre of the ore fields, and in close touch with the wood limits, not only of the St. Maurice, but of the vast territory extending to the north and south of the river, which is, as yet, primeval forest.

The Riviere-au-Lard, on the bank of which the furnace stands, affords an excellent water-power for operating ore and stone crushers, for pumping water to the furnace belt, for fire protection, and other necessary purposes. The waste gases of the furnace are utilized for fuel, and the plant itself operated therewith. The immediate plant consists of the following :

FURNACE STACK.

Height, 40 feet; Bosh, 9 feet diameter; Crucible, 5 feet diameter; height of Bosh line from Hearth, 13 feet; 4 Tuyeres of $3\frac{1}{2}$ inch diameter.

Crucible and Bosh from mantel ring down is encased and protected with a Russell Wheel and Foundry Co. Water Jacket.

Furnace Top is provided with a Bell and Hopper, capacity of which is 25 bushels.

HOT BLAST STOVE.

This is of the pipe pattern, with a combustion chamber below. Dimensions are :—

Length, 24 feet; height, 18 feet; width, 9 feet 6 inches. 68 openings between combustion chamber and pipe chamber above.

STEAM POWER.

Consists of four steam boilers, each 4 feet diameter by 25 feet long, with two 18-inch flues; shells are of $\frac{3}{8}$ inch plate and double rivetted. All boilers connected with a brick chimney 75 feet high, and all are bricked separately, and arranged to fire with either wood or gas. Gas connections are made so that boilers can be worked in batteries of two each or more, and one or two can be laid off for repairs or cleaning at any time.

WATER POWER.

This consists of a head of 24 feet, with a "New America" wheel 35 inches in diameter, capable of delivering 65 horse-power.

BLOWING ENGINES.

New Weimer Blowing Engine, size 16 x 48 x 30, set up on a solid stone foundation, which rests

on a limestone bottom. This engine is provided with a patent water heater and a Scanlan patent wind receiver and heater, capable of raising the temperature of wind to about 200 degrees Fah. before entering the hot blast stove.

AUXILIARY BLOWING ENGINES.

These are of the horizontal type, with twocylinders, each 40-inch diameter by 46-inch stroke, and are geared to be driven either by a horizontal steam engine of 14 x 20-inch cylinder, or by water-power. These engines are complete with their own wind receiver and pipes, and are so arranged that they can be used in case of an accident to or a shut down of the Weimer engine. They deliver about 2,100 cubic feet of air per minute, with a pressure of $4\frac{1}{2}$ pounds. The whole is set up in an engine house entirely separate from the Weimer, and is isolated from the latter and the boiler house.

STEAM PUMPS.

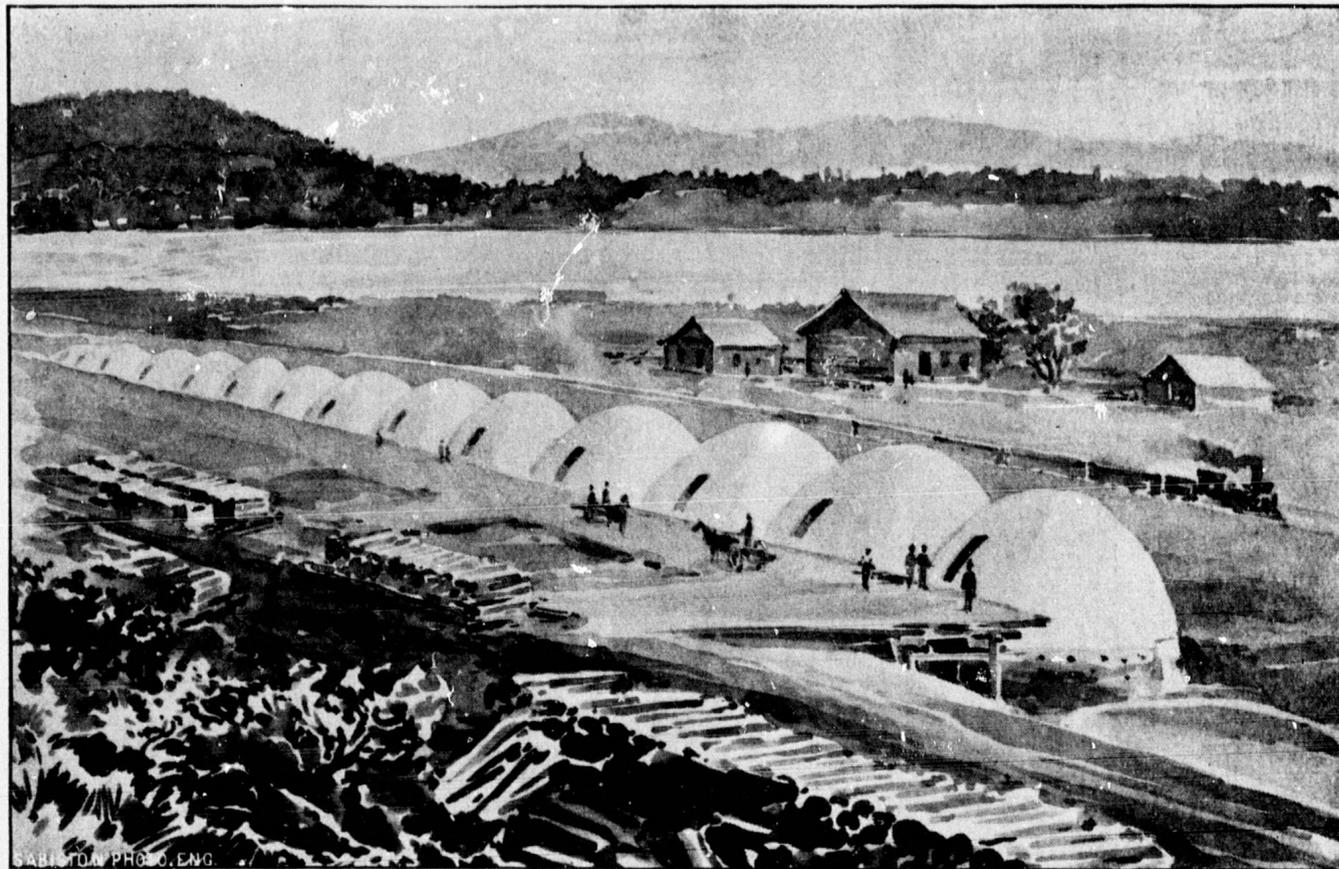
One Blake duplex pump, 12 x 7 x 12 ; one Holly boiler feed pump, 8 x 10 x 4 ; one Niagara boiler feed pump, 6 x 4 x 6 ; one Northey volume pump, 6 x 5 x 7.

FORCE PUMPS.

One horizontal force pump, 4 x 8 ; one double-acting Plunger force pump, 5 x 10.

All the above steam and force pumps are so connected that they can be used either on the furnace water jackets, tuyeres, for general fire purposes, or for boiler feed.

All the suction pipes in connection with the new engine house are laid through a stone tunnel, which leads from engine-house to river, and are always beyond the action of frost, and so arranged that alterations or repairs can be made at any time, as the tunnel is large enough to allow a man to pass or work.



SABISTON PHOTO ENG.

KILNS AT GRANDES PILES.

HOISTING POWER.

This consists of a Crane pattern double cylinder hoisting engine ; size of cylinders, 8 x 10 inch. This engine is connected with two hoisting cages, having a lift of 15 feet from floor of weigh-house to floor of top-house.

CHARCOAL KILNS.

Radnor Forges Battery consists of :—

8 Rectangular kilns, capacity, 55 cords each ; 3 Beehive pattern kilns, capacity, 55 cords each.

Grandes Piles Battery consists of :—

14 Beehive pattern kilns, capacity, 55 cords each. Others in course of construction.

Charcoal also made and supplied from pits in the Swedish manner.

The buildings and real estate in connection with the entire plant is the property of the Company in fee simple.

ORE SUPPLY.

Investigation carefully carried on by practical men, under the immediate direction of the officials of the Company, and verified by actual work in the field, has, as already mentioned in Mr. Griffiin's paper, proved beyond a doubt that there is not only an abundant supply of ore in sight to last for many years to come, but that it is steadily growing, and new discoveries are being made daily. The virtues of the ores of the St. Maurice district have been referred to in the accompanying papers. These ores of course vary in analysis, but the supply is so large that the Company are able to make such selection from the various deposits as to be able to produce fixed results. The Company have their own laboratory, and a practical chemist is permanently employed in the selection of ores, and the analysing of the furnace product.

LIMESTONE.

There is a splendid limestone quarry side by side with the furnace, furnishing a valuable flux at the minimum of cost.

CHARCOAL.

The Company have two batteries of kilns, one situated at Radnor Forges, and the other, the main battery, at Grandes Piles on the River St. Maurice. The supply of hard woods suitable for charcoal making is almost inexhaustible. The main kilns located on the Company's property at Grandes Piles can draw supplies from the banks of the St. Maurice for half a century to come. The location of these kilns secures to the Company the practical control of the navigable waters of the St. Maurice, Grandes Piles being the terminus not only of the railroad but also of navigation. The Laurentian range of mountains presents a barrier to the railway going further north, whilst the succession of magnificent water falls and rapids between Grandes Piles and Three Rivers absolutely prevents the navigation of the St. Maurice to the south. This property also gives the Company control of the Grandes Piles Falls, which with a drop of 40 ft. has a volume of water representing a power not less than 35,000 h. p. It is difficult to estimate the value of this great natural water power. Naturally it is much enhanced by the fact that it occurs at the junction of railway and navigation, and sooner or later its development will offer a splendid investment.

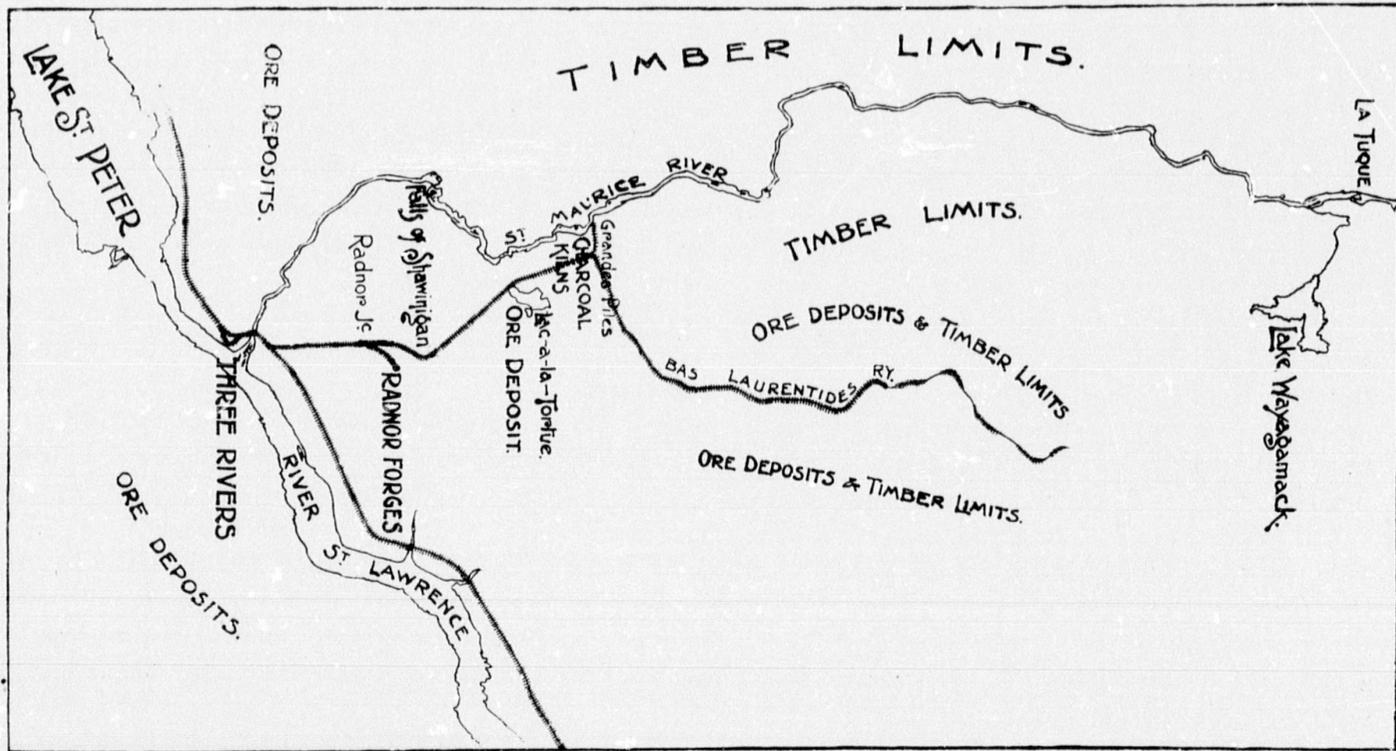
The vast territory to the north watered by the St. Maurice and its tributaries and estimated as 200,000 square miles, contains an immense quantity of pine and spruce, and at the present time its limits are attracting the attention of American capitalists, as evidenced by the fact that the American Laurentides Pulp Co. have already expended hundreds of thousands of dollars in the erection of a pulp mill and in perfecting the water power at Grande Mère, a few miles below Grandes Piles. Aside from the manufacture of pulp, the lumber produced from the spruce of the St. Maurice is of a class

coming more into use every day, as taking the place of the more expensive pine. Hard woods, such as maple and birch, are to be found in an almost inexhaustible growth all along the banks of the St. Maurice, and are specially suitable for the manufacture of charcoal for the smelting of iron. It is from this section the Company will draw its supplies for some years to come, and with great benefit not alone to itself but also to the settlers on the river, who find that in clearing their lands they are able to chop and dispose of their standing wood to the Charcoal Works at good paying figures, thus finding a cash market for what would otherwise be to them practically worthless material.

