The Canadian Mining Journal

VOL. XXXV. TORONTO, October 15, 1914. No. 20

The Canadian Mining Journal

With which is incorporated the

"CANADIAN MINING REVIEW"

Devoted to Mining, Metallurgy and Allied Industries in Canada.

Published fortnightly by the

MINES PUBLISHING CO., LIMITED

Head Office - - 2nd Floor, 44 and 46 Lombard St., Toronto
Branch Office - - - - - - 600 Read Bldg., Montreal.
London Office - - - Walter R. Skinner, 11-12 Clement's Lane London, E.C.

Editor
REGINALD E. HORE

SUBSCRIPTIONS—Payable in advance, $2.00 a year of 24 numbers, including postage in Canada. In all other countries, including postage, $3.00 a year.

Advertising copy should reach the Toronto Office by the 8th, for issues of the 15th of each month, and by the 23rd for the issues of the first of the following month. If proof is required, the copy should be sent so that the accepted proof will reach the Toronto Office by the above dates.

CIRCULATION.

"Entered as second-class matter April 23rd, 1908, at the post office at Buffalo, N.Y., under the Act of Congress of March 3rd, 1879."

CONTENTS.

ONTARIO'S NEW PREMIER

The choosing of Hon. W. H. Hearst to be Premier of Ontario, is a recognition of the ability of the man whom we have been fortunate during the past few years in having in charge of the Department of Lands and Mines of Ontario. The new Premier is keenly interested in the development of Northern Ontario and to a greater extent than most of his predecessors he has an intimate knowledge of conditions in those parts of the Province which are most in need of exploration and development.

The agricultural and mining possibilities of Northern Ontario are beginning to be appreciated, but as yet we cannot claim that we have accurate knowledge concerning a very large part of this magnificent Province, which stretches from the Great Lakes to James Bay. The fringe along the Great Lakes and more particularly the comparatively small area lying immediately north of Lakes Erie and Ontario has long been settled. But the greater part of Ontario is an undeveloped country.

Manifestly it is one of the most important duties of the Provincial Government to determine the resources of this vast territory and direct attention to them. Much was accomplished by the Whitney Government in this regard and good progress is being made. The new Premier is unusually well qualified by knowledge of the conditions and by natural ability to so shape the Government's policy that renewed vigor will be given to the development of New Ontario.

THE NICKEL INDUSTRY

The production of nickel and copper ore in the Sudbury district has fallen off greatly since the war began. The Mond Nickel company, an English company which refines its matte in Wales, has continued producing at a normal rate, but the Canadian Copper company, a subsidiary of the International Nickel company, has closed down several mines and confined production chiefly to the rich ore deposit at Creighton. This policy of decreasing production and stopping development work has necessitated the discharge of many employees.

At first thought it seems strange that a company producing nickel should be so crippled in time of war. Obviously a great demand for nickel by the countries at war and by neutrals is to be expected, for nickel-steel, an alloy containing 2.5 to 3.5 per cent. nickel, is for many war purposes unrivalled. It is, of course, probable that Germany in planning for war laid in large stocks of nickel-steel and would have continued to increase her stocks if the British fleet had not made it impossible. Nickel has been declared by Great Britain and by France contraband of war and the enemy's supply at once cut off.

On the other hand it seems surprising that there has not been a demand from the Allies and from neutrals which would make up for the loss of German business. The natural conclusion is that Germany must have been recently absorbing a very large proportion of the nickel shipped to Europe. Another possible explanation is that the stocks of nickel being usually large any temporary increase in demand can be met without continuing production at a normal rate until the situation clears up.

At present Great Britain, France, Russia and all neutral countries are able to buy all the nickel they want, while the enemy is unable to obtain delivery of what he has already contracted for. No embargo is necessary to maintain this satisfactory condition so long as Great Britain controls the seas.

Canada and New Caledonia, a French colony 900 miles east of Australia, produce nearly all the world's nickel ore. Norway is a small producer. A writer in the "Toronto Star" having made the discovery that the British Empire and France control the supply of nickel ore demands that we should prohibit the export of nickel as it may be used by the enemy for our own destruction. Certainly the Allies have it in their power to do so. Fortunately, however, such a drastic measure is unnecessary and would in fact work more to the disadvantage of the Allies than to the enemy. Manufacturers of armour plate do not want nickel ore in these times. They want nickel and nickel-steel. Obviously there is no sense in Canada putting an embargo on refined nickel for we produce only nickel matte. And if we place an embargo on nickel matte we are simply cutting off one of the sources of refined nickel on which at present the Allies can draw while the enemy cannot. We can hardly hope that Germany will be foolish enough to expect the British fleet to let nickel cargoes pass on to Germany even if they are billed to merchants in neutral countries.

REFINING NICKEL MATTE

Canada produces two thirds of the world's nickel; but exports it all in the form of matte. The "Toronto Star" wants this attended to at once. We hope that the International Nickel Co. and the Mond Nickel Co. will therefore take steps to have all nickel matte refined in Canada. The "Star" man is very much wrought up over it and if something can be done to relieve him we will be very much obliged. It will have to be done at once, however, and not more than two or three days should be spent in erecting the necessary plant and accumulating the chemicals to be used.

Possibly the easiest way to relieve the "Star" man's distress would be to move the New Jersey and Swansea plants bodily to Sudbury. Perhaps the information that Swansea is in Wales and that the Welshmen have no sinister designs on us might placate him a little. But if that New Jersey plant is not moved to Sudbury very quickly or a similar plant erected there before the end of the week that "Toronto Star" editor and his correspondent, Judge Barron, will be very wroth.

