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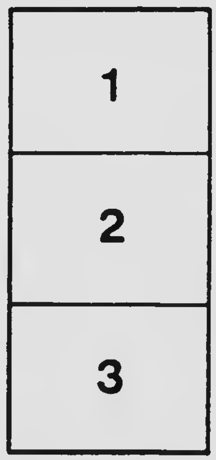
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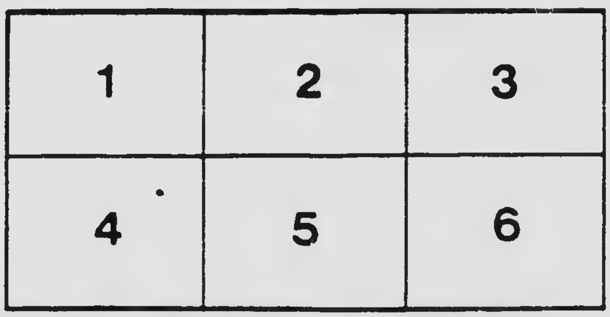
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THE MOND NICKEL COMPANY LIMITED

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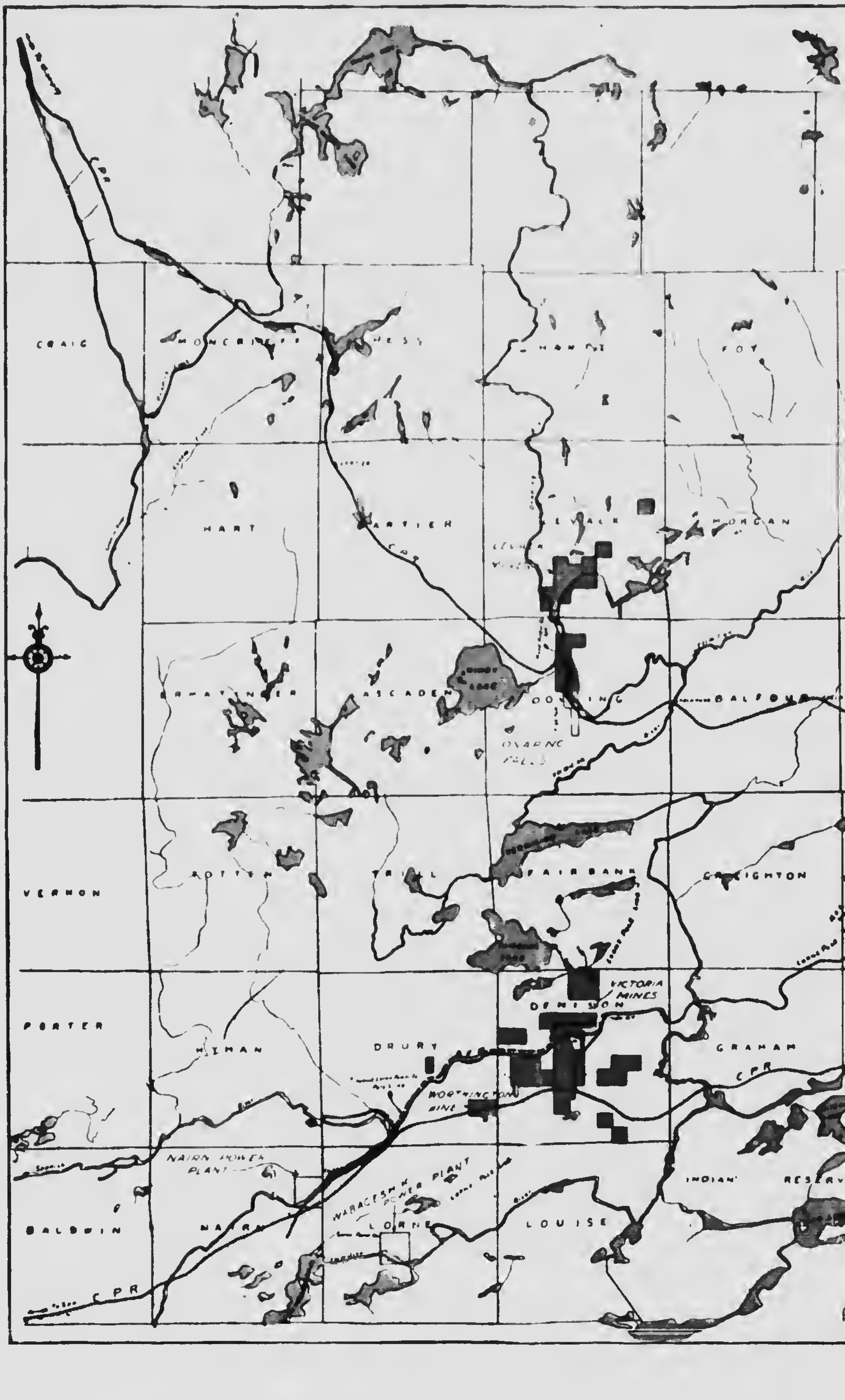
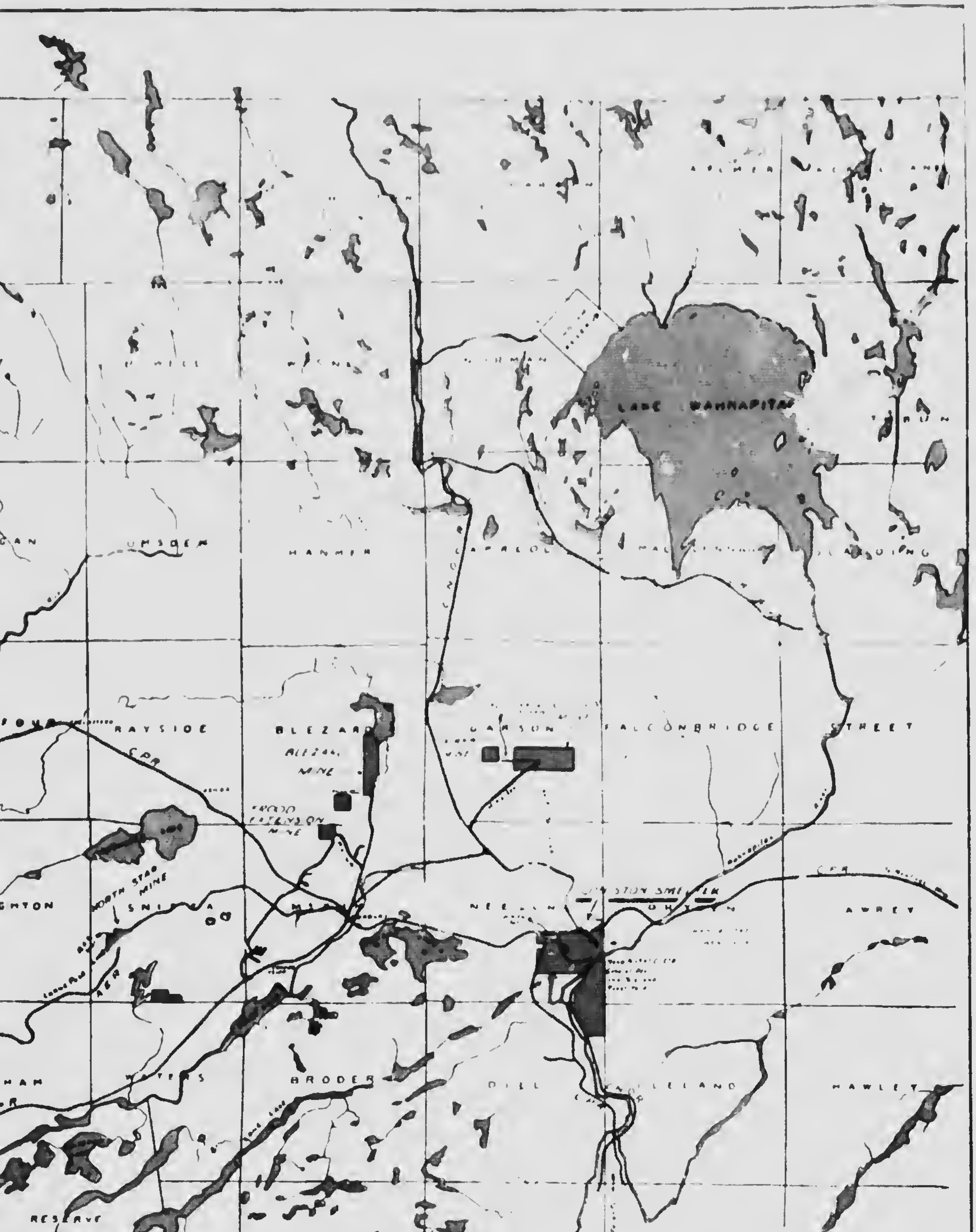
The Mond Nickel Company Limited