In addition to the valuable ore deposits and wood limits controlled by the Company they possess rich deposits of ochre, suitable for metallic paint, and also (on the property at Radnor Forges) valuable clay deposits suitable for making the finest quality of re-pressed brick.

The work of bringing the furnace plant and accessories to its present condition has been no easy task, and if in many respects Radnor Forges may seem to be behind American furnaces at the present moment, yet given sufficient time for a further development and proper systematizing, there is no reason to fear but that the works will eventually make a very creditable showing. American furnace men, the majority of whom are able to purchase their raw material, such as ore and charcoal, in the open market, will appreciate the difficulties of establishing a new furnace in what may be termed "The Wilderness." The Canadian furnace man has, so to speak, "to live within himself," to provide workmen for his entire cut of wood, to transport same to his charcoal kilns, and the charcoal to the furnace. He has also to "mine" his full supply of ore, and other necessary material. All this the officials of the Canada Iron Furnace Co. have had to do, and the greater part of the reorganization and systematizing has been carried out within the space of one year, and that too concurrently with the construction of the plant itself.

Among the serious difficulties the Company have had to contend with, was the fact that owing to



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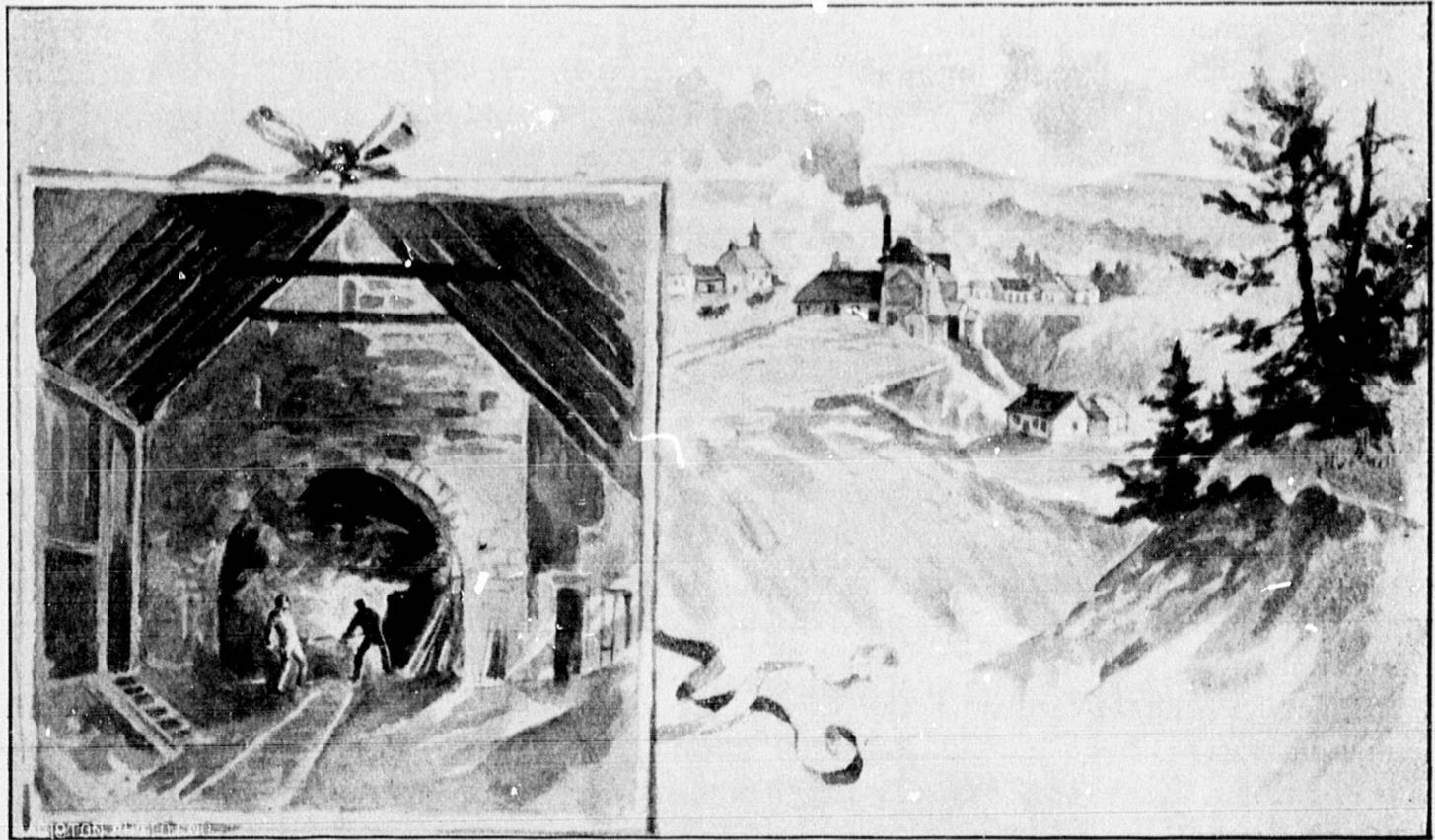
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stagnation in the lumber interests of the St. Maurice district, there was at the time of the inauguration of the Company, a great scarcity of labor, the workmen having left the country in largenumbers. Further the officials had to contend with great difficulties in their attempt to change the weights and measures that had been in vogue in this territory for many years, for instance, the *habitants* at first positively refused to supply wood of a greater length than 3 ft. and the Company desiring to be in the same position as their American competitors had to set to work to change this to the present standard of 4 ft. in the face of considerable opposition from the *habitants*. These alterations have been carried out without undue friction, and the American standard is now used in all departments. Furnacemen will fully appreciate the difficulties referred to.

In carrying out all the operations of the Company, upwards of 800 men are directly and indirectly employed during the season, the majority of whom are engaged in the securing of ore and wood supplies. Through proper systematizing the Company's employees are now taken largely from the ranks of the farmers or *habitants*, who work for the Company during their slack season between seed time and harvest, and in the winter months. These men find the work profitable in clearing their lands by supplying wood to the charcoal kilns, and in raising ore on portions of their farms which would otherwise be unproductive. In this way the work of the Company goes on almost continually over a very large territory, and the supplies of both labor and material so obtained are therefore now practically unlimited.

In connection with the foregoing, the political economist will observe that in this case the interests of the manufacturer and the agriculturalist are identical. The success of the iron industry means an increase of income to the farmer by affording him profitable employment on his own land.



OLD ST. MAURICE FORGES.

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THE ST. MAURICE DISTRICT AND THE ST. MAURICE FORGES.

The student of Geology and History, as well as the practical business man of the nineteenth century, will find much of interest to attract attention during even the briefest of visits to the historical ore-bearing district of St. Maurice.

In the accompanying paper on the "Bog Iron Ore and Ochres of the region of Three Rivers," Mr. A. P. Lowe, B. Ap. Sc. of the Geological Survey of Canada, deals fully with the geological formation of the bog iron ore of the district, and advances some novel ideas on this subject, which although not borne out by the views of other eminent authorities, will prove of great interest to geologists. Mr. Lowe's interesting discussion as to the effects of the glacial period on the surrounding country will also provide ample food for thought and discussion.

Prof. J. T. Donald's paper on the chemical aspect of the ore and its product will be read with great interest by experts on iron, and Prof. Donald has had perhaps more opportunity of studying the St. Maurice ores from a chemical and theoretical standpoint than any other living man.

Mr. P. H. Griffin's article presents the practical side of the question, dealing as it does with actual results obtained in the smelting of these ores in the furnace at Radnor Forges, and of the value of the product as used in the manufacture of car wheels and other high class castings where great strength is not alone desirable but an absolute necessity.

The relative tests mentioned in Mr. Griffin's paper, (sample test bars of which can be viewed at Radnor Forges) demonstrate the fact that in practice, if not in theory, Three Rivers charcoal iron has no superior.

The following letters show the results as obtained by leading Canadian consumers of to-day :—

TORONTO, July 30th, 1892.

Messrs. THE CANADA IRON FURNACE CO., LTD.,

Montreal.

DEAR SIRs,—Replying to your esteemed enquiry re our experience with your Three Rivers C.I.F. charcoal pig iron, would say that we are using a mixture containing 20% of your iron, and the results are most satisfactory in all respects; our stove plate is tough, smooth and high in color, a point that we have been trying for for some time, and with which we are delighted. For radiator and boiler castings it has improved the quality very much, being much stronger, softer and close, with no spongy spots, and our losses are reduced so much that we believe we will be in pocket by using this in future in our entire melt, although the price is so much greater than ordinary iron.

Yours truly,

(Sgd.) THE E. & C. GURNEY CO.,
p.p. W. H. CARRICK.

GALT, ONT., 22nd Sept., 1892.

Messrs. THE CANADA IRON FURNACE CO., LTD.,

Montreal, Que.

GENTLEMEN,—Replying to your favor of the 19th inst., we beg to say that we have tested the sample of Three Rivers C.I.F. charcoal pig iron sent to us, and we must say that in our long experience as foundrymen we have never had a better iron. It does more than you claim for it for cylinder work, and is a strengthener in mixtures. We have not the least hesitation in recommending this iron to any party who wants a really first-class iron.

Yours truly,

(Sgd.) COWAN & Co.

ST. THOMAS, ONT., Oct. 24th, 1892.

GEO. E. DRUMMOND, Esq.,
MAN.-DIR. AND TREAS. CANADA IRON FURNACE CO., LTD.,
Montreal, Que.

DEAR SIR,—Enclosed herewith, please find order for 150 tons of Three Rivers C.I.F. iron, graded as specified from 2½ to 6 inclusive.

We volunteer to say in regard to the iron we have been receiving from your Company, that it is giving most satisfactory results in our car wheel mixture, and we have found that by the aid of it we can entirely dispense with the high priced irons which we were formerly obliged to import, our records of tests showing an improvement of over 25% on the results previous to using your iron, in addition to which our percentage of loss has been greatly reduced.

We also use a considerable portion of this iron in our machinery casting department, particularly for special locomotive and machinery castings requiring close grain, strength, and fine finish, and for this purpose we find iron graded from soft 1 to 3 most desirable.

We would be glad to have you refer any parties to us for further information if desired.

Yours truly,
(Sgd.) ST. THOMAS CAR WHEEL CO., LTD.
Per JOHN H. FLEMING, Asst -Man.

PRESTON, ONT., Sept. 29th, 1892.

Messrs. THE CANADA IRON FURNACE CO., LTD.,
Montreal, Que.

DEAR SIR,—Replying to your favor of the 26th inst., beg to say we are now using a mixture of iron in our foundry which includes 10% of your iron, and we are very much pleased with the results obtained by its use. It adds greatly to the strength of the iron, without interfering with its fluidity.

Yours truly,
(Signed) CLARE BROS. & CO.

SMITHS FALLS, ONT., May 4th, 1892.

GEO. E. DRUMMOND, Esq.,
MAN.-DIR. & TREAS. CANADA IRON FURNACE CO., LTD.,
Montreal, Que.

DEAR SIR,—In reply to your favor of the 3rd inst., I beg to say that I am using Nos. 1, 2 and 3 C.I.F. Three Rivers charcoal iron in every heat, and consider it first-class iron for malleable iron purposes.

Yours truly,
(Sgd.) WM. H. FROST.

MONTREAL, 4th May, 1892.

GEO. E. DRUMMOND, Esq.,
MAN.-DIR. & TREAS. CANADA IRON FURNACE CO., LTD.,
Montreal.

DEAR SIR,—I have been using some of your Nos. 2 and 3 C.I.F. Three Rivers charcoal pig iron for special castings requiring extra strength, and have found it to give great satisfaction.

I am making a specialty of rolling mill rolls, using your Nos. 2, 3, 4 and 4½ as a mixture, and have found this iron to be close, strong and of the required hardness.

I send you a few shavings turned off a roll made from your Nos. 2 and 3. These show the tough quality of the iron. The iron had from you since the rebuilding of your furnace is of even grade and good quality.

Yours, etc.,
(Sgd.) MOSES PARKER.

1892.

BRANTFORD, May 7th, 1892.

GEO. E. DRUMMOND, Esq.,
MAN.-DIR. AND TREAS. CANADA IRON FURNACE CO., LTD.,
Montreal, Que.

ree Rivers

DEAR SIR,—In reply to your favor of the 2nd inst., we would say that we have for the past two years been using your charcoal iron, especially in our cylinder and valve castings for our engines. Previous to using your iron we used "Salisbury" iron.

ROST.

We find, in our opinion, that your iron is at least equal for this purpose to the "Salisbury," and should judge from our experience, if anything, a little better.

Yours truly,
(Sgd.) THE WATEROUS ENGINE WORKS CO., LTD.
C. H. WATEROUS, Gen'l Man.