Canadians would be very much pleased if all our exports were finished products. Nothing is to be more greatly desired. We would like to export armour plate and automobile parts instead of nickel matte; bread or flour instead of wheat; paper instead of pulp; in fact we would like to send out no raw materials. Every industry that we can successfully establish in this country adds to our wealth.

There are many reasons why we continue to export, as do most countries, some of our raw materials. The one consideration that outweighs all others is the market. If we cannot profitably to ourselves establish refining and manufacturing plants to treat all our raw materials here, we export such materials for treatment in plants in other countries. In this respect all countries are alike.

And so it is in the nickel industry. We hope sooner or later to see refineries established here. But we do not expect to see them until some company with sufficient capital to establish such an enterprise becomes convinced that such an undertaking will be a profitable one. Evidently the companies now refining nickel matte are of the opinion that the present location of their plants is the most suitable.

The "Star" is apparently of the opinion that the refineries should be located here whether it can be done profitably or not. While of the opinion that the establishment of plants here should be encouraged we cannot agree that companies should be forced into unprofitable undertakings. In locating a refinery there are many things to be taken into account. Not the least of these are the sources of all the materials needed in treating the matte.

COPPER SMELTING IN CANADA

Owing to our proximity to the United States, which country alone produces over one-half of the world's copper, the Canadian copper industry seems a rather small one. We are, however, producing, notably in British Columbia, Ontario, and Quebec, no mean quantity, the total for 1913 being 76,975,832 pounds, valued at $11,753,440.

The smelting of copper ores in Canada was first attempted in 1848 at Bruce Mines, furnace men being brought over from Wales. Since then splendid progress has been made and we now have several plants of large capacity, including two of the finest and most complete plants in the world. A description of these plants and an account of the development of the copper smelting industry is given by Dr. A. W. G. Wilson in a volume just published by the Mines Branch, Ottawa.

In the introductory paragraphs Dr. Wilson says:

"The art of copper smelting is now a well known and well established industry. It is probable that more than 95 per cent. of the metallurgical methods, appliances, and machinery employed at any one plant were evolved from the ideas of many investigators working at many different places. Only a very small percentage of the ideas involved in the construction and operation of any one plant are attributable strictly to local talent. The day has long since passed when the efficiency of any copper smelting plant and its superiority to its fellows depends, except in rare instances, upon the careful guarding of its operating secrets. This conception is now so well recognized in the American copper industry that, practically, no copper smelting plant is closed to technical men who present proper credentials when applying for admission. The management of nearly all the larger industrial plants recognize that free interchange of ideas is of mutual advantage. In preparing this report every effort has been made to avoid introducing any descriptions of processes or methods which are considered business secrets by the operators. To make assurance doubly sure every chapter has been submitted to the executive staff of the works concerned for revision. The author is pleased to be able to state that while numerous small additions and corrections were added, no important sections were deleted in this revision."

This readiness of copper mining companies to impart useful information has been frequently spoken of and to it is commonly attributed no small part in the very rapid strides made in the metallurgy of copper.

After presenting an illuminating account of the development of the industry in the several Provinces, Dr. Wilson gives detailed descriptions of the plants of the Canadian Copper Co., and Mond Nickel Co., in Ontario and of the Consilodated Mining and Smelting Co. of Canada, Limited; Granby Consolidated Mining, Smelting and Power Co.; British Columbia Copper Co., and Tyee Copper Co. in British Columbia.

To these descriptions the author adds miscellaneous summaries and a chapter on statistics of copper production.

The report is a very interesting and useful one. It contains numerous illustrations made from photographs and drawings and should prove valuable both to technical men and the general public.

LODE MINING IN YUKON

The Mines Branch, Ottawa, has published an interesting account by Mr. T. A. MacLean of the status of lode mining in Yukon. Mr. MacLean went to Yukon in May, 1912, for the purpose of examining the more important quartz deposits in the mining districts of Dawson, Duncan Creek, and Conrad, with a view to ascertaining their gold content and reporting on their probable economic value. Assisted by Mr. D. MacLachlan, he made a very careful investigation.

Placer gold was found on the Yukon as early as 1869. This river was further prospected between 1873 and 1878, and from 1881 to 1886. Bar mining on the Big Salmon, Lewes, Pelly, and Stewart rivers was conducted with increasing profit, until 1886, when coarse gold was first discovered in Fortymile region—the greater part of which proved to be in Alaska—and later on Sixtymile and its tributaries: the latter being the chief producers of Yukon until 1896, when the Klondike creeks were discovered, and in 1898 and the following years, poured forth their wonderful stream of gold, which by the end of 1912 will have reached a total output valued at more than $140,000,000.

Quartz mineral claims were first staked in 1899, about which time the Lone Star mine, situated at the head of Victoria gulch, came into prominence. Some development work was then undertaken; but this was overshadowed by the rich placer finds, and little was accomplished in connection with quartz.

The population of Yukon in 1900 was about 30,000, and the gold production $22,275,000. In 1912, the population was estimated at 8,500, and the gold production at slightly over $5,500,000; $9,500 being produced by gold lode mining operations.

With the decrease in the production of placer gold, the hopes of the residents have for some time been directed to lode mining, and a certain amount of desultory work and development have been undertaken over a large area, but with only indifferent results. This is due, in part, to the following facts: (1) that prospectors were generally unfamiliar with lode mining; (2) that little or no high grade ore had been located, and consequently, capital for development of low grade was difficult to secure; and (3) that some considerable expenditures have been inadvisedly made on a number of properties.

Claims are located over wide areas throughout the mining districts of Dawson and Duncan creek in northern Yukon; Conrad and Whitehorse in the south; besides extensive areas in the White river and other outlying portions of Yukon territory.