MAP OF THE MOND NICKEL COMPANY'S PROPERTIE



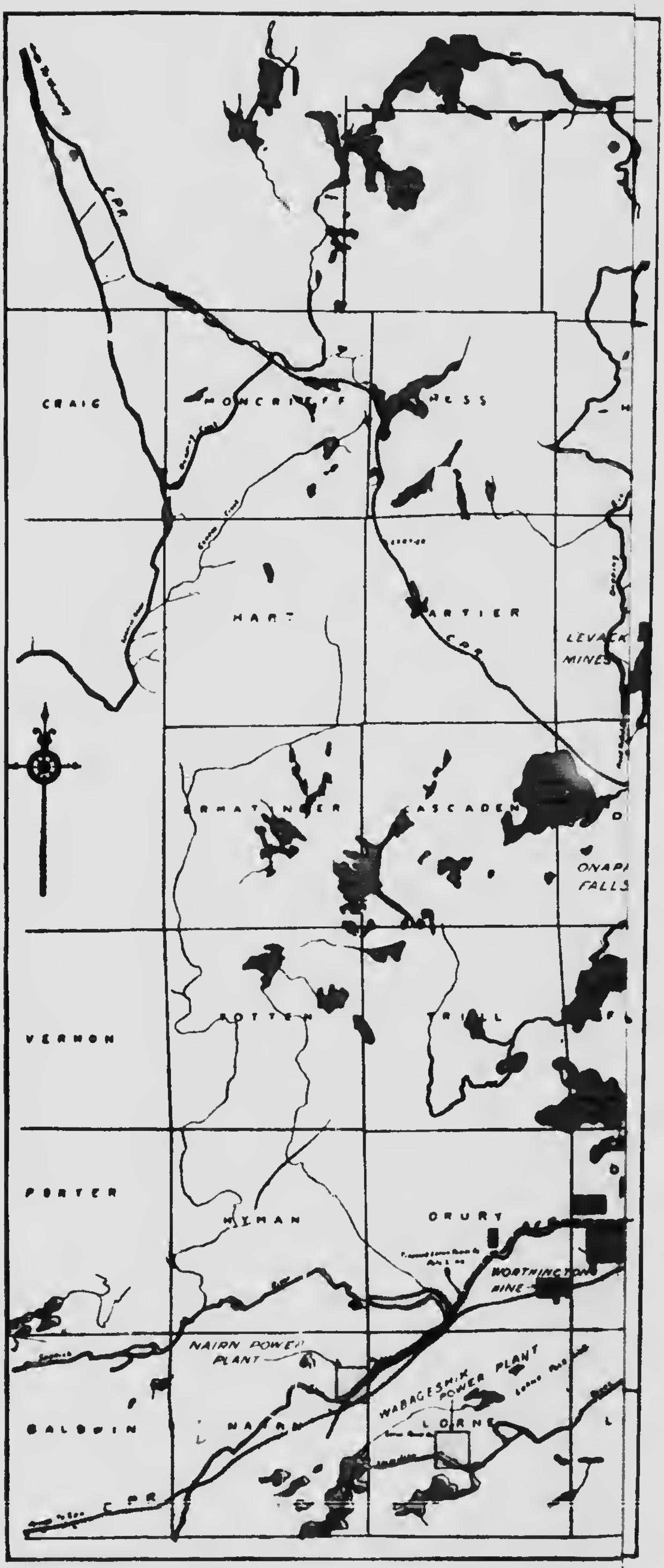
ROPERTIES IN THE SUDBURY DISTRICT ONTARIO CANADA



Mond Nickel Company's Power Plants and Transmission Lines — Yellow

Do Other Properties — Red

MAP OF THE MOND NI(



The Mond Nickel Company Limited

Directors

Rt. Hon. Sir ALFRED MOND, Bart., M.P. *(Chairman)*.
Sir ANDREW NOBLE, Bart, K.C.B.
Sir EDMUND WALKER, C.V.O. L.L.D.
Dr. CARL LANGER.
Mr. ROBERT MATHIAS.
Dr. BERNHARD MOHR.
Mr. EMILE S. MOND.
Mr. ROBERT L. MOND, J.P., F.R.S.E.
Mr. SAXTON W. A. NOBLE.

Secretary

Mr. HUGH HUGHES.

Registered Offices

30 Victoria Street, London, S.W.

Refining Works

Clydach, South Wales.

Managing Director - - Dr. Carl Langer.
Works Manager - - - Mr. F. J. Bloomer.

Mines and Smelting Works in Sudbury District of Ontario, Canada

Canadian Office and Smelters - Coniston, Ontario.
Manager - - Mr. C. V. Corless.
Chief Mining Superintendent - - Mr. Oliver Hall.

June, 1911.

The Mond Nickel Company Limited

NICKEL may certainly be classed amongst the more modern metals, although alloys containing Copper, Nickel and Zinc are said to have been used by the Chinese from time immemorial. The discovery of Nickel in modern times, however, has been attributed to Cronstedt, a Swedish chemist, who worked in and about the year 1751, but it was not until the year 1775 that the metal was obtained in its pure form.

The Nickel mines of Scandinavia were probably the first to be worked on a commercial scale until the discovery of very large deposits in New Caledonia, and later in Canada, led to rapid progress in the development of the Nickel industry.

One of the most interesting events in the history of Nickel was the discovery in 1889, by the late Dr. Ludwig Mond, F.R.S., of a volatile compound consisting of Nickel and Carbon-monoxide. While he and Dr. Carl Langer were experimenting in working out a method for the elimination of Carbon monoxide from gases containing Hydrogen, they discovered that Nickel possessed the remarkable property of forming a volatile compound with Carbon monoxide, which, when heated to 180° C. is split up into metallic Nickel and Carbon-monoxide.

On this reaction was based an entirely novel process for the production of metallic Nickel of practical chemical purity.

However, as the process has been fully described by the late Professor Sir William Roberts Austen in a paper read before the Institution of Civil Engineers in 1898, and as, moreover, some account of it will be given later, when the present Mond Nickel Company's Refining Works are described, it is unnecessary to go into any further details here.