LACHINE, September 24th, 1892.

GEO. E. DRUMMOND, Esq.,
CANADA IRON FURNACE CO., LTD.,
Montreal.

892.

DEAR SIR,—Referring to last shipment of C.I.F. Three Rivers iron, I find it is still up to the mark, and superior to any other brands which we receive.

castings

The following is a practical test made from the pipe cupola:—

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We ran short of C.I.F. and I was obliged to use a mixture composed of one-third "Carnbroe" No. 1, one-third M. and C. and one-third Siemens No. 1. This gives very good results and bars average 2,400 lbs. Upon receipt of the C.I.F. Three Rivers iron I used 25% securing an increase of strength to 2,700 lbs. I then increased the C.I.F. to 50% with the result of an increase to 3,300 lbs. The C.I.F. used in this test was No. 2½.

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I am pleased to say that in my experience in the manufacture of car wheels and castings I have not found any iron to compare with the C.I.F.

(Signed.) D. H. GILBERT, Supt. Montreal Car Wheel Co.
and DRUMMOND, McCALL, Pipe Foundry Co.

The peculiar virtues of the Three Rivers iron have long been known to the Canadian people. 225 years ago, in the very earliest days of La Nouvelle France, specimens of the bog ore of the St. Maurice District were examined in Quebec by the Sieur la Poutre, and reports sent to the Imperial Government in France. At that time the affairs of the colony were under the control of the "West India Company," who held monopoly of all the rights of the mines and minerals of La Nouvelle France, including those now owned by the Canada Iron Furnace Co.

The leading historical facts connected with the establishment of the iron industry in the district of St. Maurice have already been placed before the members of the American Institute of Mining Engineers in the able paper read at the Halifax meeting in September, 1885, by Mr. James Herbert Bartlett, of Montreal. This historical data is, however, interesting enough to warrant its reproduction.

Among the original manuscripts relating to the administration of Louis de Buade, Comte de Frontenac, allusion is frequently made to the great value of the St. Maurice iron mines. In a letter to the Imperial Government under date 2nd Nov., 1672, Frontenac says:—

"The iron mine of which I have already spoken is of great consequence. I have visited it myself in order that I may be enabled to give a more accurate account of its nature. I am gratified to learn that another mine has been discovered in Champlain which is much richer than the Cap de la Madelaine mine, and the ore is in greater abundance. I apprehend that it will be next to impossible to exhaust this mine, as there is an extent of country of four leagues in length from Cap de la Madelaine to Champlain, which is covered with iron ore; all the streams indicate its existence. I had the curiosity to taste the water, and I found it all strongly impregnated with rust and iron, but the miners whom I sent there render the affair certain, they are now working there and if you have any intention of establishing forges and a foundry, you may be certain that the material will not be wanting. There are six piles of ore now lying at Cap de la Madelaine which, according to the annexed report of the miner, would last for two castings a day for four months. The important question is the placing of the forges. According to my opinion I should prefer building them on Ruisseau Pepin, which is in Champlain, rather than at the Cap, where the Jesuit Fathers have a mill already

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in operation. By thus placing the forges they would be between the two mines, and the material could be more easily conveyed from both to the central establishment. When you have decided upon establishing the said forges, as the workmen you will send out will be competent men, they, perhaps, can decide whether there is enough water in the streams I have above mentioned to work the wheel of the projected forges, also to judge whether it would be practicable to bring in other streams in the neighborhood, such as Ruisseau d'Hertel, to increase the quantity of water. The chief miner, who is now here, assures me that this can be easily and successfully done. It is certain that if the forges are once established many advantages will result to the colony, excellent iron will be manufactured there, and the consumption of fuel will help materially in the clearing of the forest land. Moreover many men will be employed at the work and a market will thus be afforded for the surplus provisions which we have at our disposal."

In 1675 the charter of the West India Company was surrendered, and the next official notice of the mines that appears was the issue of a deed in August 1676, in favor of Dame Jeanne Jalope, widow of Maurice Poulin, Sieur de la Fontaine, the King's Attorney for Three Rivers, who, by the said deed, obtained concession of the Seigneurie of St. Maurice. This lady appears in turn to have deeded the property to her son, Michel Poulin, in 1683.

Frontenac would seem to have had great confidence in the mines, for from time to time he sought by letters to impress upon the Imperial Authorities the great value of the deposits and the desirability of developing an iron industry. In 1681, he writes :—

"I am convinced that there is a very fine iron mine in the vicinity of Three Rivers, where a forge could be profitably worked. I wish I had a man here who could plan the construction of an establishment of that kind, it would be of great use to His Majesty the King and to the whole Colony. Monsieur Vallon can inform you, my Lord, how Mons. de Colbert has tested the quality of the ore and with favorable results. I have sent a small quantity to Mons. Arnoul, who can give you an account of it. There is a large stream in the vicinity of this mine."

In 1685 the Marquis de Denonville was appointed Governor, and on the 17th Nov. 1686, in advices to the Home Government he says :—

"I have this year again had the iron mine near Three Rivers thoroughly examined. I am convinced that there is a much

larger quantity of that metal than the colony requires. The great desideratum is the discovery of a stream or water power, which can be used in winter, and it is in this respect that we require an able experienced man, who could see what could be done for the establishment. Last year I sent a sample of this iron to France, and the iron-workers, who found it of good quality and percentage, wish to have fifteen or twenty barriques to give it a thorough trial as to quality; it would be well to satisfy them on this point next year. If our Northern Company should succeed there would be no difficulty in accomplishing this desirable object."

The Poulin family seem to have controlled the ore rights and lands, at least in part until as late as 1736, as existing documents show that on the 15th October, 1736, Poulin, Louise de Boulanger, his wife, and Michel, his brother, a priest, sold the fief and seigneurie St. Maurice to François Etienne Cugnet, Pierre François Taschereau, Oliver de Vezain, Jacques Simonet and Ignace Gamelin for the sum of 6,000 livres with no terms, so long as they paid 300 livres a year.

The partnership so formed, was known under the title of Cugnet & Cie, or "La Compagnie des Forges," and the King of France, (at that time Louis XV.) by an Order in Council dated April 1737, empowered them to establish iron works, and advanced them the sum of 100,000 livres, claiming neither rent nor taxes. The firm under these conditions proceeded to erect a blast furnace, (the historical St. Maurice,) which remains to this day, and over the arch of which can yet be seen on an iron plate, the insignia of France, the Fleurs de Lys, together with the date 1752. Work was practically commenced under the direction of a French artizan but lack of capital led to failure, and finally in 1743 the Crown took possession of the furnace, and proceeded to carry on the work in the name of the King and on his account. Skilled workmen were brought over from France and Sweden to improve the furnace, rebuilding it in part at least, (about 1752) and producing the blast furnace as it now stands with Walloon hearth, in use until as late as the summer of 1883.

Amongst the most interesting of records relating to the iron interests of the St. Maurice district, is a letter written in August 1747, by Prof. Peter Kalm, professor of Economy in the University of

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Aoba, in Swedish Finland, and a member of the Swedish Royal Academy of Sciences. Prof. Kalm visited Three Rivers (in his travels through the country,) seemingly for the special purpose of visiting the iron works. He wrote as follows :—

“Whilst my company was resting, I went on horseback to view the iron-work. The country which I passed through was pretty high, sandy and generally flat. I saw neither stones nor mountains here. The iron work, which is the only one in this country, lies three miles to the west of Trois Rivieres. Here are two great forges, besides two lesser ones to each of the great ones and under the same roof with them. The bellows were made of wood, and everything else, as it is in Swedish forges. The melting ovens stand close to the forges, and are the same as ours. The ore is got two French miles-and-a-half from the iron works, and is carried thither on sledges. It is a kind of moor-ore, which lies in veins within six inches or a foot from the surface of the ground. Each vein is from six to eighteen inches deep, and below is a white sand. The veins are surrounded with this sand on both sides, and covered on the top with a thin mould. The ore is pretty rich, and lies in loose lumps in the veins, of the size of two fists, though there are a few which are near eighteen inches thick. These lumps are full of holes which are full of ochre. The ore is so soft that it may be crushed betwixt the fingers. They make use of a gray limestone which is broke in the neighborhood for promoting the fusibility of the ore, to this purpose they likewise employ a clay marl, which is found near this place. Charcoals are to be had in great abundance here, because all the country round this place is covered with woods, which have never been stirred. The charcoal from evergreen trees, that is from the fir kind, are best for the forge, but those of deciduous trees are best for the smelting oven. The iron which is here made is described to me as soft, pliable and tough, and is said to have the quality of not being attacked by rust so easily as other iron, and in this point there appears a great difference between the Spanish iron and this in ship-building. This iron work was first founded in 1737 by private persons, who afterwards ceded it to the King, they cast cannons and mortars here of different sizes, iron stoves which are in use all over Canada, kettles, etc., not to mention the bars which are made here. They have likewise tried to make steel, but cannot bring it to any great perfection, because they are unacquainted with the best manner of preparing it. Here are many officers and over-seers, who have very good houses built on purpose for them. It is agreed on all hands that the revenues of the iron work do not pay the expenses, which the King must every year be at in maintaining it. They lay the fault on the bad state of population, and say that the few inhabitants in the country have enough to do with agriculture, and that it therefore costs great trouble and large sums to get a sufficient number of workmen. But, however plausible this may appear, yet it is surprising that the King should be a loser in the carrying on of this work, for the ore is easily broken, very near the iron work and very fusible. The iron is good and can be very conveniently dispersed over the

country. This is, moreover, the only iron works in the country, from which everybody must supply himself with iron tools, and what other iron he wants. But the officers and servants belonging to the iron works appear to be in very affluent circumstances. A river runs down from the iron work into the river St. Lawrence by which all the iron can be sent in boats through the country at a low rate. In the evening I returned again to Trois Rivières."

There seems to be no doubt but that the suspicions shadowed forth in Prof. Kalm's letter, regarding what we might in the nineteenth century term the "boodling" of the Government, the Intendant, and the principal officials were perfectly correct, as documents relating to that time show that many complaints were despatched to France touching on the ruinous state of affairs being produced by the officials of the Province, and these complaints resulted in the Governor, the Marquis de la Jonquiere, being recalled and Inspector M. Franquet was sent out to visit the different posts in La Nouvelle France. The following is a part translation of a French manuscript relating to his visit to the Forges :—

"M. Bigot, Intendant of New France, who resides at Quebec, had recommended me to visit the St. Maurice forges, as the establishment was extensive, and as he had no doubt that I would be pleased to be in a position to give an account of it. By stopping at Three Rivers, I could reach the forges in two hours, so having settled upon that course, I requested M. Rigaud, who was then in charge of that post, to accompany me. We left Three Rivers at 5 o'clock a.m., with M. Tenancour and other friends, whom M. Rouville, director of the forges, had invited to accompany us. In leaving the town, we ascended a hill covered with sard, crossed a plain, and passed through a wood of stunted trees, on emerging from which we stood on a hill overlooking a valley, in which the said forges of the King are situated; we crossed a wooden bridge built over a small stream, and disembarked from our conveyance at the door of the director's dwelling. After the first ceremony of reception by the Director, his wife, and the other employes, we proceeded to visit the works. The stream which drives the machinery is dammed up in three places, the first dam drives the wheel for the furnace, the second and third each a trip hammer. Each dam has a water-pass to prevent overflow in highwater, it is supposed that the stream or water power is sufficiently strong to drive two other hammers. The buildings of the post are irregularly situated on the banks of the stream, and little or no taste seems to have been displayed in placing them. The principal building is the Director's residence, a very large establishment, but scarcely large enough for the number of employes who have to be accommodated.

"On entering the forge I was received with a customary ceremony, the workmen moulded a pig of iron about 15 feet long for my special benefit. The process is very simple, it is done by plunging a large ladle into the liquid boiling ore, and emptying the material into a gutter made in the sand. After this ceremony I was shown the process of stove-moulding, which is a very simple affair, but rather an intricate operation. Each stove is in six pieces, which are separately moulded; they are afterwards fitted into each other, and form a stove about three feet high. I then visited the shed where the workmen were moulding pots, kettles, and other hollow-ware. On leaving this part of the forge we were taken to the hammer forges, where bar iron of every kind is hammered out. In each department of the forges, the workmen observed the old ceremony of brushing a stranger's boots, in return they expect some money to buy liquor to drink to the visitor's health. This establishment is very extensive, employing upwards of 180 men. Nothing is consumed in the furnace but charcoal, which is made in the immediate vicinity of the post. The ore is rich, good and tolerably clean, it formerly was found on the spot, now the Director has to send some distance for it. The management of these forges is economical. It must be readily understood, that owing to the numerous branches in which expenditure must be incurred, unless a competent man be at the head of affairs, many abuses would be in consequence. Among other employes, his Majesty the King supports a Recollect Father at this establishment, with the title of Aumonier. This iron is preferred to the Spanish iron, and is sold off at the King's stores in Quebec at the rate of from 25 to 30 castors (beaver skins) per hundred weight. In order to obtain a better knowledge of the position of these works, I would refer to the notes sent to the Court of France on this subject, wherein will be found all details of their management. I may say, however, in conclusion, that they are unprofitable to the King, and I am assured that if they were offered on lease at public sale, one hundred pistoles per annum might be procured for them. After a splendid dinner at M. de Rouville's mansion, we returned to Three Rivers highly pleased with our visit, and took supper at M. de Tonnancour's. The distance from the town to the forges is nine miles."