Mr. MacLean gives detailed information concerning a very large number of properties. His report is accompanied by 6 maps, 39 sketches, and 40 photographs. The sketches are designed, primarily, with a view to their being of use to prospectors in the field: by indicating the points sampled on their various properties.

In summing up Mr. MacLean says:

"The examination herein described has verified the fact that throughout the whole district traversed quartz is found abundantly. It has also established certain preliminary values in connection with practically all the known deposits of the Dawson and Duncan Creek mining districts, and also in connection with at least a few of those in southern Yukon. A number of these deposits have proven sufficiently good to warrant the opinion that further development, accompanied by more detailed sampling, might demonstrate beyond reasonable doubt that the prospects have a future as mines. The chief among these are situated in southern Yukon, where the ore consists generally of quartz carrying argentiferous galena and gold. The Humper group of Merrers. Dail and Fleming, and the Venus mine, both on Windy Arm, show values in gold and silver which range from $2 or $3 up to $96 per ton. The Whirlwind group and the Tally-Ho group, both on Wheaton river, show up well. In northern Yukon the prospects at Dublin gulch are considered to be good ones. Chief of these is the Stewart and Catto group, with values which range generally between $3 and $16 per ton. The Olive and the Eagle groups, adjoining these, are also worth while. The latter shows assay values as high as $70.80 per ton, but has undergone little development.

"In the vicinity of Dawson are the Lone Star mine, the Violet group, the Mitchell, the Gold Run group, and others, deserving of mention. These properties could not, in one season, be examined in sufficient detail, nor can the report on them be sufficiently final to interest capital. Mining methods, except in a few cases, have been crude and unscientific; and money has been expended in the vicinity of possible ore deposits rather than in the development and proving of these deposits. Methodical sampling has generally been neglected. The territory is in great need of more prospectors and lode miners, and of funds to finance them, as well as of mining engineers to direct and assist them.

"The cream of the known placer deposits has been already skimmed, and the Canadian people, as a whole, have benefited greatly as a result of mining operations in Yukon. Already, prospectors and miners now in the field have been encouraged by the interest shown by the Dominion Government in undertaking the work above described; and during the past season have frequently suggested that much good would result if the services of a mining engineer were constantly available throughout the district. Certain it is that the work of further testing the better properties, in addition to looking over others that have so far not been examined, should be pushed with vigor.

"In Dawson mining district, with its typical occurrence of free gold in spots, mill tests of quartz from such properties as the Violet, the Eldorado Dome, the Virgin mineral claim, the Mitchell, etc., should be made. This might be done by special arrangement with the owners of the Lone Star mill. It is believed that the latter company would be willing to work in harmony with the owners of these claims, to the extent of allowing such tests under the supervision of a government mining engineer, who would look after the interests of the different parties and check results. In the case of prospects at Dublin gulch, and of those in southern Yukon, the conditions are different. The gold here generally occurs either disseminated as minute dust or in refractory form with sulphides; hence these prospects will advantageously admit of more detailed sampling and assaying in connection with any further investigation of their individual extent and economic value.

"In connection with the placing in operation of the government diamond drills, it should be noted that there is very important work for them in proving the Whitehorse copper deposits at depth. It has been stated in this report that shipments of copper ore from Whitehorse amounted, during the season of 1912 to about 30,000 tons. It is important to Yukon that these operations continue, as they undoubtedly must, if the ore bodies are ultimately found to be of sufficient extent and value. The work of testing with these drills should, in the interests of the public, be supervised by a government mining engineer. It is probably unnecessary to refer to the fact that of the 200,000 square miles in this territory only the fringe has been scratched. Upon the government of the day devolves, in a measure, the responsibility for development of the Canadian frontier, and that it realizes this responsibility is amply demonstrated by such recent incidents as the Stefansson grant, for the purpose of northern exploration, and by similar aid in connection with the coming to Canada of the International Geological Congress during the season of 1913. As a result of this Congress, it is expected that, after looking over the Canadian field, mining engineers and geologists from practically every country will carry away with them a conception of the possibilities of Canada's mineral wealth, and advertise it the world over.

"It is, therefore, worth noting that this is a crucial period in the history of lode mining in Yukon, when, as yet, practically all the properties are at prospect stage; hence, too much stress cannot be laid upon the necessity of giving the prospectors and miners further assistance. The latter, in many cases, have reached a point beyond which, through lack of means, they cannot go. If a further examination of the promising properties substantiates the opinion formed, as a result of the above mentioned preliminary examination, a report to that effect would be definite and conclusive, and capital for development would doubtless flow into the district. If even two or three properties were then placed on a paying basis, a great impetus would be given the lode mining industry throughout the whole territory. If, on the other hand, prompt aid along the lines suggested be now withheld, the district will probably experience a serious setback, and what has already been done during the past season will be rendered largely ineffective."

"BUSINESS AS USUAL" ON THE RAND.

"You may depend on it that no matter what happens supreme efforts will be made to keep the gold mines and mills of the Witwatersrand working at full capacity," remarked a well known mining man to a representative of the South African Mining Journal in reply to a question as to the outlook for a maintenance of operations along the Main Reef series. "And you can depend on it, too," continued our informant, "we shall succeed in these efforts and that there will be no appreciable diminution of production from the auriferous conglomerate beds of the Rand. Probably no other industry in the Empire is of such immense importance to Greater Britain in this critical juncture of our history than the gold mines of the Witwatersrand. Gold is one of the few articles that the world is prepared to buy in large quantities at the present time. It is essential not only to this country that the Rand, which produces nearly two-fifths of the gold output of the world and is by far and away the greatest industry in South Africa, should not be interrupted in any way, but it is of paramount importance to Greater Britain and to the trade of the whole Empire that our mines should continue to yield up gold, for gold whilst it is valuable in times of peace is doubly valuable in times of war. Yes, the industry will be kept going. The outlook for delivery of future supplies is very bright, and every possible precaution is being taken to ensure its ordered running."