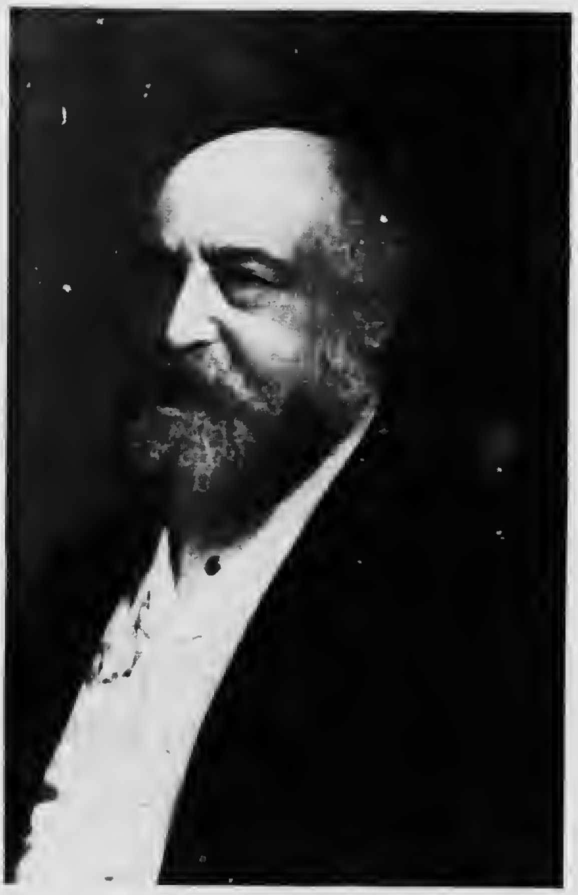
Suffice it to say that eventually Dr. Mond decided to develop this Nickel refining process on an industrial scale, and his attention being drawn to the Nickel-Copper Ore deposits in the Sudbury district of Ontario, Canada, he purchased some mining properties there in 1899, and at about the same time began to construct Refining Works at Clydach, South Wales.

At the present time Dr. Mond's invention is being worked by the Mond Nickel Company, Ltd., who own the various mines and smelting works in Canada, as well as the refining works in Wales. Their official headquarters are at 39 Victoria Street, London. The Company was formed in the year 1900 to take over the Nickel Patents and Mines owned by Dr. Mond. These mines are situated, as already mentioned, in the Sudbury district of Ontario, Canada, where the ore is mined and roasted, then smelted and converted into Bessemer matte containing about 80% Copper and Nickel combined. This matte is shipped from Canada direct to Swansea and treated by the Mond process at the Company's refining Works at Clydach. The fact that Mines, Smelter, and Refinery are all in British territory has its own particular interest, for it enables the Company to place on the market a metal which is entirely a British product, a merit, by the way, that cannot be claimed for any other Nickel.

Extensive Nickel-Copper properties have been acquired from time to time by the Mond Nickel Company in the same district, so that at the present time the Company hold some 9,000 acres of mining land. The history of the successive acquirements of mining properties indicates, better than anything else could do, the rapid expansion of the Mond Nickel Company's business.

When the Company was formed in 1900 the mining properties consisted of the Victoria and Garson Mines. Extensive exploration work has since been undertaken by the company, and has resulted in the acquisition of additional mining properties in the townships of McKim, Drury, Blezard, Garson and Levack, all in the Sudbury district, Ontario, Canada. Mining operations have been extended as rapidly as success in exploration permitted, so that now seven mines in all, Victoria, Garson, Worthington, Kirkwood, North Star, Frood Extension, and Levack, are being worked. Frood Extension and Levack are just being opened up, and a large amount of development and construction work is being carried on. It is expected that shipments of ore from the last two-mentioned mines will be begun during the present year.

The number of men employed by the Company in Canada has been gradually increasing with the opening up of various mines and the general expansion of the Company's operations. During the earlier years they numbered only 100 to 150, but since 1908 each year has seen an annual increase, until to-day 1,100 men are employed, and it is anticipated that the number will shortly be increased to 1,500.



THE LATE DR LUDWIG MOND, F.R.S.

MINES

The Victoria Mine

TO go for a moment into somewhat greater detail respecting the Company's properties in Canada, we begin with the Victoria Mine. This, the pioneer mine, practically the only source of ore during the first few years of the Company's existence, remains possibly the most interesting of all. Shipments were begun in 1901, and, with short interruptions, mining operations have continued steadily from that date. This is the deepest mine of the district, the lowest level to which the shaft has been sunk being 2,025 ft. At this depth a drift is being put in. The upper half of the orebodies are worked under-hand and the lower half overhand, thus permitting extraction at high speed. Only a few thousand tons of ore remain above the 1,371-ft. level. The west orebody is developed at the 1,812-ft. level, and in all about 400 ft. of vertical depth is developed ready for mining. Up to the present time the mine has produced about half a million tons of ore of high grade.

During the first eight years of operations at the Victoria Mine steam power only was available, but in 1908, when the Company's electric power plant at Wabageshik on the Vermilion River was put into operation, the mine was equipped with electrical machinery, and since April, 1909, electrical power only has been used. To ship the ore to the new Coniston Smelter, a new rockhouse was erected in 1913, and from this the ore is shipped by the Algoma Eastern Railway to Sudbury and thence to the Company's Smelter at Coniston by the Canadian Pacific Railway.

VICTORIA MINE

Station at 2,025 ft. Level

VICTORIA MINE
General View of Plant

VICTORIA MINE (Electrical Hoist)

North Star Mine

NORTH STAR MINE was worked to some extent in 1902-4, when it was shut down. Since its reopening in July, 1912, a good deal of development has taken place, and the shaft is now down to 375 ft. At the present time ore is extracted above the 250-ft. level, while a new level is being opened up at 350 ft. Shipments from this mine are now being made every month by the Algoma Eastern Railway.

The mine is operated electrically from the Company's Power plant at Wabageshik.

NORTH STAR MINE

General View of Mine Plant

Garson Mine

THIS mine was acquired at the same time as the Victoria Mine, but it was only opened up in 1906-7. Shipments of ore began in 1908, and since then Garson has been the main producer. Indeed, over half a million tons have already been shipped to the Company's Smelter. So far the mine has been developed to the 600-ft. level, and the shaft sunk to the 800-ft. level. It is worked at present by one central shaft and consists of a number of orebodies at some distance apart which appear to converge at a lower depth. The existence of ore has been proved by diamond-drilling to a vertical depth of 1,300 ft. below the surface.

The growth of the mine has necessitated increasing the plant from time to time. The power plant now includes a transformer station, a large electrical hoist, and four electrically driven compressors having a total capacity for seventy-two rock drills. The ore is received at the rockhouse, where it is sorted and then shipped by the Canadian Northern Railway to Coniston. The plant also comprises machine and blacksmiths' shops, warehouses and wash-houses for the workmen.

The Garson mine is connected with the Company's electric power plant at Wabageshik by a pole-line over forty miles in length. From this source it obtains a considerable portion of its power supply, the remainder being obtained from the Wahnapitae Power Company's plant, some seven miles distant.

GARSON MINE

General View of Plant

WORTHINGTON MINE
General View

Worthington Mine

THE WORTHINGTON MINE was worked over twenty years ago by the Dominion Mineral Company, but has since been shut down. It was, together with its sister mine the Blezard, purchased by the Company in 1913. At the present time a new shaft has been sunk down to 300 ft. and a new level is being cut at this depth. At the same time ore is being taken out of the old workings above the 170-ft. level. Moreover diamond drilling has indicated the continuation of ore to a considerable depth. Shipments have already been made to the Smelter at Coniston.

A new hoist has been designed and erected at Worthington. The Power plant includes transformers and an electrically driven hoist and compressor. The rockhouse arrangements are in a general way the same as at Garson, comprising a Hadfield crusher and somewhat more complete picking arrangements.

The Power supply is derived from the Wabageshik power plant.

WORTHINGTON MINE—ELECTRICAL HOIST

WORTHINGTON MINE (POWER HOUSE)

Canadian Pacific Railway in the foreground

WORTHINGTON MINE (ELECTRIC COMPRESSOR)

Kirkwood Mine

KIRKWOOD is a relatively small mine not far from Garson. Operations on a small scale were started in 1915 and up to now nearly 20,000 tons of ore have been mined. An aerial tramway connects this mine with Garson whence the ore is shipped by the Canadian Northern Railway to the Company's Smelter at Copper Cliff. Practically no plant has as yet been placed at Kirkwood, operations being carried on by compressed air conveyed by a pipe line from the plant at Garson.