The next official notice of the forges is perhaps its mention in the articles of capitulation between Major-General Amherst, Commander-in-Chief of His Britannic Majesty's troops in North America, on the one part, and the Marquis de Vaudreuil, Governor for the King in Canada on the other side. These articles were dated 8th September, 1760. Article 44 says :

"The papers of the Intendancy of the officers of Comptroller of the Marine, of the ancient and new treasures of the King's magazines, of the officers of the revenue, and forges of St. Maurice, shall remain in the power of M. Bigot, the Intendant, and shall be embarked for France in the same vessel with him, these papers shall not be examined."

M. Bigot sailed for France, and on his arrival there received more than a warm welcome, being seized, imprisoned, and made to disgorge most of his ill-gotten gains (vide Parkman's *Montcalm and Wolfe*). St. Maurice forges, with all accessories, then passed into the hands of the British Crown, and belonged thereto until as late as 1846.

Amongst other matters of historical interest, connected with the St. Maurice forges, may be mentioned the fact that in 1775, during the American invasion, Pellisier, one of the lessees of the forges, aided and abetted the Americans with both goods and money, and further, he actually cast shot and shell, to be used by them in their siege of Quebec. Finally he absconded by way of Sorel to the United States, carrying with him all the funds belonging to the forges, and also all the vouchers given for money advanced to the Americans, about £2000 in all. His American friends seemed to have cashed these vouchers, after which he sailed for France, leaving his co-directors in the Company then operating the forges practically insolvent. The works passed by lease from the Government, through various hands, until in 1793 the lease became vested in Messrs. George Davidson, David Munro and Matthew Bell. The Hon. Matthew Bell, Seigneur of St. Maurice, seems to have had "friends at Court," as he was able to renew the lease with the Government authorities from time to time, down to 1846. During his régime the St. Maurice forges were known far and wide throughout the country, not alone as an iron producing centre of first importance to the colony, but also for the princely hospitality extended to all visitors by the Seigneur and master.

At this time the iron industry was the most important of all the enterprises of Canada. Hugh Gray, in "Letters from Canada, 1809," page 22, writes, "There existing then a considerable export of cast iron articles, principally of stoves."

The trade of the St. Maurice forges seems to have been very great during Mr. Bell's time. He had, in addition to the furnace, extensive forges, foundries and work shops. The number of men em-

ployed were from 250 to 300, the Superintendents being mostly English and Scotch, and the workmen generally Canadians. Stoves were the principal articles manufactured, and these were sent broadcast over the country ; indeed many specimens of these stoves remain till this day, and demonstrate the splendid quality of the iron used in their manufacture. Mill machinery, potash kettles, and other articles were manufactured in large numbers,—and, in addition to this, bar iron was manufactured and even exported. The inhabitants of the country recall with wonder, even to this day, the princely magnificence in which the Hon. Matthew Bell lived during his regime at the St. Maurice forges. He kept open house at his Chateau, and entertained, at various times, the Governor and British officers, besides other dignitaries. He kept a stud of horses and a pack of fox hounds, and as the district of St. Maurice has always been famous for the abundance of fish and game to be had, there was no lack of attraction for sportsmen. On the death of the Hon. Mr. Bell the Crown resolved to sell the property, and it was bought at auction by Henry Stuart, Advocate, of Montreal, in August, 1846, and was leased by him to James Ferrier (afterwards Senator Ferrier) who worked it successfully for four years, viz., from 1847 to 1851.

Later on the forges passed through the hands of Messrs. Stuart and Porter of Quebec, and finally to the Messrs. McDougall of Three Rivers, who operated the furnace until as late as the summer of 1883, using the iron thus produced in the manufacture of railway car wheels, with the very best of results, as far as the quality of the product is concerned.

In 1860 Radnor Forges became the chief seat of the industry.



VIEW OF OLD STONE FURNACE AT RADNOR.

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RADNOR FORGES.

About the year 1860, Messrs. Larue & Co. (the firm consisting of Larue, Turcotte and Messrs. G. B. Hall & Co.) after a very careful investigation, made with a view to locating the best point in the St. Maurice district for the erection of a blast furnace, etc., decided upon the site of the present Radnor Forges in the County of Champlain, thus strangely enough transferring the chief iron industry of the district of St. Maurice to the very site foreshadowed by Louis de Buade, Comte de Frontenac, as far back as 1672, as the most desirable location in all that country for the erection of a blast furnace.

Messrs. Larue & Co. carried out what, for that time, was a most elaborate plan, and established not only the blast furnace, but forges, rolling mills, and car wheel foundry (the latter located at Three Rivers). In addition to this they had 40,000 acres of freehold lands. From 200 to 400 men were employed, and the works were carried on for some time with a product of 4 tons of pig iron per day. A pair of car wheels together with an axle manufactured at these works were sent by Messrs. Larue & Co. to the International Exhibition of 1862, and attracted much attention, as the wheels had actually run 150,000 miles. Still better results have been obtained in later years from the same iron.

The wrought iron produced at the establishment was used largely for the manufacture of scythes and nail rod iron, and was much prized by consumers, who considered it equal if not superior to the very best Swedish iron.

In the establishment of the works over one million of dollars was sunk, and the greater part of it was lost through disastrous fires, and, it is said, "bad management." There is no doubt, however, that the lack of railway facilities which prevented supplies being taken from a greater radius than seven miles handicapped the proprietors in their attempt to find a market for the product, and had as much to do with the failure as anything else. This disadvantage is now entirely overcome

by the fact that the Canadian Pacific Railway connects with Radnor Forges, and shipment can be made by rail and water routes, the latter from the present Company's property and dock at Three Rivers.

In 1889 the Canada Iron Furnace Company, limited, acquired Radnor Forges, together with the extensive property and interests belonging thereto.

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THE MANUFACTURE OF CHARCOAL IRON FROM THE BOG AND LAKE ORES OF THREE RIVERS' DISTRICT.

By P. H. GRIFFIN, M.E., of Buffalo, N.Y., President Canada Iron Furnace Company, Ltd.

(Read at the International Mining Convention, Montreal, 1893.)

The manufacture of Iron in the Province of Quebec forms one of the most interesting subjects in the development of this great industry in America. Its inception followed in a comparatively short period after the first steps taken in the New England Colonies, where iron was first practically made in America. In both cases the ores smelted were what is known as "Bog Ores." In Quebec the first work was done in and about the town of Three Rivers, and many interesting facts in connection with the development of this industry may be found in the paper read by Mr. James Herbert Bartlett, of Montreal, before the Halifax meeting of this Institution in September, 1885. In that paper Mr. Bartlett traces the industry from its first inception, about the year 1730, down to the condition in which it existed in the year 1883, at which time he stated that the St. Maurice forge was the oldest active furnace on the American continent.

A few years after the date last named we became interested in the matter, and have carried it forward on more extended lines than any before attempted, and in fact, so far as the manufacture of this particular class of iron is concerned, it has never been attempted on the scale we are carrying on to-day. This work is not being done on any experimental basis, but so far has been carried on for the purpose of supplying a grade of iron hitherto procurable only at heavy cost for Canadian consumption from the United States, and for English consumption from Sweden.

The manufacture of iron in the Province of Quebec was carried on entirely with the use of bog ores during the period referred to, and as the supply of iron made elsewhere from cheaper ores became

more abundant, the local manufacture, handicapped by want of shipping facilities, lack of capital, and other such natural causes, was gradually discontinued. It was always admitted that for certain purposes the iron made in the province possessed special value, but the demand for articles requiring such special virtue was limited, and cheaper grades were gradually substituted for general manufactures. That iron of the special character of that produced from the Bog Ores of the Three Rivers' district has been for many years the most important industry in Sweden will be referred to later on in this paper, as well as the present condition of its manufacture in that country, and the uses to which it is now put.

Some years ago we were induced to test in our car wheel shops at Lachine and St. Thomas a quantity of Canadian charcoal iron, the product of an antiquated stone stack situated at the village of Fermont, or Radnor Forges, Champlain Co., Que. We were told that this iron was made from the bog and lake ores of the Three Rivers' district, celebrated in the history of the Canadian iron industry, and that it had peculiar merits in strengthening mixtures for car wheels and other high class castings. At that time we were using largely "Selected Salisbury" charcoal iron imported at a very heavy cost from the United States. We were loath to make any change in our mixtures as we had always pursued a most conservative course in the selection of iron entering into our wheels, but we finally decided to enter upon a series of careful tests with Three Rivers Canadian iron. Several trials proved that it was an iron of undoubted merit, which if the ore and wood supplies of the district warranted, could and should be made in large quantities, not alone to the advantage of the parties operating the furnace, but to the advantage of every consumer of iron in Canada who required castings of special quality, and certainly to the great gain of the Province and Dominion. We found the iron soft, tough, clean, close in texture and with fine chilling qualities—the higher grades admirably adapted for the manufacture of chilled car wheels, the medium grades for castings requiring great strength, and the

lower grades soft enough for the finest stove work. To give some idea of the strength shown in these tests we give the following result of the experiments made by us:—

The basis of strength on first class standard car wheel mixtures is expressed by a strength of 50,000 pounds per square inch transverse strength, obtained from a bar 1" x 12" the bar being supported on the extreme ends. By the introduction of 33% of Three Rivers' iron into our car wheel mixtures we were able to secure a strength of 65,000 pounds without difficulty. It was impossible, however, to procure any considerable or regular supply of the iron, the capacity of the old Radnor furnace being very limited and its operation irregular.

We did not at that time think it possible to develop the manufacture of any great quantity of this special kind of iron, but we did prove to our satisfaction that with proper arrangements a considerable quantity, say 3,000 to 5,000 tons, could be made annually with every prospect of the maintenance of this product for many years. Later work has developed the fact that this particular iron can be made in very much larger quantities, probably sufficient for any demand that may be made. The reason for this will be stated later on.

The results obtained from the tests referred to led us to make a thorough investigation with the view of determining the extent of the ore deposits in the Three Rivers' district and vicinity, and to find just what dependance could be placed upon the supply of wood for charcoal making. Our investigations were satisfactory and in August, 1889, we purchased the entire plant and lands of the company, including the village of Fermont or Radnor Forges, situated on the Piles Branch of the C. P. Railway, a village of some sixty houses, with a population of 350 to 400 people. Also a large property at the town of Grandes Piles, with lands on both sides of the St. Maurice River, giving us control of the great water power of the Grandes Piles Falls. The River St. Maurice is navigable for 70 miles above Grandes Piles, and drains, with its branches, a country some 200,000 square miles in extent. This country is

covered with the finest timber for charcoal making and with invaluable beds of bog and natural ores. The purchase also included the Three Rivers' property, situated on the St. Lawrence River, with railroad and dockage facilities for future use. There was also purchased and leased a large amount of other property for use in obtaining ores and other supplies needed for the manufacture of pig iron. Further investigations were at once commenced in all directions looking to the supply of ore to be depended on and about one year was spent in prosecuting this work, making leases and purchases to secure the company in its further development. During this period the old furnace was operated with such improvements as could be made upon it, for the purpose of ascertaining further by our own practice the possibilities of the metal. In the meantime arrangements for the supply of ore, wood, etc., had progressed to the point where the erection of a new furnace of large capacity and improved construction could be undertaken. In the early stages of the work it was contemplated to erect a furnace of twenty to twenty-five tons capacity at Radnor Forges for the manufacture of this special iron, but the possible supply of raw materials proved to be so much larger than anticipated that a larger furnace was decided upon and plans were made for one of fifty tons daily capacity. A furnace giving this product is quite a small affair compared with the great furnaces running on common ores throughout the world, but it must be remembered that the product is of a special class and the development of this particular work was of necessity conducted on moderate lines. As it is, a charcoal furnace running exclusively on bog ores, turning out fifty tons of metal per day, is a thing not to be found elsewhere in the world, if my information on these matters is correct. As the operation of such a furnace on the particular kind of ores referred to is a novelty in this day, some facts on the bog ore supply, its distribution and characteristics, and of the metal made from them, will be of interest.

The manufacture of iron from bog ores has been carried on for many years in Sweden, and the bar iron and steel made from it needs no comment or praise. Swedish bar iron is known the world

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over, and Swedish pig is the base of nearly all the famous steels made in England and other countries. Of late years there has been a falling off in the quality of Swedish pig iron and English makers have in vain offered higher prices for the quality furnished them in the past. Reliable authorities ascribe this deterioration to the gradual increase in the output of Swedish furnaces and to the introduction of common ores to that end. Whether it is possible to found in Canada an industry that will produce an iron equal to the old Swedish or not, is the question, and to this end a consideration of the supply of bog ores is most pertinent.