TO INVESTIGATE LABOR CONDITIONS.

Hon. W. L. Mackenzie King, ex-Minister of Labor, has accepted a most important position offered him by the trustees of the Rockefeller foundation to conduct a world-wide investigation into ways and means of improving the relations of capital and labor and benefiting the conditions of the workers, etc. The foundation, which is backed by an endowment of upward of $100,000,000, has selected Mr. King for the position as being the author and first administrator of Canada's labor legislation for the prevention of strikes and lock-outs and one of the best known authorities on the continent on labor and social problems. He will have full charge of the investigation, which will be searching and thorough, and will be conducted for years in the hope of securing legislative and industrial reforms throughout the world.

In speaking of the appointment Mr. King said:

"I have been granted by the foundation a perfectly free hand in the shaping of the work and necessarily it will involve the giving up of much of the political work to which I have devoted most of my time since 1908, when I resigned the position of Deputy Minister of the Department of Labor to enter politics."

GOLD MINING IN THE CITY OF EDMONTON, ALBERTA

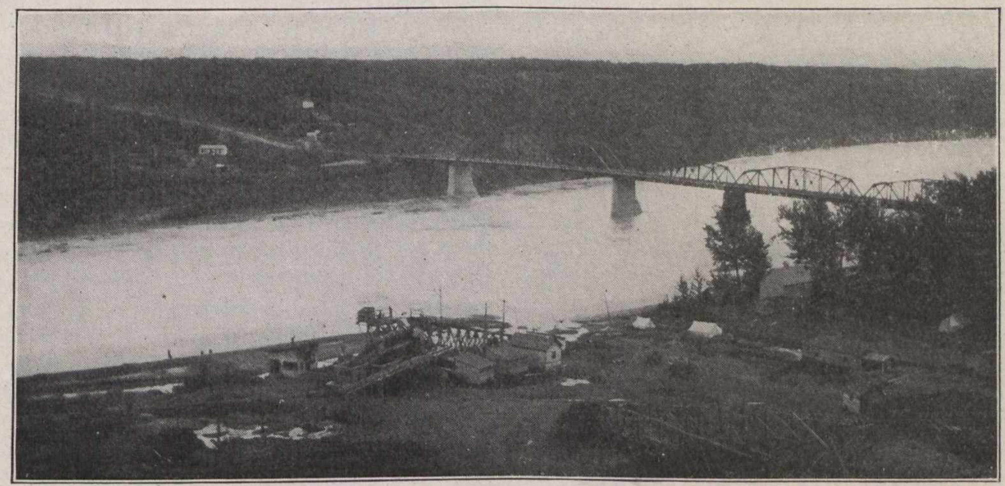
By F. J. Dickie.

In Edmonton since the outbreak of war the bars and banks of the Saskatchewan river, which runs almost directly through the centre of the city, are being once more worked for gold. In the early days and up to as late as 1900 miners worked on the river, making from three to fifteen dollars a day; but of late years the river has been deserted. With the outbreak of war and the possibility of many being out of employment the City Council turned their attention to the river bars. A number of old mining men, who settled in Edmonton after the rush to the Yukon constructed several sample "grizzlies." One of these was placed back of the City Hall, and for a few days demonstrations were given by experienced miners on how to work them. As a result within two weeks the river banks were dotted for several miles with "grizzlies" and about a hundred men are now at work in these unromantic diggings situated in the heart of the city and within sight and sound of its traffic.

The work is not easy, nor is any sudden fortune apt to be gained, the average daily clean-up per man running about one dollar and a half to two dollars per day, but more than sufficient is being made to keep the workers living. Many of the workers are married men with families dependent upon them.

Some of the miners have found a little difficulty in disposing of their clean-ups, not on account of the quantity so much as because many of the banks lack the necessary scales to weigh it properly. Then again, they are dubious of its quality, as some of the miners are inexperienced, and when collecting it by mercury method do not clean it properly, allowing impure matter to remain in the nugget. In the past week the Imperial Bank, which is accepting a good deal of the gold, took in about two hundred dollars' worth. It is difficult to estimate the amount mined in the last month, as many are slow to cash in their clean-ups.

Daily, as they become satisfied that there is a good living wage to be made, more persons are erecting their "grizzlies" along the river.



SASKATCHEWAN RIVER AT EDMONTON

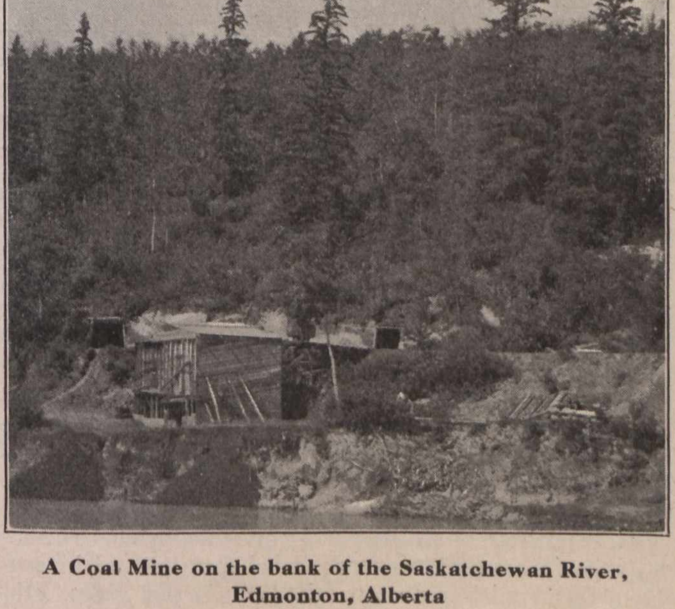
The gravels are being panned for gold. In foreground is a gravel sorting plant from which some gold is recovered incidentally

LAKE SUPERIOR CORPORATION.