LEVACK MINE

Breaking Surface Ore

Levack Mines

THE LEVACK MINES, comprising three separate Mines, were acquired in 1913 and diamond drilling has indicated the existence of a very large ore deposit in the mine known as Levack 1. Some years of development, however, will be required to bring this large mine into full production. At the present time a small tonnage has been mined by a temporary plant, and shipments of ore are now being made to Copper Cliff by the Canadian Pacific Railway. This mine will eventually be a very large producer, the existence of over four million tons of ore having been proven by drilling down to a depth of about 900 ft.

So far temporary plant only has been installed, but electrical equipment has been ordered and an electrical transmission line has been built. Moreover, the work preparatory to plant-erection is already far advanced. A Railway spur four miles long, including a railway bridge over the Onaping River, has been built in from the Canadian Pacific Railway, and an extensive plant is being erected.

LEVACK MINE

Breaking large blocks of ore at Levack in an open cast

Frood Extension Mine

FROOD EXTENSION MINE was purchased in 1911 and at the end of that year a shaft comprising four compartments was started. This has now reached a depth of 1000 ft. The chief orebody of the property lies at about this depth and ore production should start by the end of 1911.

Up to the present a temporary steam plant of 200 h.p., supplemented latterly with an electrically driven compressor, has been used. A large permanent plant is now being installed which will include a very large Nordberg hoisting equipment comprising electrically driven compressor, air receivers, preheater and air hoist capable of hoisting a 5-ton load from a depth of 3000 ft. at a speed of 1000 ft. per minute. A large rockhouse has been designed, while shops and dry house are to be erected.

This very extensive mine obtains its power supply from the plant at Wabageshik and is connected with the Coniston Smelter by the Canadian Pacific Railway.

FROOD EXTENSION MINE

Station at 750 ft. Level

FROOD EXTENSION MINE

Power House and Temporary Rock House

POWER PLANTS

THE Company's Mines and Smelters were at first operated by a steam plant at Victoria Mines but the power requirements of the Company increased so largely that in 1907 it was decided to use electricity instead of steam for purposes of power. Thus at the present time the Mond Nickel Company's Mines and Reduction plants are operated electrically.

Since the original charter of the Mond Nickel Company did not provide for any developments of hydro-electric power, a subsidiary Power Company was formed called the "Lorne Power Company Limited." This Company has already erected one power station at the Wabageshik Falls about four miles from the village of Nairn, Ontario, on the Soo branch of the Canadian Pacific Railway. At this plant which is on the Vermilion River there are two 58 in. diameter water wheels under 54 ft. head at high water stages and 70 ft. head at low water stages, developing 4,400 horsepower.

At the forebay the water passes through the intake racks and through two 10 ft. diameter screw operated steel gates to the two steel penstocks which are 8 ft. in diameter and made of 5/16 in. steel. At the lower end these penstocks form part of the water wheel casings. Directly connected to the two water wheels are the two 3 phase 60 cycle, 2,200 volt 1,500 K.V.A. Generators. Between the two water wheels and generators are two 60 K.W. Exciters connected direct to two small water wheels. The 2,200 volt current from the Generators is stepped up to 17,000 volts in the three 1,000 K.V.A. single phase transformers located in the Transformer Tower. This power plant is equipped with switchboards on which are mounted switches for Exciter control, main Generator control, outgoing line control, all with necessary instruments and switches for lighting circuits. The lightning arresters are of the electrolytic type and of ample size to protect the plant and line.

WABAGESHIK

Main Dam and part of Log Chute

Power Distribution

The power is distributed by copper wire carried on cedar poles. The first power is taken off at Worthington Mine over eight miles of pole-line, and at this point 600 h.p. is used. The current is received at about 17,000 volts and transformed to 550 volts, at which voltage it is used in motors.

The next sub-station is located at Mond, Ontario. At this point, twelve miles from the power plant by pole-line, another 600 h.p. is taken and used in the same way as at Worthington.

Thirteen miles further on the pole line or twenty-five miles from the Power Plant another sub-station at the North Star Mine takes off 500 h.p. At the Frood Extension Mine, thirty-five miles from the Power Plant by pole line, another sub-station takes off about 850 h.p. Here also the current is received at about 17,000 volts and transformed to 550 volts.

The Garson Mine sub-station, located at the end of forty-three miles of pole line from the power plant, transforms about 1,620 h.p., part of which is at present developed at the Company's Wabageshik Power Plant and 600 h.p. by the Wahnapitae Power Company at their Power Plant situated on the Wahnapitae River. This 600 h.p. is taken over about seven miles of pole line at 16,000 volts and transformed to 550 volts at the Mine sub-station. All the machines at the Garson Mine are arranged with double throw switches so that any machine can be operated from either of the Mond Power Company's plants or from the Wahnapitae Power Company's plants. This sub-station is connected with both distributing systems. A 5-in. air pipe-line 9,600 ft. long extends from this sub-station to Kirkwood Mine.

The mines are all equipped with compressors and other machinery, and in addition to this the power is required for the hoists at the different mines. By means of the raising of the Company's dam, which has been done during the past year, at the Wabageshik Power Plant, the power available has been considerably increased, so that this plant alone will operate the total mine equipment so far installed by the Company.

The power required to operate the Coniston smelter is purchased, under a long-time contract, from the Wahnapitae Power Company mentioned above, and has the advantage of being generated only one and a half miles from Coniston. The current is brought in at 16,000 volts to the transformer station at the Power House, and from there it is distributed at 550 volts to the different points as required.

The Wahnapitae Power Company have another plant at Burnt Chute, about eighteen miles below the Wahnapitae Plant, from which the smelter power can be taken in case of accident or any unavoidable shutting down of the principal plant.

WABAGESHIK POWER PLANT

Exterior view of Power House showing Penstocks

WABAGESHIK POWER PLANT

Interior View of Wabageshik Power House

NAIRN FALLS PLANT

Showing head water on main channel of Spanish River at Nairn Falls

Nairn Falls

The Lorne Power Company is at present building another hydro-electric power plant at Nairn Falls, Ontario, which, when developed, will generate another 4000 h.p. Two water wheel and generator units will be installed, and space for a third unit will be provided for in the building. This third unit can be installed later if necessary without interfering in any way with the operations of the two first units. This plant when completed will be connected up with the Wabageshik Power plant, so that in case of any accident to either plant the mines can be kept in operation up to the limit of the power generated at any one of the Company's power plants.

Another water power, the "High Falls" on the Onaping River, close to the Levack mines, has been arranged for in order to provide power for any future need at the Company's Mines and Smelter at Coniston.

NAIRN FALLS PLANT

Showing [illegible] Dam looking up [illegible] of Spanish River

NAIRN FALLS PLANT

Showing [illegible] the falls in main channel of Spanish River at Nairn Falls

Coniston Smelter

ORIGINALLY the Mond Nickel Company, Ltd., carried on its smelting operations at the Victoria Mine Smelter; indeed, as recently as June, 1909, the plant was remodelled for electric power. But the increase in the tonnage of ore to be smelted was so rapid that steps had to be taken for the working out of a broader scheme. In 1911 it was decided to abandon the Victoria Mine Smelter altogether and to erect new smelting works at Coniston, a site which both geographically and topographically is almost ideal.

Coniston lies eight miles east of Sudbury, at a junction of three railways, in a district consisting chiefly of low rocky hills. It is on the main lines of both the Canadian Pacific Railway and the Canadian Northern Railway, being also served by the Toronto branch of the Canadian Pacific Railway, which joins the main line a little further west.