Bog ores are found in nearly all countries to a greater or less extent, but they do not often exist in quantities sufficient to make their working practical. As stated, Swedish iron has been largely made from them for many years, and no doubt the supply of the ores is growing limited in that country. The quantity of bog ores that exists in Quebec is difficult to even estimate in definite figures, but the investigations that have been made, and the very thorough ones that we have made, prove its existence in immense quantities. All the bog ore used up to our working was taken from the country immediately surrounding the furnaces, not exceeding a range of three or four miles from the centre. We find it entirely practical to take ore over a range of 75 to 100 miles by establishing depots for the accumulation of stocks from which shipments can be made by rail in large quantities. In treating of the source, growth and quantity of bog ore in Quebec it may be stated that the district to which allusion will be made may roughly be said to extend from north east of Quebec city to west of Ottawa, a distance of, say, 400 miles long by 40 to 60 miles deep. Bog ore is found throughout a much wider range however. The northern limit of this district is the Laurentide Range of Mountains and throughout the whole of this range iron ore seems to exist, generally mixed with the rock. The general formation is such that it favours strongly the natural forces, weather, etc., in the disintegration, and its reduction by attrition. The latter produces principally the fine iron sand found not

only along all the river beds, but in fact throughout the entire formation, sand or clay, of this and adjacent counties, and to this attrition, without doubt, the immense iron sand deposits of Moistic and the lower St. Lawrence are due. Owing to the presence of titanium—which exists more or less in all Laurentian ore—this sand seems to possess the peculiar properties of resisting disintegration by natural decay, to which many other ores seem liable.

Beds of hard bog ore are invariably found on hill sides above which swamps or marshes exist, or in runs which lead to or from these swamps. Wherever this dark swamp water flows sluggishly, and especially where swamp moss, fine grass or decayed vegetable matter exists, it will gradually form a light film with every appearance of that caused by oil, which gradually becomes thicker and sinks to the bottom in some quiet spot, where it takes a yellowish and slightly rusty tinge. This gradually becomes thicker and when the water becomes lower in the dry summer, it becomes denser and either sinks lower to the firmer beds below the grass, or hardens and becomes bog ore. One very large deposit of soft ore entirely filled a deep ravine leading from an immense swamp. This ravine was being drained with a view of removing the ore for the purpose of making metallic paint. To all appearance it was simply a dark muck, yet contained on analysis over 45 per cent. of oxide of iron. As the top became dry it caked and broke, the top crust showing as clean, black and brilliant a fracture as the best hard bog ore. This proved that the immense beds of soft ore—known as paint ore—known to exist throughout our swamps, will, when drained from natural or artificial causes, become more perfect, dry up and take the form of hard bog ore beds. Some beds of ore when the top layer was removed exposed a heavy bed of soft ore beneath. This being uncovered and exposed to the action of the sun for a time became so hard that it required heavy work with a pick to remove it. In the particular section alluded to many of the beds are soft on top and harder beneath, while others are the reverse. This would plainly indicate that in midsummer the water in the small swamps become

so low that the ore deposited in the run-ways and during high water when the swamps overflow, had time to harden. In some, apparently, the water when again high, overflowed the old hard ore and deposited more ore on top, while in others it found an exit by oozing out beneath and leaving an additional deposit below.

The ground on which bog ore will, or has been formed, applies to all marshes or hill sides between the mountain ranges and the river bottoms into which the water finally finds its way. Much land on which ore is found is to-day comparatively dry, owing to drainage from natural or artificial causes, but a glance at the surrounding country will show that the ground was once the natural drain-way from higher lands. On such places as these the ore is, as a rule, massive and hard.

Once the foundation of a bed of ore is formed it seems to grow more rapidly, partly on account of its affinity or power to draw the iron which is suspended in the water, as the following facts will demonstrate: The Riviere au Lard, from which we obtain our water power, as well as water supply for the furnace and boiler, etc., takes its rise in "Grand Ple" or swamp, in the midst of which lies Lac-a-la-Tortue. This water at all times is dark and rusty in appearance, and a piece of iron suspended or allowed to lie in its bottom rapidly becomes heavily beaded to the depth of an eighth to a quarter of an inch with a pure deposit of iron ore, and this without corroding the iron. Besides, ore in this shape will accumulate in all our supply pipes in the same manner, no matter how rapid the flow may be. This at one time was a source of considerable anxiety, but latterly, as the pipes remained longer in use these deposits appear to attain a certain size and lose their power of adhesion. A blow from the hammer will liberate the heavier and clean the pipe fairly well.

Bog ore, as a rule, is found twelve to eighteen inches below the surface. This season, however, we are getting ore at a depth of four feet six inches, and the beds are heavy, thick and good, apparently of old formation. Ore has been raised from a depth of eight feet in the "Grand Ple," and

although this immense swamp is covered with a soft, floating top, pockets of small-sized ore have been found in paying quantities on the surface. These facts, taken in connection with the deposits of so-called paint ore in this swamp, lead us to anticipate the discovery of large bodies of ore in the bottom, explorations for which we intend to push during the coming season. Excavations to a depth of ten, twelve and fifteen feet, in the immediate vicinity of Radnor, show as strong indications of ore at the bottom as at the top.

LAC-A-LA-TORTUE.

This lies in the midst of an immense swamp, "Grand Ple," and to all appearance it is the last remnant of what, at one time, was a lake which included the entire surrounding swamp, but one that probably was never very deep, hence its gradual filling in from natural causes. Besides three small creeks flowing into the lake—very sluggishly—the water oozes in around the shores, which are very low. Soft ore is found throughout the surrounding swamp, and in small patches, on the top of what is apparently a floating beaver meadow, hard ore is found. The entire bottom of the lake is more or less covered with ore, but the richest deposits are immediately opposite, or around the mouths of the various creeks. In some places the ore is too heavy for our dredge, and an attack on it generally results in broken chains and buckets. The only portion of the lake thoroughly worked in the past is Sturgeon Bay; the principal creek enters this bay. Its extent at the widest part is not over 2,000 yards and length about the same. For thirty years this bay has been worked by hand and dredge, and time and again declared to be worked out, and yet this season our dredge hardly stirred from it, and made more than double the ore ever taken from it in one season before. This will give some idea of the extreme richness and rapidity with which the ore is formed. It is hardly possible to estimate the quantity of the ore in existence in this lake, as without doubt it is growing steadily. An experiment was made one year ago (1891) in Sturgeon Bay. The dredge frame was allowed to work down into

ore have deposits of ore in the to a depth ations of the mud for six feet, at which depth it brought up a fine dark ore, not quite so hard as the surface, and instead of flat cakes, like the latter, it was small and round, similar to gravel in size, but softer, yet as fine an ore in every way. In other parts of the lake heavy massive veins exist several feet thick, and this is the portion which our dredge finds it difficult to work. If necessary, dynamite will have to be used on this. Explorations for ore on the lake shore, where nothing but sand showed on the surface, found heavy cakes over twelve inches below, showing that the old deposits may gradually become covered up.

When we commenced operations we found that, according to popular opinion, even among our best ore makers, and those most conversant with the business generally, there was not sufficient bog ore left in the country to give a constant supply to a ten ton furnace. Investigations developed the facts that although furnaces have been working at Batiscan, St. Maurice and L'Islet, etc., since 1737, they had drawn almost their entire supply of ore from the immediate vicinity. In no case did they entirely exhaust the supply, except perhaps within a radius of three or four miles around the furnaces. Then again these furnaces have not been worked steadily, hence steady employment—which alone would produce good explorers—could not be given, and, as a matter of fact, when we commenced operations we did not find a single employee or man who could give us good and reliable information regarding ore fields generally, their knowledge being only of local beds and very superficial.

With regard to the wood supply, there is not a location on the American Continent that offers greater inducements for the establishment of a large charcoal iron industry than does the district of Three Rivers. It is not too much to say that the supply of wood suitable for charcoal making, to be had from the banks of the River St. Maurice, and the great territory to the north of that river, is sufficient to keep a number of charcoal iron furnaces in fuel for the next century to come. The St. Maurice is one of the largest tributaries of the St. Lawrence. It takes its rise on the borders of the

north-west territories, about 250 miles north-west of the city of Three Rivers, and from thence flows through the Province of Quebec to the outlet at Three Rivers. The tributaries of the St. Maurice are : Shawinigan, Matawan, Rat, Vermillion, Flammond, Ribbon, and Manoran from the west, and Mekinak, Petite and Grand Bostonnais, Croche, Grande Pierriche, Tranche and Wyndigo from the east, these rivers culminating in the St. Maurice, the whole draining a territory of upwards of 200,000 square miles. Throughout its entire course the banks of the St. Maurice river are quite thickly wooded with just the class of wood necessary for the manufacture of the highest class of charcoal, viz., hard maples, beach, birch, iron wood and oak. This wood has been left practically untouched by the lumbermen, who have been working on the river for years past, taking out pine and spruce. The vast territory stretching to the north of the St. Maurice River offers a wide field for the future supplying of wood, and the same applies to the country which the Lower Laurentian railway traverses. Other new railway lines are projected from Three Rivers north, which will open up a new district rich in timber. Altogether the fuel supply is beyond question.

Apart from the bog and lake ore deposits, vast mines of Titanic iron are known to exist in the Laurentian range of mountains, and elsewhere in the Province of Quebec. At the present time these ores cannot be utilized profitably, but science will sooner or later find a means of using these titaniferous ores, not alone with economy, but also I believe with great benefit to the metal into which they enter. The able article of Mr. Auguste J. Rossi, of New York City, read at this meeting, deals exhaustively with the possibilities for the use of these ores, and the data secured by his investigations should prove of the greatest interest to metallurgists.

BOG IRON ORES AND OCHRES OF THE REGION ABOUT THREE RIVERS, QUE.

By A. P. LOWE, B. Ap. Sc. Geological Survey of Canada.

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In 1667 bog iron ore was first found in the neighborhood of Three Rivers, and the right to work the deposits was granted in 1676. Little or no work was done towards mining or smelting them until 1733, when a company was formed and forges erected on the west side of the St. Maurice, some eight miles above Three Rivers. In 1743 the forges passed to the Royal domain, and were carried on for several years in the name of the King. Besides other extensive repairs, a walloon hearth was built, and over one hundred and eighty men were employed. At the cession of Canada in 1760, they passed, with other Crown property, to the English Government, and were worked, under the military authorities, for five years, and then transferred to the civil government of Three Rivers. In 1767 they were leased for a term of sixteen years, at an annual rental of £25.

At the expiration of this term in 1783 the forges and lands pertaining to them were again leased for another sixteen years for £18 15s. annually. The property subsequently passed through a number of hands, the rental rising to £850 per annum, until in 1845, owing to the dissatisfaction of settlers in the neighborhood, the forges were separated from the lands and sold at public auction, the forges bringing £5,575, while the fiefs St. Etienne and St. Maurice were sold for £4,500 subsequently.

In 1861, owing to various reasons, the Government bought in the lands and resold them to the numerous squatters already settled on them. The forges in 1863 became the property of John MacDougall & Sons, and were successfully and profitably worked by them until 1883, when

operations ceased, as other furnaces had been erected at Radnor, where ore and fuel could more easily be obtained. The ruins of an old forge may be seen on the east side of the Batiscan River, at the head of navigation, near St. Genievre. This forge has not been in operation since the beginning of the present century.

In the region about Three Rivers, where the bog iron ores and ochres under consideration are found, the valley of the St. Lawrence River is from twenty to sixty miles broad, extending from the Laurentian hills on the north to the highlands of the eastern townships on the south. From the level of the river on both sides the country rises in a succession of steps and flat terraces, cut out of stratified clays and sands, that here fill up and cover all irregularities of the underlying rocks, to a height of 600 feet above the present level of the river. The otherwise almost level plain is broken by narrow valleys cut by the rivers and small streams of the region. The clays almost underlie the sands, which vary in thickness from a few inches to 100 feet and over. These sands, generally of a distinct yellow color, are charged with a considerable percentage of iron, and from them are derived the numerous deposits of bog iron and ochre that are here found.

The gneisses and basic granites of the archean area to the north of Three Rivers, contain a considerable amount of iron in the form of magnetite or more commonly ilmenite or titaniferous iron ore. It occurs generally in small grains, intimately associated with the other minerals of the rocks, and its presence is so constant as to appear to be a constituent rather than an accessory mineral of the rock. Often the ilmenite occurs in large segregated masses, which are sometimes so abundant as to form the greater part of the rock mass.

Previous to the glacial period the surfaces of these rocks, exposed to the action of the weather, must have been more or less decomposed. During the time of the glacier the ice moved down from the highlands to the northward, and covered all the country far to the south of the St. Lawrence. In

its flow southward the ice not only removed from the archean hills any decomposed material that may have covered them, but rounded, grooved and polished the rocks beneath, by the abrading action of the material carried by the ice and pressure of its mass. The material removed by the glacier was often reduced to a fine state, the quartz to sand, and the feldspars to clay. As a rule this material was not transported far by the ice, being deposited in any place sheltered from the direct action of the moving ice, as in valleys, or behind rocky hills, where the force of the glacier was broken. At or towards the close of the glacial period the level of the country was about 600 feet lower than at present, and the wide valley of the St. Lawrence was occupied by a deep arm of the sea. Into this was poured the waters of the St. Maurice and other rivers, now falling into the St. Lawrence.

Coming from the retreating foot of the glacier these rivers must have been greatly swollen by the water from the melting ice, and with their great volume and strong currents removed much of the finer drift material left by the glacier in the valleys drained by them, and deposited it again in the quiet waters of this arm of the sea. The clay being most easily held in suspension, was carried far out, and was deposited over the entire bottom of the valley, the sands being less finely divided were thrown down along the margin of the old sea bottom.