The annual meeting of the Lake Superior Corporation was held on Oct. 7 at Cambden, New Jersey. The old board of directors was re-elected as follows: J. Frater Taylor, W. K. Whigham, H. Coppell, F. McOwen, J. T. Terry, W. E. Stavert, J. S. Dale, C. B. Gordon, W. C. Franz, D. C. Newton, T. Gibson and Jas. Hawson. J. Frater Taylor was re-elected president of the company.

President Taylor, in addressing the shareholders, stated that the aim of the management since 1909 has been to concentrate the resources of the corporation on the building up of its largest earner, Algoma Steel Corporation, Ltd. In pursuance of this policy several assets have been sold.

The Algoma Steel Co. now has a steel plant equipped with every modern appliance, comprising 110 coke ovens, 3 blast furnaces, a Bessemer plant, an open hearth plant consisting of 740 ton furnaces with a 250 ton mixer, representing a steel making capacity of



A Coal Mine on the bank of the Saskatchewan River, Edmonton, Alberta

500,000 tons, rolling mills with a capacity of 400,000 tons of rails and merchant mills with a capacity of 80,000 tons per annum.

The geographical position of the plant places it in a commanding situation to supply the great and increasing market in the Canadian West, whilst the quality of the steel rails produced has an excellent reputation in Canada and the United States.

The company makes its own coke from coal from its own mines and operates its own limestone quarries. Very large deposits of iron ore have been located on the line of the Algoma Central and Hudson Bay Railway, one of the corporation's subsidiaries. These ores are continually used in the blast furnaces.

The corporation mined in the year ending June 30, 1914, 114,782 tons iron ore, 560,181 tons Cannelton coal, 140,125 tons Pocahontas coal and 300,828 tons limestone, and manufactured 433,679 tons coke, 311,904 tons pig iron and 325,680 tons steel rails.

Net earnings for the year were $1,762,109.91, in addition to a surplus of $172,855.99 in operating the coal and limestone properties.

A falling off in demand for steel rails is expected, and it is probable that mills will be installed for the manufacture of structural steel and plates.

ASSAYING COBALT SILVER ORES

Mr. A. M. Smoot, in a communication to the Secretary of the Canadian Mining Institute, published in the September bulletin, discusses Mr. Campbell's paper on "Sampling Cobalt Silver Ores." Regarding methods of assaying he says:

The method of assay used in our laboratory, and I believe practised elsewhere both in the U. S. and Canada, is quite different from the straight scorification method used at Cobalt. Quarter or half assay ton portions of the pulp are taken, the former weight if the sample contains over 2,000 oz. per ton, the latter if the silver is less than this. The pulp is treated in beakers with strong nitric acid added a little at a time until danger of frothing is past. About 75 C.C. of acid is required for ¼ A.T. portions and 100 C.C. for ½ A.T. portions. The solutions are heated on a steam bath until red fumes cease to be generated and then they are diluted with 200 C.C. of distilled water and allowed to stand until cold—best over night. It is very important that the solutions be allowed to stand before they are filtered because with certain ores containing much arsenic together with some antimony and lime, a white crystalline coating appears on the bottoms and sides of the beakers which cannot be detached by washing, or even scraping. This coating contains a little silver, and if it is not allowed to form in the original nitric acid solution it forms later on in the process and makes trouble. Insoluble residues are filtered off and washed thoroughly. If there is any coating on the sides and bottoms of the beakers which cannot be readily detached with a piece of filter paper, it is treated in the beaker with a hot solution of caustic soda which quickly disintegrates it. The caustic soda solution is acidulated with a little nitric acid and washed into the filter with the insoluble residue. Most of the silver is dissolved by the original nitric acid treatment and passes through the filters as silver nitrate, but a little remains with the insoluble. If the insoluble residues are large in amount they are dried and burned in crucibles, fused with sodium carbonate, borax glass, litharge and a reducing agent. If they are small, they are dried and burned in scorifiers and scorified with test lead and borax glass. In either case, the lead buttons from the insolubles are reserved. Standard sodium chloride solution is added to the nitric acid solutions containing most of the silver in amount sufficient to precipitate all silver as chloride, but avoiding any considerable excess of the precipitant. The silver chloride is stirred briskly until it agglomerates and then allowed to stand for an hour until it settles and the supernatant liquid becomes clear. If it remains cloudy, rapid stirring is repeated and it is again allowed to settle. The clear solutions are filtered through double filter papers and the silver chloride precipitates transferred to the filters by a water jet and there washed slightly with water. The beakers are washed well with a wash bottle jet and any traces of silver chloride remaining in them are wiped off with small pieces of filter paper which are placed in the filters. Filters containing the silver chloride are transferred to scorifiers which have been glazed on the inside by melting litharge in them and pouring away the excess. The glazing is done to prevent the porous scorifiers from absorbing moisture from the damp paper, and as a further protection, a small disk of pure sheet lead is placed beneath the filter papers. The scorifiers are transferred to a closed oven heated to about 250°-300°C., where they are dried and the paper is slowly charred until it is practically all consumed except a small amount of carbon. This method of burning the filter papers is an essential step, since it avoids losses of silver chloride which are apt to occur if the burning is done rapidly in a muffle. Fine test lead is sprinkled over the burned silver chloride residues and the lead buttons resulting from the crucible fusions or scorifications of the corresponding residues insoluble in nitric acid are added. Scorification is then conducted at a low temperature so as to obtain 15-gram lead buttons. These are cupelled at a low temperature, taking care, in the case of large silver buttons, to avoid "spitting" at the end of the cupellation.