CONISTON PLANT

[illegible]

At the Coniston Plant the ore is fed into blast furnaces, in which it is concentrated into a matte containing the Nickel and Copper and part of the Iron in the form of Sulphide. Most of the Iron and the rocky matter in the ore are converted into slag. The molten matte and slag flow from the bottom of the furnace into a large settler lined with chrome brick. Here a separation is obtained, the matte containing the copper and nickel settling to the bottom, while the slag floats on the top and is allowed to overflow to waste. The operation is continuous. Furnace matte is drawn off from a tap-hole at the bottom of the settler from time to time. Each furnace is capable of smelting from four hundred to five hundred tons of ores per day.

CONISTON PLANT

General View of Smelting Plant

The furnace matte is run from the settlers into ladles of about ten tons capacity, and these are lifted by electric travelling cranes. Then the matte is poured molten into converters. These are 25 ft. 10 in. long by 10 ft. in diameter, lined with basic brick, and each holding about forty tons of matte. Seven thousand cubic feet of air per minute is blown through this molten matte. The iron and sulphur are oxidised, the sulphur dioxide passing off as a gas and the iron oxide being made into an easily fusible slag by the addition of siliceous copper and copper nickel ores.

The final result is a Bessemer matte containing about 41% of copper, 41% of nickel, 17% of sulphur, and less than 1% of iron. This is poured molten into ladles and thence into moulds where it solidifies. It is then crushed, barrelled, and ready for shipment to the United Kingdom.

The ore and other materials are received from the C.P.R. and the C.N.O.R. in standard gauge cars which are self-dumping and of fifty tons capacity. Roasted ore is delivered to the Smelter bins in similar cars owned by the Company. The Company operates their own steel bottom-dump fifty-ton ore cars, flat cars, slag cars, locomotives as well as two switching engines. There are about ten miles of railway track and of standard gauge of eighty pound (per yard) rail owned by the Company. The maximum grade of the Company's line is 2.4%, and the maximum curvature 14° per hundred feet.

Great credit is due to Mr. C. V. Corless, the Manager of the Company in Canada, and to the Engineering Staff for the laying-out, design, and erection of the magnificent Works at Coniston. The plant was designed by the Company's Engineers late in 1910, and the Manager then estimated that the Works would be completed and ready to start operations by the 1st of June 1913, the actual date of starting being May 13th, 1913.

The magnitude of the work involved is graphically illustrated by the photographs which show:

1. Site of the Works before erection, September, 1911.
2. Foundations of the Plant, June, 1912.
3. Works in process of erection, October, 1912.
4. Works nearly finished, December, 1912.

CONISTON SMELTER SITE BEING CLEARED, SEPTEMBER, 1911

A PART OF THE FOUNDATIONS OF CONISTON SMELTER June 1912

CONISTON SMELTER IN COURSE OF ERECTION, October, 1912

CONISTON SMELTER NEARLY FINISHED, December 3, 1912

Power House

THIS is a building 74 ft. by 120 ft., with steel frame, brick walls, reinforced concrete roof, and steel floor. Attached to one corner is a transformer house 24 ft. by 24 ft., built of the same materials. Power is received from the Wahnapitae Power Company at 16,000 volts, three-phase alternating, and is transformed to 550 volts. There are installed three 200 h.p. induction motors, one with three speeds, drive three Connersville blowers, each supplying 17,700 cubic feet of air per minute to the blast furnaces. There is also a 44,000 cubic foot blower driven by two 300 h.p. synchronous motors. Two Nordberg blowing engines driven by 500 and 345 h.p. induction motors respectively supply 10,000 and 7,000 cubic feet of air per minute at eleven pounds per square inch pressure to the converters. Air for pneumatic tools, etc., is provided by a motor-driven air compressor at eighty pounds pressure, while electric light and power for electric charging locomotives, electric travelling cranes, and a number of small motors is supplied by two Motor generators of 100 and 150 kilowatts capacity.

CONISTON SMELTER—Supports of Charge Floor

Water Supply

WATER is obtained from the Wahnapitae River and is pumped to a one hundred thousand gallon tank at the Smelter through six thousand feet of 10-in. steel pipe. Duplicate turbine pumps are installed in a concrete pump-house 24 ft. by 26 ft. Each pump is capable of delivering fifteen hundred gallons per minute against a head of five hundred feet. The pumps are connected direct to three hundred h.p. electric motors. The village is supplied by a 6-in. branch from the 10-in. line. Pump pressure is constantly available in case of fire, the house services being taken from pressure reducing valves.

CONISTON PLANT

Smelter Building, Dust Chamber, and Stack

CONISTON PLANT

Locomotive and Tender. Total Weight One Hundred and Thirty Tons

Roast Yard

At the Roast Yard, situated about one mile from the Coniston Smelting Plant, the coarse ore is piled on about two feet depth of cordwood into large roast heaps which are then covered with a layer of fines from the outside. The cordwood is lighted, igniting the ore. Free access of air is prevented by the fines. The whole roasts for two or three months, about one quarter of the sulphur and iron present being oxidized. Each heap contains twenty-five hundred tons of ore.

The ore is received in side bottom dump ore cars, and these are dumped first on one side and then the other into a ditch between two tracks of rails laid at twenty feet centres. After one side has been dumped the car is switched to the other track so as to present its other side to the ditch. Fifteen-ton locomotive cranes are used.

The Roast Yard site has ample room for expansion.

CONISTON PLANT

Locomotive Crane digging Roasted Ore from Roast Yard

CONISTON PLANT

Blacksmith's Shop, Machine Shop, etc.

CONISTON PLANT

Locomotive Crane transferring Ore to Roast Bed

General

THERE are also at Coniston a temporary warehouse and a temporary oil-house, various shops built of wood with corrugated iron roofs, heating plants, and the Company's Canadian General Offices.

CONISTON PLANT

Canadian Pacific Railway Station, Coniston

Village

THE Company has done everything in its power to ensure the comfort of its employees at Coniston by planning a whole village for them to live in. The site was good and much thought was given to the ultimate appearance of the village with the most satisfactory results. It now comprises a Club House, a Boarding House and Public Library, eleven houses for the staff and forty-six houses or cottages for the employees, all owned by the Company. Two schools have been built and presented to the School Board, together with leases of suitable grounds. Churches, Stores, etc., occupy land leased by the Company. Moreover, a considerable number of dwellings have sprung up near this village and help to provide accommodation for the men in the Company's employ.

It may be mentioned by the way that the Company have built houses for their employees at the various mines, and large villages now exist at both Garson and Victoria Mines.

CONISTON PLANT

Looking north along First Avenue, Coniston Village

CONISTON PLANT

Second Avenue, Coniston Village

CONISTON PLANT

Third Avenue, Coniston Village

CONISTON VILLAGE

[illegible]

CONISTON VILLAGE

[illegible]

CONISTON VILLAGE

Manager's House,
Coniston Village

CONISTON VILLAGE

Mine Superintendent's
House
Coniston Village

CONISTON VILLAGE

Switching Engine and
Passenger Car *en route*
from Plant to Village at
Dinner Hour

The

Refining Works at Clydach

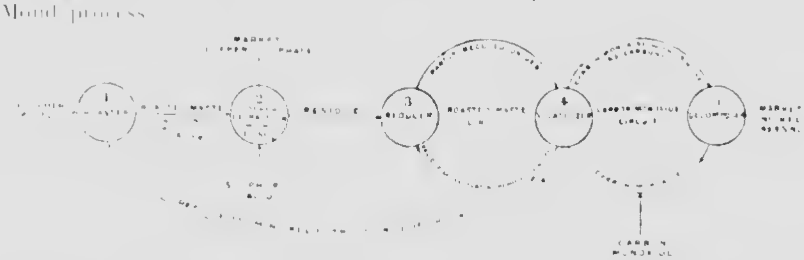
The Process

THE Bessemer matte is shipped from the Company's Smelters at Copper Cliff via the Canadian Pacific Railway or the Canadian Northern Railway to Montreal and thence to Swansea, Wales, near which port the Company's Refining Works are situated. Here the matte is refined by the Mond Nickel or Nickel Carbonyl process.