As the land rose to its present height it remained at the level of each terrace long enough to allow the waves to cut deep faces into the one above, and the sand thus cut down was carried farther out by currents, until finally they nearly everywhere covered the lower clays. The grains of magnetite and ilmenite in the glacial debris were carried along and deposited with the sand. It is to the presence of these more or less decomposed grains that the prevailing yellow color of the sand is due.

The present surface of the greater part of this wide valley is sandy ; but, as before stated, the

sands are everywhere underlaid by beds of stiff blue clay, impervious to water. As a consequence, in many places where there is little or no slope, a slight uplift of the clay along the front of the wide terraces has rendered the drainage defective, and has formed vast swamps, while the lower portions of the overlying sands have become charged with water. These swamps support a rank growth of vegetable matter, their higher parts being covered with a thick forest, whose roots penetrate deep into the sandy soil.

Decay goes on quickly in these swamps during the summer, and as a result of this decomposition, quantities of organic acids are formed, which remain in solution in the waters of the swamps. These waters coming in contact with the finely divided iron mixed with the sand, the acids reduce the peroxyd to a soluble protoxyd, and it is brought to the surface either as a carbonate of protoxyd, or, when organic matter is abundant, as a combination of protoxyd of iron, with some of those organic matters which have received the names of crenic, geic, and humic acids. These protosalts of iron absorbing oxygen from the air, the metal is rendered insoluble, and is precipitated from the solution of the carbonate as a hydrated sesquioxyd, or, from the organic solution, as a compound of this oxyd with the vegetable acid. The bog iron ores consist of variable mixtures of hydrous sesquioxyd of iron with the organic compound, while the ochres are probably the organic compound in a nearly pure state.

The bog iron ores occur in patches near the surface of the sandy soil. These patches are from a few square feet to several acres in extent, and from three to thirty inches in thickness. They are always found in or near the borders of the swamps.

These deposits seem to be formed by the ferruginous solution from the swamps, percolating through the adjacent sands, where, coming in contact with the air on the porous soil, the iron is precipitated in the form of concretions about particles of sand. These concretions, covered by

successive layers of iron, continue to grow as long as the supply of ferruginous water is kept up. In size they vary from that of small shot to masses several inches in diameter, and when large they have the form of irregular rounded discs, that often show concentric rings of growth.

The region about Three Rivers was carefully examined by Sir William Logan in 1852, and a number of the following localities are mentioned by him in the Geological Survey Report 1852-53.

Many of these deposits have since been worked, and now only afford moderate quantities of fine grained newly formed ore. On the west side of the St. Maurice River, in the augmentation of the township of Caxton, there is a deposit covering about one hundred acres, this locality was worked for a number of years to supply the old St. Maurice forges and is now nearly exhausted. Northeast of this locality, about four miles, there is a considerable swamp in the fourth range of the fief of St. Etienne, it has an area of about 1,200 acres. Ore is found at uncertain intervals of space along the northwestern border of the swamp, and it probably occurs in patches over the greater part of it.

About two miles and a half southeast from this locality, in the second range of St. Etienne, bog ore is met with in patches over a surface from thirty to forty acres. The thickness of the mineral patches in this ground appears to range from six to nine inches. Further south, in the seigniory of Pointe-du-Lac, there are several localities from which large quantities of ore were once taken but they are now nearly exhausted.

To the east of the St. Maurice River, and between it and the Batiscan River, are several localities abounding in this mineral. Near the banks of the St. Maurice, about a mile and a half below Pointe-a-la-Hache, there are indications of ore.

To the northeast of this, at a distance of six miles, is a triangular area lying in the St. Felix and Ste. Marguerite ranges, partly in the seigniory of Cap-de-la-Madeline and partly in that of Champlain. Its superficies extends over about six square miles, it has a uniform level about two hundred feet

above that of the St. Lawrence. Throughout this neighborhood areas from one-sixteenth to three-quarters of an acre are more or less occupied with patches of ore, from two to four and occasionally six parys across, and from six to ten inches thick.

In the seigniory of Champlain a considerable field of the ore exists on the south side of the Champlain River. It has a breadth of twelve to eighteen acres and its superficies is about 1,100 square acres. There is another band northwest of it, and separated from it about ten acres, this band has an area of about seventy-five square acres.

The ore, as in other instances, is found in these bands in numerous patches, the thickness of which varies from three inches to a foot. From that part of the band which lies in the vicinity of the river A. 1-Lime the old forges on the Batiscan River were supplied with ore. On the eastern side of the Batiscan River, bog ore is found on the River Veilette, upwards of a mile and a half from the bend in the Batiscan, below the old forges. It occurs in several patches, one of which extends over a third of an acre, with a thickness of from three to six inches and sometimes a foot. A mile and a half beyond, on the road to St. Prosper, it is found not far from the boundary between the seigniories of Batiscan and St. Anne-de-la-Perade, here the patches are small and the thickness does not exceed three or four inches.

In the seigniory of St. Anne-de-la-Perade indications of ore are met with on the southwest side of the road which turns up from the St. Anne River and runs parallel with the Charest, but the patches do not seem to be numerous, the thickness is from three to four inches.

Lac-a-la-Tortue is situated in the southern part of Radnor, about one mile beyond the north line of the seigniory of Champlain and two miles from the St. Maurice River. The lake is about three miles long from northeast to southwest and has an average breadth of about one mile. It occupies the lowest depression of a great swamp called Grand Ple, that extends north and south from the lake. At

its centre the water is under twenty feet deep, and shoals gradually to the shore. By removing an obstruction at the discharge the water has been lowered some six or eight feet, and a wide margin of its bed has been exposed on all sides.

The lake is fed by a number of small streams flowing from the surrounding swamp, these are highly charged with salts of iron, giving the water of the lake a very ferruginous taste and coloring it a rusty yellow. The ore is found in the form of concretions scattered through the soft greenish mud, for several feet below the surface of the bottom. It appears to be formed by the precipitation of the protosalts in solution, which take up oxygen from the surface and becoming insoluble, sink to the bottom, where they collect about various particles of foreign matter and form flat porous concretions of various sizes, the largest being often six or eight inches in diameter, by over an inch in thickness, and show distinct rings of growth.

The growth of the ore in the lake bottom is quite rapid, it having been found that paying quantities of ore can be obtained from areas completely exhausted some eight or ten years ago.

Work is carried on by hand in the shallow portions along shore, and in the areas left bare by the lowering of the level of the water. The operation consists in shovelling the mud containing the ore into iron sieves of about thirty inches in diameter, where the ore is washed free from mud and then made into convenient heaps for removal. In the deeper parts of the lake the ore is raised by a dredge with three rows of iron buckets on an endless chain. This dredge is capable of working to a depth of twelve feet, and brings up the ore mixed with soft mud; this is dumped into a long cylindrical sieve, placed on an incline so as to discharge on to scows moored alongside.

Along the axis of the sieve are arranged a number of jets of water, which as the sieve rotates, wash away the mud and allow the clean ore to fall out at the lower end on to the scows. The loaded

scows are towed to the west end of the lake where the Pilles Branch Railway passes close to the water, and from there loaded cars are run direct to the furnace at Radnor.

During the past season large deposits of massive ore were discovered in the bottom of the lake which are claimed to be two feet and upwards in thickness, and although work has been carried on here for more than thirty years, the supply of ore last season was much greater than in any former one. The ore was formerly supposed to lie in the mud within a foot or so of the bottom, but this year paying quantities were found in the underlying sands to a depth of six feet, the limit to which the dredge would work. From this it will be seen that the supply of ore in Lac a-la-Tortue is far from exhausted.

On the south side of the St. Lawrence—opposite Three Rivers, in the second, third and fourth ranges of Gentilly, the Canada Iron Furnace Company have discovered and are working a number of remarkably rich beds of ore. These are generally found along the faces of the terraces. The largest bed is about ten acres long by half an acre wide. Work here has been carried on to the depth of four feet without reaching the bottom of the bed, which will reach five or six feet in places. The ore on top is fine, but towards the bottom it becomes heavy and massive and has to be broken out by picks.

Medium sized patches of ore have been found extending over an area of six square miles in this locality and no doubt many others will be found in the neighborhood.

Work has also been carried on by this company in the fourth range of Kildare, County of Joliette, where one patch is three acres long by half an acre wide, with an average thickness of twelve inches, all of fine rich ore. There is a band here that is said to have been traced for a distance of seven miles.

It will thus be seen that although iron has been mined and smelted in the vicinity of Three Rivers

for a period of one hundred and seventy years, there yet remains considerable quantities of ore in the deposits first worked and that new beds of great extent continue to be found containing sufficient ore to supply the larger and newer furnaces for probably as long a time to come.

OCHRE.

The ochres are found along the courses of small streams flowing from swamps, or in the old beds of small shallow lakes. Near the surface the ochre is generally yellowish-brown, becoming reddish in the parts most exposed to air and light. At a short distance below the surface, however, the color is greenish, and when recently exposed is greenish-white, indicating a compound of protoxyd of iron, which grows yellowish from peroxydation as the mass dries.

The water that oozes from the ochre is at first colorless, transparent and ferruginous in taste, but, by exposure to the air, soon lets fall a reddish-brown precipitate of ochre and becomes tasteless. As the precipitate is buried by subsequent accumulations of the ochre, it is again reduced to a protoxyd, either by the reaction of the organic matter which it contains, or by that derived from the decaying roots and trees which are generally abundant in the deposits, and it thus assumes the greenish color already noted.

In some of the deposits there are layers of a brownish-black color, due probably to the presence of manganese; and in some places the whole deposit is made up of this dark colored ochre.

Indications of ochre are seen along with most of the deposits of bog ore, but it also occurs without the presence of the latter, and often in great masses.

The principal deposits in the region under consideration occur on both sides of the St. Maurice River.

A very large ochre bed is situated on the St. Nicholas range of Pointe du Lac. It is crossed by the range road, running north-westward over a mile from the point where this road starts from the

river side road. The deposit extends on each side of the road about a quarter of a mile to the south-west and a mile to the north-east, the breadth is irregular, and varies from fifty to eight hundred yards, and the whole area may be about four hundred acres. The thickness of the deposit ranges from six inches to four feet, and may have an average of about eighteen inches. The prevailing colors of the ochre are red and yellow, with bands of a purple tinge, and others of a blackish-brown. Farther to the northwest, on the road of the same range, patches of ochre occur in considerable abundance for upwards of a mile; but are not so pure or thick as the great one just described.

About a mile and a half below the old St. Maurice forges, but on the opposite side of the river, a patch of ochre is found associated with the bog ore there. It has an area of about 200 square yards, and is from three to six inches thick, and of exceptional quality.

On the north-west side of that part of the road through the St. Marguerite range, which runs south-west of the River-au-Lard, small patches of yellow and brown ochres are met with for a distance of six miles. They all contain more or less sand, and rarely exceed four inches in thickness.

In the St. Malo range of the seigniory of Cap de la Madeleine a great deposit of ochres occurs opposite to the end of the road which turns up from the margin of the St. Lawrence, about two miles below the Cap de la Madeleine Church. The locality is about half a mile from the front of the St. Malo range, and about a quarter of a mile north of the C. P. Railway. Its breadth on a line continued from the road is about six hundred yards, and it extends rather more to the north-east than to the south-west, with a total length of about two miles, and the area is thus upwards of six hundred acres.

Two openings on adjoining lots are worked by the St. Maurice Paint Company and the Johnston Paint Company.

The former company have the mining right extending over twenty-one lots. At their present

opening the deposit is about five hundred feet wide, and varies from one to twenty feet in thickness, with beds of peat interstratified with the ochre. Small patches of bog ore rest on top and the ochre is of a dark yellow, for from three inches to two feet below the surface ; beneath this the color is a light green, and many stems and roots are present. In places the bands are of a purplish black color, due probably to the presence of maganese.

At the openings of the Johnston Paint Company there is about eighteen inches of peaty matter covering the ore, which is of a light green color, and is worked to a depth of six feet. At both places the ore is burnt on the spot, and thirteen shades of red and brown are produced.

On lot fourteen, in the second range of Radnor, and about half a mile west of St. Tite Junction, large deposits of ochre are worked by the Radnor Paint Company. The ochre is found in two gulleys, which join and descend to the St. Maurice.

The deposit has been proved for a distance of half a mile, and is from 50 to 150 yards wide, and in places fifteen feet thick. The prevailing colors are brownish or purplish black, due probably to manganese.



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THE COMPOSITION OF THE BOG AND LAKE ORES USED AT RADNOR FORGES,
AND OF THE IRON PRODUCED THEREFROM.

By J. T. DONALD, M. A.,

Professor of Chemistry, Medical Faculty of Bishop's College, Montreal ; Consulting Chemist to the
Canada Iron Furnace Co., Ltd., &c., &c.

The principal ores used at Radnor are the Bog and Lake ores of the district, ores which are smelted with great ease on account of their porous nature and their associated organic matter.

The source of these ores, in a general way, may be said to be the area drained by the St. Maurice and its tributaries. It is well known that water containing organic acids (formed from decaying vegetable matter) takes up in solution more or less of the iron of the rocks over which it flows. When such ferruginous water reaches low swampy regions the iron is gradually deposited as hydrated peroxide. Deposits of bog ores are the sites of former low-lying areas which served as precipitating basins for the iron collected from the adjoining highlands and carried down by the streams. The same process of solution and precipitation is going on to-day and must continue as long as there is iron in the rocks traversed by water containing vegetable acids.