This combination method, properly conducted, yields results higher and more concordant than can be attained by any all-fire process. It is, nevertheless, a commercial assay and is acceptable to the smelters since it does not include slag and cupel corrections. Inasmuch as all impurities likely to effect variations in the volatilization and slag losses are removed prior to the fire work, the results of assays made on different days and in different muffles, under different conditions, are more uniform than when the fire assaying is done directly on the untreated ores.

WILL INVESTIGATE IRON MINING INDUSTRY.

Pursuant to a request made to the Dominion Government for the granting of some measure of assistance toward the development of iron ore mining in Canada, and in accordance with the statement of the Honorable the Minister of Finance in his budget speech during the 1913-14 session of Parliament, that the iron mining industry would be investigated, a committee has been appointed to enquire into the situation and to report the facts to the Government.

Every owner or operator of an iron ore property in Canada should be interested in facilitating this enquiry and should communicate with the Deputy Minister of Mines at Ottawa, or the secretary of the committee, who will furnish a schedule of questions covering the information required by the committee.

THE MOND NICKEL COMPANY'S SMELTING PLANTS AT VICTORIA MINES AND CONISTON, ONTARIO*

By A. W. G. Wilson.

The Mond Nickel Co. owns about 4,500 acres of mining lands, in fee simple, and controls about 2,500 acres under lease, a total of 7,000 acres in all, situated in the townships of Blezard, Denison, Snyder and Garson, Sudbury district, Ontario; additional areas have also been acquired recently. The ores mined are deposits of nickeliferous pyrrhotites containing some chalcopyrite, and occurring in norite; they contain about 2.3 per cent nickel and 1.75 per cent. of copper in addition to small amounts of gold, silver, platinum and palladium. For many years the principal property was the Victoria mine, first opened about 1899. Two ore bodies, about 160 ft. apart, occurred on this property. They lay with their longer horizontal axes almost on an east and west line, and had a uniform dip of about 75 degrees towards the east. Development work was by diamond drilling, followed by shaft sinking and the running of levels. The main shaft is a 3-compartment shaft, 800 ft. in depth, 4′ × 12′ inside the timbers; ten levels have been driven from this shaft to reach the ore body.

The other important mine which has supplied ore for a number of years is the Garson. There are two ore bodies at this mine, about 100 ft. apart, and the development and mining have been through a 500 ft. shaft.

Extensive diamond drill work, based on the results of magnetic surveys, has shown the existence of a large body of ore on property belonging to this company, adjacent to the Frood mine, lot 6, concession 6, township of McKim. Preparations are now being made to mine this ore body on a large scale.

The company also owned and operated a smelter at Victoria Mines, Ontario, on the Soo branch of the Canadian Pacific Railway, about two miles from the Victoria mine, and 22 miles west of Sudbury.

The company has erected a modern and fully equipped plant at Coniston, about seven miles east of Sudbury. The new plant is more conveniently situated with respect to railway transportation and the future ore supply. Descriptions of both the old and the new works are included in the present report.

The ore supplied for the old plant was conveyed to the roast yards and thence to the smelter over a Bleichert aerial tram line, 11,000 ft. in length. Ore from the Garson mine was brought about 31 miles in 50 ton bottom dump steel railway cars to Victoria Mines; from here a portion was sent to the roast yards over the tram line and the balance went directly to the furnaces.

Ore supplies for the new smelter will be derived chiefly from the Garson and the Frood mines, a portion of the ore body of the latter being on the property of this company. The haulage distance to the new roast yards, about a mile and a quarter from the smelter, will be 10 and 12 miles respectively, chiefly over the Canadian Northern Railway.

Power for the Victoria mine and smelter was furnished by a hydro-electric plant, owned by the company, and located at Wabagishik Falls on the Vermilion river, in Lorne township, and about eight miles from Victoria Mines. Power for the Garson mine was procured from the lines of the Wahnapitae Power Co., whose two power plants are located on the Wanapitei river not far from Coniston. The new smelter is operated by Wanapitei power.

Historical.—In the year 1899 the company began operations in the Sudbury district by extensive stripping and other development work at the Victoria mine. This work included the building of roads, the preparation of a roast yard and other preliminary work. In 1900 the smelter was erected on its present site, under the supervision of Hiram W. Hixon. The Bleichert tram line, 11,000 ft. in length, was installed by the Trenton Iron Co. of New Jersey to connect the mine, roast yards and smelter. The furnaces were first blown in early in 1901. The mine and smelter were closed down in December, 1902, and were not again in operation, except for a few months in the summer of 1903, until near the end of 1904. Since that date the plant has been in continuous operation, with only slight interruptions. The first furnaces were 44″ × 120″ at the tuyeres; in 1908 the plant was remodelled and the size of the furnaces was increased to 44″ × 180″.

In 1911 the site for a new smelting plant was selected at a point about 2 miles from Romford Junction on the Canadian Pacific Railway, conveniently located, both with respect to two transcontinental railway lines and to the principal mines owned by the company. A new modern smelting plant has been erected on this site. Two blast furnaces, 50″ × 240″, have been erected and space for a third is provided. Two Peirce-Smith basic converters, 10′-0″ × 25′-10″, are also installed. All the auxiliary equipment necessary has been provided.

Victoria Mines Plant.