This process has been described in detail by Sir Roberts Austen in a paper read before the Institution of Civil Engineers in 1898. Five operations in all are required to produce the Nickel.

1. Roasting to free the matte from sulphur.
2. Extraction of two-thirds of the copper by Sulphuric Acid.
3. The reduction of the nickel and remaining copper by water gas rich in hydrogen at a temperature not higher than 400° C.
4. The treating of the reduced matte in an apparatus called a "volatiliser" by carbon monoxide at a temperature not exceeding 80° C.
5. The nickel carbonyl as produced by the previous operation passed into a "decomposer" in which it is heated to 180° C., when the nickel is deposited in metallic form.

The following diagram illustrates the five operations involved in the Mond process.



The process is not completed by one passage through the five stages, as only about 60-70% of the nickel has been removed from the matte by the nickel carbonyl gas. The residue from this operation, which does not differ very much in its composition from the original matte, is returned to the first operation and follows the same course as before.

In operation 5, the carbon monoxide is released and returned to the "volatiliser" to take up a fresh charge of metal. The nickel is deposited on granules of refined nickel, which are automatically removed after they have grown to a certain size.

The product obtained contains between 99.8% to 99.9% of nickel, not counting cobalt, and is the purest form of nickel which is at present obtainable in commercial quantities.

The process is a continuous one.

Large quantities of coal are required for this process, and full advantage is taken of the situation of the Refining Works, which are in the midst of the Welsh Anthracite and Steam Coalfields, and it is therefore possible for the Works to be supplied at a very low cost with the coal which in the process is largely used for power, steam and gas.

The products made in the process are:

1. Sulphate of Copper.
2. Nickel.
3. Nickel Salts.

Copper Sulphate

The Copper Sulphate is shipped from Swansea to Italy, France and Spain, and all other wine producing countries, as the principal use of this article is for spraying the vines, in order to prevent mildew and other fungoid diseases. It is recognised that the spraying of Sulphate of Copper is the only preventative against these diseases. Copper Sulphate is also used for prevention of disease in other plants, for spraying potatoes, olive trees, for killing weeds, etc., etc.

Nickel Salts

which are manufactured by the Company are largely used in the Nickel Plating industry, and lately this article has been used as a catalyser for fat hardening purposes.

REFINING WORKS AT CLYDACH, SOUTH WALES

COMPANY'S VILLAGE AT CLYDACH

THE MOND NICKEL COMPANY have always done everything in their power to look after the comfort of their employees. With this object in view they erected a model village near the Refining Works at Clydach where, as shown in the photographs, comfortable and distinctive accommodation is provided for the workmen and their families.

The social activities of Clydach village centre round its Club. This was opened in January, 1909, and that it has fully justified its existence is shown by the fact that it can boast of more than 500 members.

The Club House itself was built by the Company at a cost of nearly £4000. Its main feature is a large Concert Hall with seating accommodation for 450, wherein fortnightly concerts are held throughout the winter. Admission is free, and members are entitled to introduce their friends.

There are also a Billiard Room with two tables, an Air Rifle Range, a Photographic Dark Room, a Reading Room, a Refreshment Room and the usual Committee Rooms.

In the Club Library, which is well stocked with excellent works of fiction, biography, travel, science, etc., there are more than 1000 volumes from which members can make their selection, while in the Reading Room technical publications, the leading daily newspapers, as well as weekly and monthly journals, are provided for their entertainment.

CLYDACH ESTATES

But the Clydach Club is not limited by four walls. Its activities extend far beyond the actual Club House. For instance, affiliated to the Club are football, cricket, hockey, and hurling sections, and members of a musical turn of mind have an opportunity to display their talents in the Brass Band, Orchestral or Male Voice Party sections.

In addition the Club has a photographic section, not to mention a flourishing Gardening Society, in connection with which a Flower Show is held every year.

In fact, every employee at the Mond Nickel Company's Refining Works at Clydach is pretty sure to be able to find in the Club some opportunity for the gratification of his particular tastes in whatever direction they may lie.

WORKS BAND CLYDACH

WORKS FOOTBALL TEAM, CLYDACH

CLUB HOUSE. C[illegible] Hall

CLUB HOUSE. Billiard Room

CLYDACH ESTATES

Houses built for use of Employees and Workmen

THE USES OF NICKEL

General Uses

THE uses of Nickel are so many and are multiplying so rapidly as to be almost innumerable, and although the importance of pure Nickel is growing daily, the principal use of the metal is in the production of alloys, particularly Nickel Steel, in which the greater part of the nickel refined is still employed.

[illegible] BRITISH [illegible] AT SHEPHERD'S BUSH

The alloy of Nickel and iron is no novelty, since all native iron of terrestrial as well as meteoric origin contains nickel. Moreover, as far back as 1822 experiments were made by Faraday in alloying nickel and iron, and since then improvements in the process have been made continually.

PROJECTILES MADE FROM NICKEL STEEL

Manufactured by Hadfield's Steel Foundry Co. ... Sheffield

MOND NICKEL USED FOR NICKEL STEEL

Nickel Steel

Nickel Steel has many uses and is constantly being tried for new purposes. Steel containing from 2% to 4% of nickel has certain of its properties greatly improved, so that in many directions it is replacing ordinary structural steel.

The following table, which shows a comparison of Carbon and Nickel structural steels, gives some idea as to its superiority:

	Carbon	Nickel
Percentage of Carbon	0.20	0.38
Percentage of Ni	0	3.50
Elastic limit, lbs. per sq. in.	30,000 Min.	60,000 Min.
Ultimate tensile strength, lbs. per sq. in.	60,000 Min.	100,000 Max.
Modulus of elasticity	29,000,000	30,000,000
Safe working stress (in tension), lbs. per sq. in.	16,000	28,000

Perhaps the most important use to which it is put is for the manufacture of armour and heavy ordnance, where its great strength and toughness has proved of great value. It has been used for engines and propeller shafts for a number of years and has proved so much superior to other steels that it is now considered unrivalled for such purposes. On account of the increase in strength or decrease in weight it has been used for crank pins, light forged engine frames, bolts for extreme hydraulic pressure, hydraulic forge cylinders, and railway axles; and from its peculiar resistance to fatigue under vibration it is employed very successfully for piston rods in steam engines and drills.

THE MANHATTAN BRIDGE, EAST RIVER, NEW YORK CITY, U.S.A.

The value of Nickel Steel for armour plates when cemented and face hardened consists not only in its greater resistance to penetration but in its non-fissibility. So completely is this recognised that since the Washington Navy Yard first began experimenting with Nickel Steel in 1876 every country in the world has come to rely on Nickel Steel for the armour plating of its first class ships of war.

Incidentally, it may be mentioned here that Nickel prepared by the Mond Nickel Company is largely used in the manufacture of armour plates for the British Government.

There is also an increasing demand for Nickel Steel for the building of bridges. Nickel Steel has been used for the rebuilding of the Quebec Bridge which collapsed so disastrously a few years ago. Nickel Steel has also entered largely into the construction of the Manhattan Bridge at New York. This is now the heaviest suspension bridge in existence, and for its length the heaviest bridge of any kind in the world.

THE QUEENSBORO BRIDGE QUEBEC CANADA

Although its span is 100 ft. less than the span of the big cantilevers of the Forth Bridge, the enormous load which the bridge is designed to carry calls for a weight of cables and suspended superstructure that makes this by far the heaviest and strongest bridge yet constructed.