As pointed out by the writers of other papers, bearing on this subject, these ores have been known and worked for many years and occur in deposits of various size extending over a wide area of country. As a consequence of these two circumstances, many analyses have been published, and these show that the ores have a wide range in composition and this is well shown in the quantities of phosphorus and manganese occurring in different bodies of the ore. Dr. Harrington, of McGill College, some time ago informed the writer that in certain of these ores he had found not more than a faint trace of phosphorus. On the other hand I have, in one sample, an extreme case, found as much

as nine-tenths of one per cent. of this element. It is much the same in the case of manganese. In the Report of the Geological Survey for the year 1863, there is given the analysis of a certain ore "exploited for the St. Maurice Forges," and in it this element is found in traces only. In some samples recently analysed I have found no less than 22.82 % of manganese. There is nothing very remarkable in this variation in composition. The same is seen elsewhere, for instance, in Nova Scotia, the great iron area of Eastern Canada. A judicious selection is all that is required in order to obtain from the deposits of the Three Rivers' district ore that will yield iron of excellent quality. Column I. in the subjoined table is my analysis of a sample representing a large quantity of bog ore selected from various points for the Radnor furnace in December, 1890.

A portion of the ore used at Radnor is known as "Lake Ore." This ore is found on the bottom of Lac-à-la-Tortue, and until the recent discovery of similar deposits in Lac au Sables was the only known extensive deposit in this province, if not in the Dominion. Such lake ores are quite common in Norway, Sweden and Finland. The Lac-à-la-Tortue ore is very similar to the the neighboring bog ores and yet differs from them in certain respects. The former shows concretionary structure to a much greater extent, and curiously enough, analysis shows that in many cases the lake ores contain less water than the bog ores.

Column II. in the table is my analysis made in December, 1890, of a sample representing a large quantity of Lac-à-la-Tortue ore. Column III. is the analysis of an ore from the same lake made by Prof. Carlyle, of McGill College.* Column IV. is an analysis of a lake ore from Flaten Wermland, Sweden, by Svanberg, as cited in Phillips' Metallurgy.

* Canadian Record of Science, Vol. III., No. 1, p. 43.

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COMPOSITION OF IRON ORE.

	I.	II.	III.	IV.
Ferric oxide	60.74	70.04	69.64	67.59
Ferrous oxide.....	0.72
Manganic oxide.....	1.18	1.78	2.99	1.45
Alumina.....	2.59	2.20	2.43	4.18
Lime.....	3.47	0.3247
Magnesia.....	0.93	0.27	0.60	.23
Phosphoric anhydride.....	0.69	0.76	0.47	.18
Sulphuric anhydride.....	0.19	0.23	0.09	...
Silica.....	13.94	7.84	8.17	7.81
Loss on ignition	16.49	16.84	15.00	17.81
	100.22	100.28	100.11	99.72
Metallic iron.....	42.52	49.03	49.31	47.32
Phosphorus.....	0.302	0.331	0.205	.081
Sulphur.....	0.078	0.093	0.036

The paper which Mr. Griffin has read has dealt largely with the iron produced at Radnor. It will suffice for me to cite the following analysis of Radnor iron to show the nature of the metal in so far as the influence of the ore is concerned. The sample analyzed was of grade No. 1½, and the analysis was made by me in May, 1892.

ANALYSIS OF RADNOR IRON NO. 1½.

Iron.....	93.52
Carbon.....	.701
Graphite.....	3.256
Silicon.....	1.269
Sulphur.....	.0406
Phosphorus.....	.6532
Manganese.....	.557

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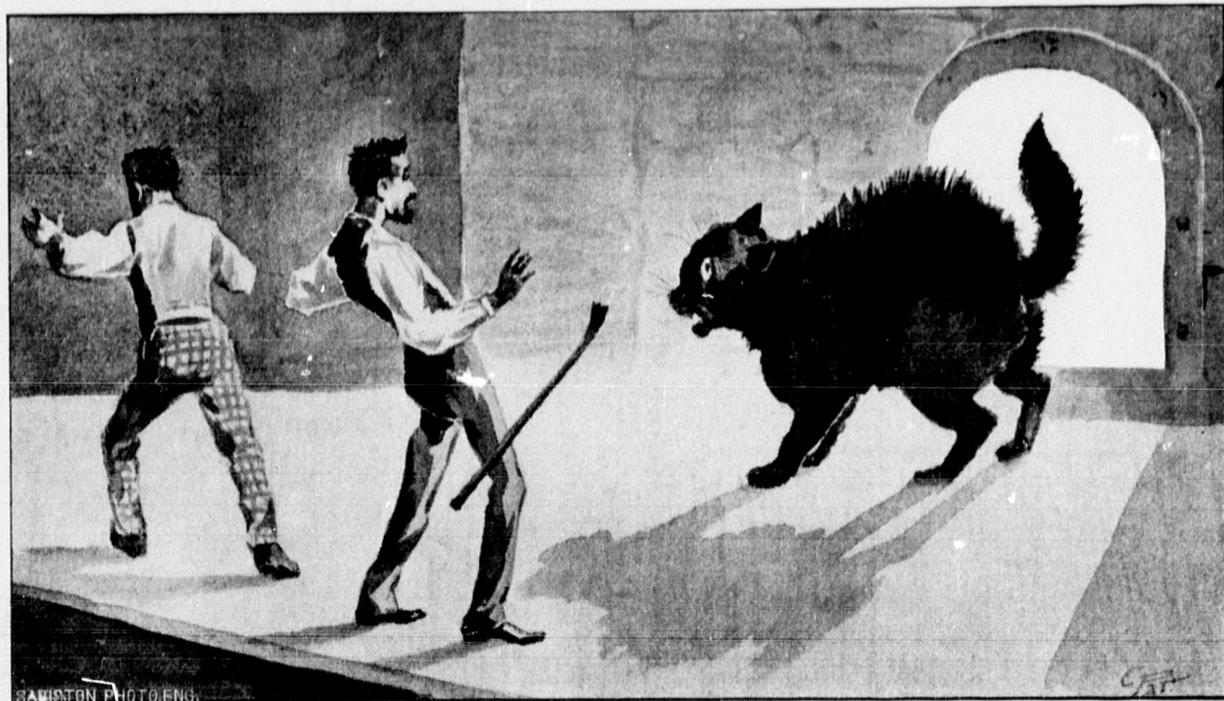
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Translated from the French of M. L'Abbé Caron, of Three Rivers, by C. A. DUCLOS, B.A., B.C.L.

Several interesting legends cluster about the Old Forge at St. Maurice. The origin of most of which are found in a dispute which arose between Mr. Bell, the proprietor of the Forge, and Miss Poulin, of Three Rivers. Miss Poulin was the owner of land covered with fine maples, and Mr. Bell continued to cut these maples for charcoal. She naturally resisted this invasion and several lawsuits between the parties were the consequence, in which Miss Poulin appears to have been usually worsted. She was not among the most devout, and being finally exasperated beyond endurance declared that since she could not enjoy her own property she would give the whole of it to the devil. And on her death-bed refused to make a will, still declaring that she instituted his satanic majesty her universal legatee, adding, that she hoped that the thieves who robbed her during her lifetime, would not enjoy their stolen property in peace.

The devil seems to have taken this donation seriously, and from the moment of Miss Poulin's death, took possession as owner not only of her property but even of the Forge itself.



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Among the many legends which this supernatural possession gave rise to, the following may be cited as of special interest :—

Every day a mysterious stranger, whose features could not be distinguished, who neither spoke nor answered when spoken to, of doubtful color, was seen walking about the Forge with paper and pencil, apparently taking note of all that was going on. Leading to the Forge was a long road, called "La Vente-au-diable," as it is still called. This was precisely on the property bequeathed to the devil, and it was there that the most splendid manifestations of his presence took place. At night a large fire could be seen with a great number of persons around it, the noise of chains, howlings, cries of rage and noisy laughter filled the air, and the belated traveller trembled in his shoes as he heard horrible blasphemy and insults hurled at him.

In some instances the devil chose to appear less offensive and to take delight in amusing the peasants. On Sunday, on one of the coldest days of January, the people of the Forge returning from mass were astonished to perceive a man in his shirt-sleeves, bare-headed, quietly shaving himself in front of a little glass suspended from the bark of a tree. The scene was too funny for fear, but none of the good people doubted but that this was a frolic of their enemy.

Nearly all those who passed along this road experienced some mishap. Generally, the horses would suddenly stop, and nothing would induce them to start. It was terrible to be thus caught right in the devil's own quarters. There was, however, one infallible means to make the horses start ; the bridles were turned upside down and immediately the horses started at full gallop.

You would laugh, said Pere Louison, the narrator of these remarkable events, but the thing has been told to me hundreds of times. You see, said he, many strange things have happened upon this road. Why, even at the Forge itself, the devil seems to have taken complete possession. Here he took a new shape. Every evening, a big black cat used to come and lie at the door of the furnace, at

the place where no human being could exist one minute, so great was the heat, but there lay the cat, hour after hour, its paws resting upon the door. Nothing could induce it to move. Some workmen would attempt to strike it with an iron bar, immediately the cat's fur became ruffled, and the cat itself grew to extraordinary proportions, until fear drove the men away, and left our feline friend in undisturbed possession. When leaving, it generally entered the furnace and disappeared among the flames.

The worthy clergy of the parish were not slow to turn even these legends to advantage and for the better instruction of their parishioners, and to them may be probably due the following one :—

The carters were in the habit,—at least the majority of them,—of getting a load of charcoal on Sunday morning, on the pretense that it was necessary to keep the furnace going during the day. One Sunday, at sunrise, several carters were on their way to get their loads as usual, when at the top of the hill they met someone already returning with his load. This man was seated on the front of his wagon, but his hat was drawn so far over his eyes, that no one could see his face. The carters began to insult him. “ You must have got up early this morning? I believe you were up all night? Who are you anyway ? ” The dark carter did not answer, but when he had arrived at the brow of the hill, instead of turning to enter the village he kept straight on and disappeared over the precipice. The carters took this vision for a warning, and ever since they hurried more on Saturday and never were obliged to work on Sunday morning,—so that the devil even may preach a good sermon.

This last legend is more intimately connected with Miss Poulin : She was very rich and had large sums of money kept in a strong box. In order that no one might get it she had caused this box to be buried in the Piniere, and afterwards threw the keys in the brook. She died, as has been stated, bequeathing her property to the devil. Nevertheless, after her death, the man who had buried the chest thought he might as well share the inheritance. He sought for the chest, but behold, it was

gone, neither could the keys be found, although there is not at any time more than six inches of water in the brook of the Piniere.

Even to-day some still look for that chest by means of magic, with a divining rod they succeed in finding the place where it is hidden, but when they come to take it, the devil changes its position and the work has always to be begun again.

Now, dear reader, if some day you should travel along the sandy road towards Three Rivers, and that it should please your horse to stoop and drink in the brook of the Piniere, you will no doubt remember the lost keys and the hidden chest, but do not waste your time looking for them, they cannot be found.



SHAWENAGAN FALLS.

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To the traveller wearied with treading the old and well-beaten paths which so many have trod before him, there is something peculiarly attractive about the scenery of the Laurentides. Here everything is almost as it was when the first Jesuit missionary penetrated the wilds of the St. Maurice two hundred and fifty years ago, and nature yet reigns supreme. Here the stately moose still lingers, tho' in sadly diminished numbers, while the shy woodland Caribou is everywhere found in abundance. The Speckled Trout (*Salmo fontinalis*) swarms in nearly every lake and stream of that region and specimens weighing upwards of five pounds have not infrequently been caught by the skillful angler. No doubt the plentiful supply of fish and game still to be found in the Laurentides is largely due to the protection afforded by the different fish and game clubs which lease from the Provincial Government the sporting privileges of this vicinity. The most prominent organizations are the "Laurentian," which has for its president Mr. Frederick Stancliffe, of Montreal, and the "St. Maurice," which is presided over by Dr. W. H. Drummond, also of Montreal. The aggregate strength of these two clubs is three hundred and fifty members, but strange as it may seem, they are principally composed of American citizens, as for some occult reason—difficult to divine—Canadians have always been



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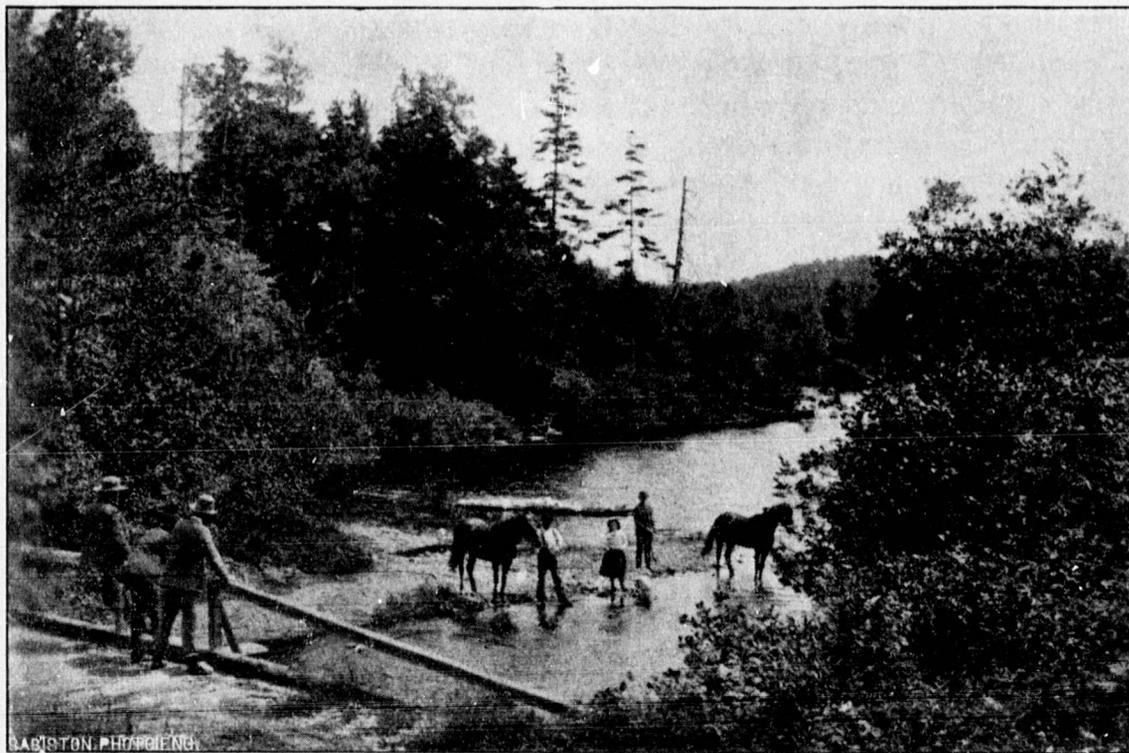
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lamentably blind to the beauties of their own fair heritage, and it is but fair to admit that but for these same Americans—mostly men of culture and refinement—neither of the above mentioned clubs would be in existence to-day.