This plant has ceased operation. It has, however, served its purpose well and has been an important factor in the development of the copper-nickel industry of the Sudbury district. A brief description of the equipment and the method of operation is of interest and may also be of future value as a matter of record.

General Statement of Equipment.—The plant is equipped with two water jacketed blast furnaces, 44″ × 180″, each capable of treating 400 to 450 tons of ore charge per day, under present practice. The converter building is equipped with two electric operated converter stands, and 6 shells, each 84″ × 126″, and a 30 ton, three-motor, Morgan travelling crane. Power is electric, supplied by the company's plant at Wabagishik falls on the Vermilion river; a boiler plant is held in reserve at the smelter. The blower plant includes two Connersville blowers, and a Nordberg compressor for the converter air. The buildings include office and laboratory, engine house, well equipped shops, club house, boarding houses and about 40 detached dwellings.

Bleichert Tram Line.—This tram line is 11,000 ft. in length and runs from the Victoria mine to the smelter. It is equipped with loading terminals at the mine, at the roasting yards and at the smelter, and with discharging stations at the roast yards and smelter. The buckets each hold about 700 lb. and travel the 2 miles from the mine to the smelter at such a rate as to deliver about 100 loads per hour. The roast yards are located between the mine and the smelter and about

*Extracts from "The Copper Smelting Industries of Canada," by A. W. G. Wilson, Mines Branch, Ottawa.

half a mile from the latter. Ore from the Garson mine is delivered into tram bins near the smelter by Canadian Pacific Railway ore cars; this ore is then raised by a small skip to charging bins on the tram line whence it is conveyed to bins at the roast yard. The tram line also carries Victoria mine ore to the roast yards, roast ore to the smelter and waste rock from the Victoria mine to the dump. The operation of this tram line is such that each bucket is idle for only a short portion of the entire round trip from Victoria mine to smelter and return.

The difference in elevation between the mine and smelter is only about 160 ft. Owing to the heavy duties required of the tram, this fall is not sufficient to operate it, and additional driving power was furnished by 30 h.p. motor installed at the lower end.

Flue System and Stacks.—The downtakes of the blast furnaces lead to a steel dust flue with continuous V bottom. Slides are provided on either side at about 4 ft. centres, for the removal of flue dust. The main stack is of steel plate and is about 115 feet in height. The lower part of the stack, about 24 ft. in height, is shaped as a truncated cone, the upper portion is cylindrical. The converter flues connect with the main stack.

Buildings.—The smelter building is a steel frame structure, covered with corrugated iron sheeting. The electrical sub-station, in which the power plant was also placed, was a wooden trussed brick building with concrete floors, 50′ × 90′; the roof was composite, being covered with corrugated steel on the outside and lined with matched pine. The various shops were housed in wooden structures.

Coke, Fluxes, Silica.—The coke used in the furnaces comes from Pennsylvania. It is shipped by water to Algoma Mills, 73 miles west of Victoria Mines, where it is loaded into box cars, or coke cars, and hauled to the smelter by the Canadian Pacific Railway. The freight charges amount to about $5.60 per ton on coke that costs $1.10 per ton at the ovens.

Limestone, which forms about 4 per cent. of the furnace charge, is obtained from the Fiborn quarries in Michigan.

Blast Furnaces.—The two furnaces are each 44″ × 180″ at the tuyeres. They are mounted on concrete foundations at an elevation of 6 ft. above the converter floor. The superstructure is of structural steel above the charging floor; the hood, stack and downtake leading to the flue are of steel plate. They are water-jacketed steel furnaces with brick tops, and cast-iron sole plate 2 in. thick. Their capacity is 400 to 450 tons of ore charge per 24 hours for each furnace, under the present method of operation.

The furnaces as originally constructed each consisted of two tiers of water-jackets, three jackets on each side to each tier. The upper tier has now been replaced by brick; the inside brickwork is of firebrick, the outside of common brick. The furnaces are charged from the side, the charge doors being operated with a pneumatic lift. The charging floor is 14 ft. above the tapping floor. The furnaces are provided with special water-cooled cast-iron spouts, each provided with only one set of water pipes. The spouts are lined with chrome brick and similar brick is also used at the tap holes. The crucible is built within a plate steel box, and is carried by the sole plate. Chrome brick laid in magnesite cement is used for this; the magnesite cement is mixed with magnesium sulphate water.

The settlers are circular, each 12 ft. in diameter and 4 ft. in depth.

Converters.—There are two electrically operated converter stands and six Allis-Chalmers improved, 84″ × 126″ shells. The stands are operated from a pulpit by individual controllers and air valves. The converter shells and 5 ton cast-steel matte ladles are handled by one 30-ton, 3-motor Morgan travelling crane.

Lining for the converters is prepared by a 7″ × 10″ Blake crusher, and two 6 ft. Chilian mills direct connected to a 30 h.p. direct current motor.

Blower Plant.—Air for the blast furnaces is supplied by two Connersville blowers, each having a capacity of 15,340 cubic ft. of air per minute at 40 oz. pressure running at 130 r. p. m. Each of these is belt connected to a 200 h.p. constant speed motor, taking current at 550 volts, and running at 580 r.p.m. The air pressure at the furnaces is about 38 oz. Air from the blowers is delivered to a common receiver, and conducted to the bustle pipe of the furnaces. Bustle pipes run along each side of each furnace and across one end.

Air for the converters is supplied by a Nordberg duplex air compressor, capacity 6,000 cubic ft. of free air per minute, compressed to 12 lb. pressure, at 82 r.p.m. The low pressure cylinder is 34 in. in diameter, the stroke 42 in. The flywheel is 18 ft. in diameter and is grooved for 18 ropes each 1.25 in. in diameter. This machine is driven by a constant speed 315 h.p. induction motor running at 345 r.p.m., receiving current at 550 volts. This blowing engine is fitted with mechanical inlet Corliss valves and poppet discharge, and is regulated by the air pressure from the receiver through floating levers to the governor, this controlling the cut-off on the Corliss inlet-valves.