The suspension bridge proper, disregarding the approaches, consists of a main span 1,470 ft. long and two side spans each 725 ft. in length. The total width of the floor of the bridge is 120 ft.

A novel feature is the use of Nickel Steel in the upper and lower truss chords, which are subjected to a working stress of 30,000 lbs. per square inch. The Nickel Steel rivets are subjected to a working stress of 20,000 lbs. per square inch, and notwithstanding the higher cost of the Nickel Steel, the saving in weight is such as to make the trusses actually cheaper than if they were built entirely of ordinary structural steel.

The weight of steel in the superstructure from anchorage to anchorage, exclusive of the cables, is 10,400 tons of Carbon Steel and 8,000 tons of Nickel Steel. The weight of the cables is 6,500 tons, and the total weight of steel in the whole bridge, including anchor chains, cables, towers and suspended span, is 42,000 tons.

The following table will show the approximate saving in weight and cost of bridges effected by the use of Nickel Steel:

Mixed Nickel and Carbon Steel:
- Saving in weight up to 25 per cent.
- Saving in cost up to 17 per cent.

Nickel Steel throughout:
- Saving in weight 10 to 30 per cent.
- Saving in cost up to 12 per cent.

Nickel Steel is especially valuable for motor car parts because it possesses high tenacity and is very durable and has a remarkable coefficient of expansion. For the same reason it is particularly well adapted for steel rails, and in places liable to special stress it is much used. For instance, it is estimated that in a sharp curve one nickel steel rail has a life as long as that of four rails made of ordinary steel.

Nickel Steel is also used in wire cables, torpedo defence netting, electric lamp wire, umbrella wire, corset wire, mountings of lenses, mirrors, balances for clocks, weighing machines, springs, cutlery, harness mounting, boiler tubes, axles, brake beams and transoms for field artillery wagons, as used by the French Army since 1898.

ARMOUR PLATE FOR BATTLESHIP (Officially Tested)
Manufactured by Sir W. G. Armstrong Whitworth & Co., Ltd., Openshaw Works
MOND NICKEL USED IN MANUFACTURE

Currency

A GREAT many countries have adopted Nickel or Nickel alloy for the manufacture of small currency for the reason that only Nickel and Nickel alloy completely fulfil the requirements of such currency. The metal used must be comparatively cheap, of handsome appearance, not liable to oxidation or alteration by any chemical agent, and it must be not too difficult to mould, roll, punch and stamp, taking a good impression of the die, durable in wear, and difficult to counterfeit.

Formerly pure Copper was most frequently used for such coins in nearly all countries. It is cheap and easy to work, but very liable to oxidation and too soft. Moreover, the risk of counterfeiting can scarcely be avoided, as Copper can be had everywhere, and offers no difficulty in working.

Bronze has also been tried in order to enhance the hardness of Copper, but the coins of this alloy suffer from nearly all the disadvantages of those made of pure Copper.

German Silver, which is an alloy of Nickel, Copper and Zinc, has been used for coins in various states of South America. Although better than copper and bronze, it oxidises too readily and soon loses its bright appearance.

German Silver with an addition of pure Silver was tried by the Swiss Government, but the coins made of this alloy soon became yellowish and unsightly, and Switzerland has since adopted pure Nickel and Nickel alloy for its coinage.

Small copper coins coated with silver have been used in many countries, but the silver coating soon disappeared, and the appearance of the coins became so paltry, and the dirt stuck to them to such a degree, that many countries in which they were in use discarded them altogether.

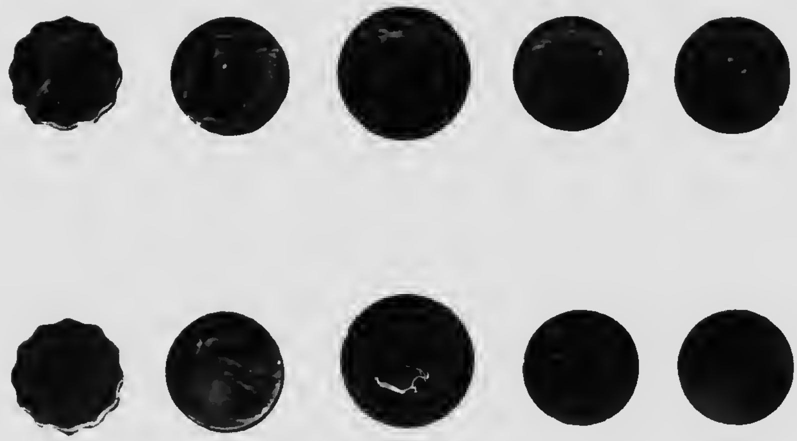
The first experiments with alloys of nickel and copper were made in the United States of America and Belgium. They varied from 10% nickel and 90% copper to 50% nickel and 50% copper. In both these countries, and later in several others, including Germany, it has been proved that an alloy of 25% nickel and 75% copper possesses to a high degree the qualities desirable for material for small currency. Coins of this alloy being harder than bronze, the material being much dearer, and greater skill and a powerful plant being required to work them, it is practically impossible for counterfeiters to produce imitations with any chance of success.

It is only a few years ago that a process was discovered to roll, hammer and stamp pure nickel, but already the Governments of Austria-Hungary, Italy, Switzerland, Denmark, Montenegro, Mexico and other countries are being supplied with coins of this metal. These coins are the most excellent that have been made; they are most durable in wear, they never oxidise, and it is simply out of the question to endeavour to counterfeit them successfully.

How widespread is the use of Nickel and Nickel alloy for small currency can be seen by the following table of the countries which have adopted nickel coinage:

Argentine	Germany	Portugal
Austria-Hungary	Greece	Persia
Belgium	Guadeloupe	Paraguay
Bolivia	Guatemala	Philippines
Bulgaria	Hayti	Panama
Brazil	Honduras	Roumania
Ceylon	India	Reunion
Congo	Italy	Servia
Chili	Japan	Switzerland
Colombia	Jamaica	Siam
Corea	Kiautchow	Salvador
Costa Rica	Luxembourg	United States of America
Crete	Mexico	Uruguay
Denmark	Montenegro	Uganda
Egypt	The Netherlands	Venezuela
Ecuador	Nigeria	
France	Peru	

Specimens of Nickel Currency



India   Italy   France   Austria   Germany

Jamaica

Kitchen Utensils

THE remarkable properties of nickel, which approaches the precious metals in its chemical powers of resistance, while far exceeding them in hardness and toughness, have in later years led to its employment, firstly for cooking utensils and kitchen ware, and secondly, in an ever increasing degree, for cookers, dishes, basins, baths, crucibles, stills and hollow vessels of every description used throughout the technical arts.

Indeed, as a metal for cooking utensils Nickel is the ideal.

Tinned or "tin" vessels, sheet iron coated with tin, are mostly thin and very liable to injury. Enamelled vessels have the great drawback that the enamel coating is extremely liable to chip. Thus when damaged enamel utensils are used the food comes into direct contact with the iron and is apt to acquire a metallic flavour. There is also the great danger of detached chips of enamel being swallowed with the food and giving rise to appendicitis and other forms of inflammation.

Copper cooking utensils undergo strong oxidation and can only be used provided they have a thick inside coating of tin. This coating wears away very rapidly and has often to be renewed; thus there is always the danger of the formation of poisonous copper salts which dissolve in the liquid food and have on many occasions led to serious cases of poisoning. Copper utensils under any circumstances mean a great deal of work for the kitchen staff. Every time after use they must be not only washed but scoured to remove the discolouration caused by the fire.