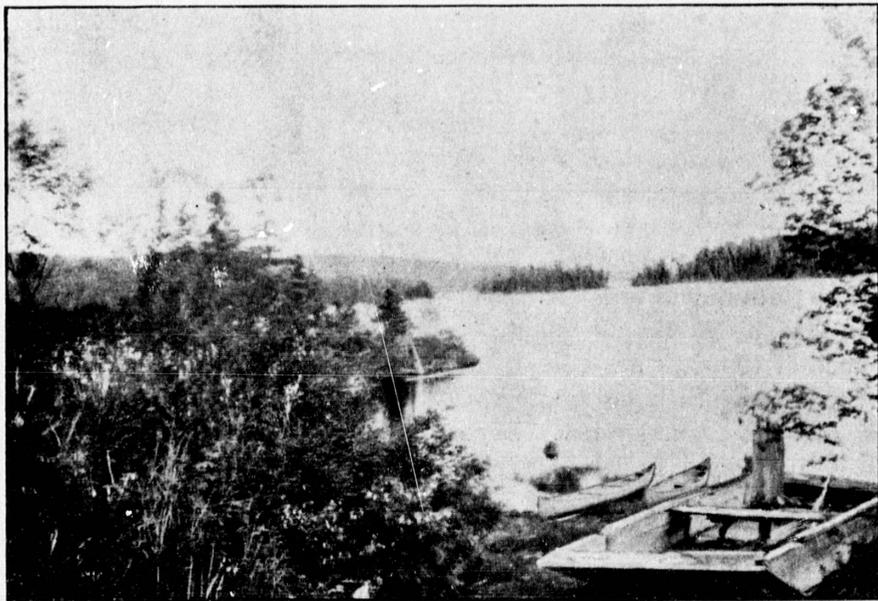
On the St. Maurice river, between Three Rivers and Grandes Piles, are the Shawenagan and Grand Mère Falls. The Shawenagan, seen at any season of the year, is "a sight, once witnessed, for ever remembered." From Three Rivers, or Radnor Forges, the visitor can drive over a good road to the falls and return the same day. Every approach to the cataract is through the forest primeval, and save for the modest but comfortable little stopping place, situated on a point just overlooking the falls, there is nothing whatever *modern* in the surroundings of what might properly be termed the Queen of Canadian Waterfalls. Niagara is awful, sublime, in its immensity. Shawenagan is all this; but Shawenagan has also beauties of its own, which even Niagara does not possess, and when one contrasts all the cheap tawdry and tinsel decorations so common in the vicinity of the fashionable Meccas of the present day with the natural unadorned loveliness of Shawenagan, one cannot help feeling thankful that it is as yet too far removed from the beaten track to attract to its shrine aught but the most devoted worshipper of nature.

The fall is separated into two distinct parts by a well-wooded island in the centre. The temporarily divided streams unite at the foot of the island, and the "meeting of the waters" is very different to that which takes place in the Vale of Avoca. Like restless thoroughbreds the currents champ and fret, until finally they run away altogether. Down the slope 160 feet, and at every conceivable angle, the resistless waters pour. Converted into a thousand different shapes the spray rises up in huge smoke-like masses until at last it gradually dissipates into thin air.

From both sides of the river, and from every vantage point, the scene is one of wild and unsurpassed beauty. Not infrequently a perfect rainbow arches the falls from shore to shore, and as the varying



ST. ELIE, HEADQUARTERS OF THE WINCHESTER CLUB.



LAKE WAYAGAMACK, ST. MAURICE CLUB.

gusts of wind and spray mingle together the kaleidiscopic character of the *Arc en Ciel* can better be imagined than described. Through the narrow and rocky gorge below the turbulent waters pour with arrowy speed until after a long series of twistings and turnings they resume the "even tenor of their way," and journey on to meet their sister stream at Three Rivers.

The Falls of the Grande Mére, some distance above Shawenegan, are only fifty feet in height, but are also well worthy of a visit. Higher up the St. Maurice, and at the beginning of the navigable portion of the river, is situated the village of Grandes Piles. To the writer Grandes Piles is strongly suggestive of pictures he has seen of Harper's Ferry, Virginia. Here we are at the very gateway of the Laurentians proper. Huge rocks rise up on every side and the only possible passage-way is by the river, which runs a serpentine course from La Tuque to Grandes Piles, a distance of seventy miles. It is not too much to say that the Upper St. Maurice holds very high rank as a picturesque and beautiful river, and no less an authority than Mr. Lucius O'Brien, president of the Royal Canadian Academy, gives as his opinion that the St. Maurice surpasses the Rhine in everything save "song and story."

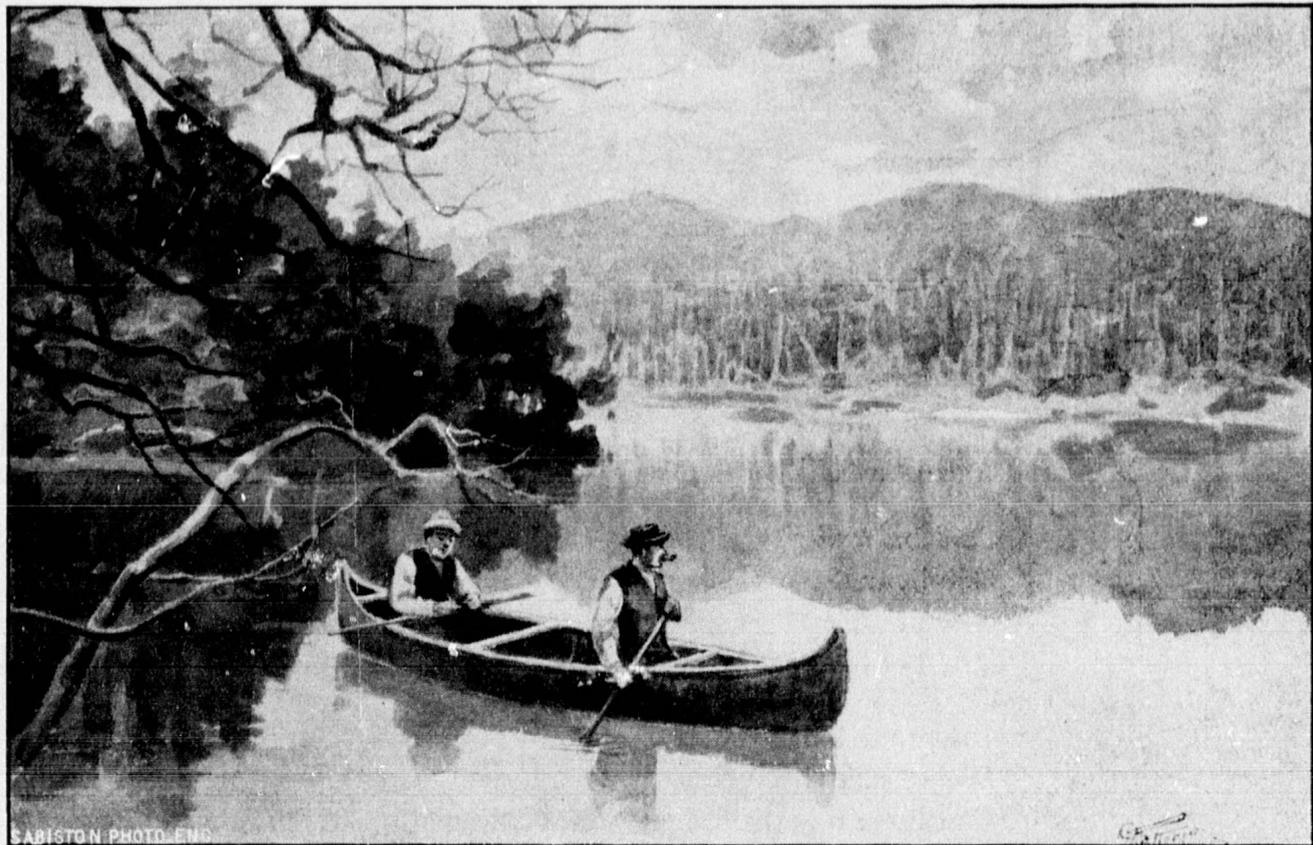
The country back of the river abounds in lakes of various dimensions, over one hundred of which are leased by the St. Maurice Fish and Game Club. The largest of these lakes being the Wayagamack which is fifty miles in circumference. Beyond the territory of the Wayagamack lies the country of the Tete Boule and Abenaki Indians, and here the Hudson Bay Company has had stations and trading posts for upwards of a century and a half. The Indians of this vicinity are a remarkably harmless and inoffensive people and depend almost entirely for subsistence upon the product of the chase. Living the simple lives of their forefathers and uncontaminated by the civilization of modern times, the Tete Boules and Abenakis have not decreased in numbers to any appreciable extent; they still remain in most respects "untutored children of the forest," and if they only respect the sanctity of the game laws, long may they increase and prosper."



O spirit of the mountain that speaks to us to-night,
Your voice is sad, yet still recalls past visions of delight,
When 'mid the grand old Laurentides, old when the earth was new,
With flying feet we followed the moose and Caribou.

And backward rush sweet memories, like fragments of a dream,
We hear the dip of paddle blades, the ripple of the stream,
The mad, mad rush of frightened wings from brake and covert start,
The breathing of the woodland, the throb of nature's heart.

Once more beneath our eager feet the forest carpet springs,
We march thro' gloomy valleys where the vesper sparrow sings.
The little minstrel heeds us not, nor stays his plaintive song,
As with our brave *coureurs de bois* we swiftly pass along.



Again o'er dark Wayagamack in bark canoe we glide,
And watch the shades of evening glance along the mountain side.
Anon we hear resounding the wizard loon's wild cry,
And mark the distant peak whereon the ling'ring echoes die.

But spirit of the Northland ! let the winter breezes blow,
And cover every giant crag with rifts of driving snow.
Freeze every leaping torrent, bind all the crystal lakes,
Tell us of fiercer pleasures when the Storm King awakes.

And now the vision changes, the winds are loud and shrill,
The falling flakes are shrouding the mountain and the hill,
But safe within our snug *cabane* with comrades gathered near,
We set the rafters ringing with "*Roulant*" and "*Brigadier*."

Then after *Pierre* and *Philerome* have danced "*Le Caribou*,"
Some hardy trapper tells a tale of the dreaded *Loup Garou*,
Or phantom bark in moonlit heavens, with prow turned to the East,
Bringing the Western *voyageurs* to join the Christmas feast.

And while each backwoods troubadour is greeted with huzza,
Slowly the homely incense of *tabac canayen*
Rises and sheds its perfumes like flowers of Araby,
O'er all the true-born loyal *Enfants de la Patrie*.



And thus with song and story, with laugh and jest and shout,
We heed not dropping mercury nor storms that rage without,
But pile the huge logs higher till the chimney roars with glee,
And banish spectral visions with *la chanson Normandie*,

“ Brigadier répondit Pandore
Brigadier vous avez raison,
Brigadier répondit Pandore
Brigadier vous avez raison.”

O spirit of the mountain ! that speaks to us to-night,
Return again and bring us new dreams of past delight,
And while our heart-throbs linger, and till our pulses cease,
We'll worship thee among the hills where flows the *Saint-Maurice*.

W. H. DRUMMOND.

*Entered According to Act of Parliament, in the office of the Minister of Agriculture, Canada,
by the Canada Iron Furnace Company, Ltd.*

The Sabiston Litho. & Publishing Co., Designers and Printers.

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