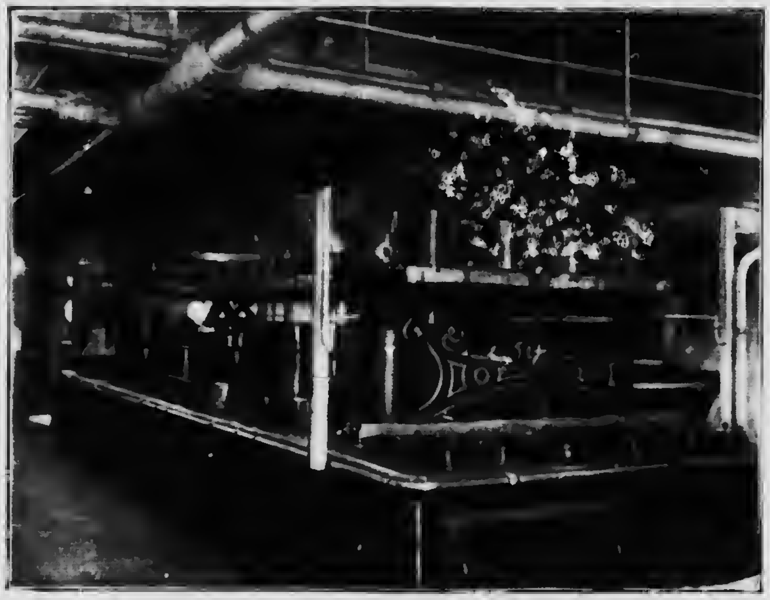
[illegible]

One of the [illegible] advantages of the [illegible] nickel kitchen utensils is that [illegible]. Everybody [illegible] knows [illegible] constant expense [illegible] in getting kitchen copper constantly retinned. The expense is very great, the retinning bill of large London hotels running into a very considerable amount. This recurring expenditure is now entirely avoided by the [illegible] nickel utensils.

Nor do cooking utensils made of aluminium provide a satisfactory substitute for copper or iron. The melting point of aluminium is comparatively low, so that it is extremely sensitive to the action of heat, and vessels of aluminium unfilled with water frequently melt if they are put on a strong gas flame or fire. Moreover, the constant recurrence of a dull grey layer of oxide necessitates constant scouring, and aluminium being exceedingly soft requires specially careful and delicate handling in this

CURZON HOTEL, LONDON
Nickel Kitchen Utensils

CRANSTON'S TEA ROOMS, LTD., GLASGOW
Nickel lined Steam Jackets



WHITE STAR LINE, SS "OLYMPIC"

Nickel Kitchen Utensils

operation. It must not, for instance, be scoured over vigorously with sand, nor must soap and water in which washing soda has been dissolved be used in cleaning it, because in course of time decomposition and gradually complete dissolution of the metal would take place.

Aluminium is also dissolved in liquid food and forms metallic salts which may sometimes be poisonous.

All the dangers and disadvantages enumerated are entirely absent from Nickel utensils. Pure Nickel does not oxidise like iron, copper, or aluminium; it is harder than these metals, and is therefore much more durable; it may therefore be described as positively indestructible. Pure nickel utensils, moreover, when worn beyond possibility of further service, still retain a high metal value, which makes it possible to return the old utensils in part payment of new ones. Hence it is not surprising that in recent years very many large up-to-date hotels and ships' kitchens have been equipped with pure nickel cooking utensils. Furthermore, hospitals, lunatic asylums, barracks, and other establishments which cater for large numbers with strict attention to the precautions of modern hygiene, employ pure nickel cookers almost exclusively for their kitchen apparatus.

From the ordinary barracks cooker it is only a short step to the manufacture of field kitchen appliances.

Owing to the great strain and rough treatment to which military cooking appliances are exposed, they must be made of a material:

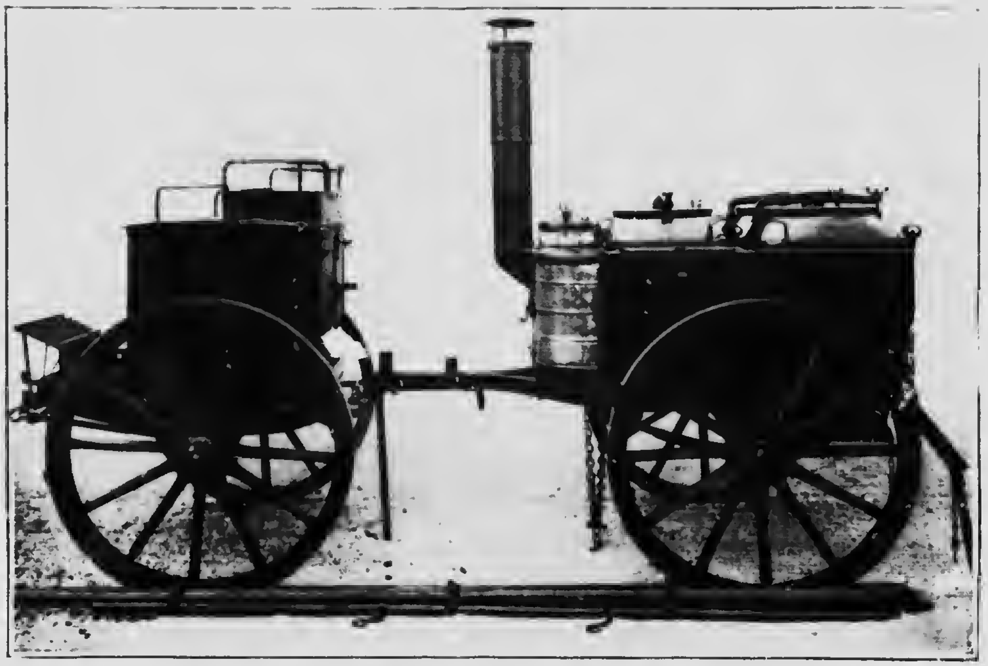
(*a*) which possesses sufficient strength and durability to withstand even the rough handling inevitable in the field;

(*b*) not liable to injury even if the cooker be wrongly heated, *i.e.*, when empty or insufficiently filled;

(*c*) which is faultless from a hygienic standpoint, and precludes every possibility of injury to health;

(*d*) which does not require repair in the field, such as would inevitably happen with copper and iron owing to the necessity of re-tinning.

Pure nickel alone is capable of responding to these varied requirements, and it is to be expected that many countries will soon follow the examples of the Austro-Hungarian and German Governments in introducing pure Nickel field kitchens for the use of their armies, as experiments conducted for some years past with Army field kitchens have furnished proof



ARMY FIELD KITCHEN
Interior Fittings, pure Nickel

that those sections of the troops that were fed on food prepared in field kitchens showed a very small proportion of men falling out in comparison with troops not provided with this form of apparatus.

The field kitchens for Military purposes are designed in such a way that they can prepare the food for 250–260 men in the course of a few hours, even during marches.

A further article for the efficient feeding of troops, especially mountain troops, is the Cooking Chest. This consists of a pure nickel field kettle of about 6·72 gallons capacity, together with an iron under frame for heating. The kettle and [illegible] are made to telescope into each other and are put into a chest made of veneered wood lined with asbestos, straw, oil paper and cork. The chest is fitted in such a way as fully to retain heat. Some hours before the meal is required, the food is heated to boiling temperature, and the kettle is then put into the chest; the latter is closed and mounted on the saddle, and during transport the food becomes thoroughly cooked. The design of the chest is so ingenious that after 18 hours with an outside temperature of 32° F. the food is still found to have a temperature of 182° F.

The photographs relating to Nickel Kitchen Utensils and Field Kitchens are reproduced by the kind permission of the Berndorf Metal Works, 231 Regent Street, London W., who are the manufacturers of these articles.

ARMY FIELD KITCHEN
Interior Fittings made of pure Nickel

ARMY COOKING CHEST
Made of pure Nickel