Fine dust is drawn from the flue through the slide doors into a barrow. It is wetted and fed to the furnace from hand barrows.

Smelting Practice.—Roasting—About two-thirds of the ore treated is first sent to the roast yards, about half a mile from the smelter and north of Victoria Mines station. Green ore is received at the tramway unloading station in the roast yards and dumped in a pile. Here it is shovelled into buckets and hoisted to the level of the staging that is built over the roast yards and is loaded into end-dumping hand lorries, holding about 1,000 lb. each, which are pushed by hand to the roast piles. Each roast pile, when completed, contains about 3,000 tons of ore and covers an area of 40′ × 150′; the piles are built in a row, with the longer exes parellel, and about 10 ft. between piles. To build a new pile a light pole staging is erected over the roast bed, and rails are laid in this staging to accommodate the lorries. A bed of dry wood, about 3 ft. in depth, carefully and properly piled, is then laid as a base for the proposed roast pile. Upon this wood ore is piled, to a depth of about 10 ft. A top dressing of 8 in. to 10 in. of fine ore is then spread over the top of the pile and down the sides and ends. The rails and stringers of the staging are then removed, the poles being left standing in the pile. The wood of the pile is then ignited; the whole pile will be alight in about four days. The pile is carefully watched, blow holes are stopped whenever they appear, and the roast continues for about 100 days, by which time about half the sulphur has been burned out, the green ore containing about 20 per cent. of sulphur, at the start.

After cooling, the roast heaps are loosened up by blasting. The roasted ore is shovelled by hand into cars and hauled by a horse to the aerial tramway. Here it is hoisted by a skip and dumped into the loading bins. Three men are required at the hoist in the roast yards; two men are required on each lorry; about 15 men in all are employed in these yards. The average output of the yards per day is, approximately, 475 tons of roasted ore, when the plant is operating at full capacity.

All ore from the Victoria mine is weighed into the roast yards at the mine; that from the Garson mine is weighed at the smelter before being sent to the yards. All roasted ore is weighed out of the yards.

Smelting.—At the smelter, ore, coke and fluxes are all stored in bins placed with their discharge chutes above the level of the charging floor, so that the charge barrows can be run beneath them. The furnaces are charged by hand lorries holding about 800 lb. each. The ore charge consists of two parts roasted ore to one part of green ore; the coke makes up about 8 per cent. of the whole charge. A typical charge will consist of about 1,200 lb. of roasted ore, 600 lb. of green ore, 300 lb. of scrap and slag, including 75 lb. of limestone and 250 lb. of coke.

The practice is to granulate the furnace slag, which is then flushed out to the edge of the dump.

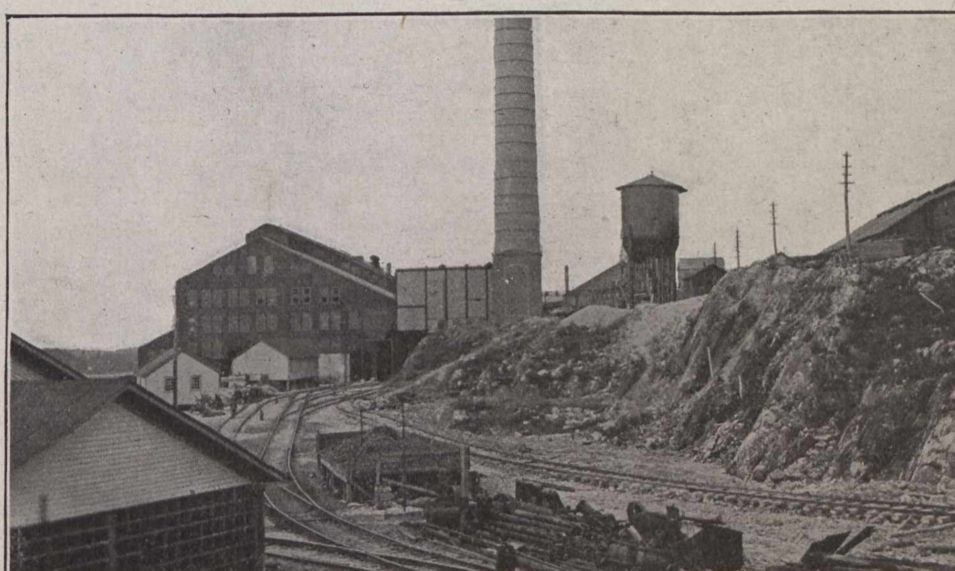
Coniston Plant.

The site for the new plant at Coniston was chosen only after very careful surveys. The new smelter is located on a rocky hillside overlooking a large swampy flat which gives ample storage room for large slag piles.

The roast yards are located about three-fourths of a mile from the smelter, to the south-east, on the other side of the ridge at whose foot the smelter is placed. They are connected directly with the Canadian Northern Railway and the Canadian Pacific Railway, and are also connected with the smelter by a spur line belonging to the company.

A new townsite has been selected and laid out, north of the Canadian Pacific line and about one mile from the smelter. Coniston will be a model town provided with every modern convenience.

General Statement of Equipment.—The main smelter building has a concrete substructure resting on bedrock, and a structural steel superstructure. In this building are placed two new modern water-jacketed blast furnaces, 50″ × 240″, and two Peirce-Smith converters, 10′-0″ × 25′-10″. Provision has been made for an additional blast furnace which will be added when required. The power building is located on the hill above the smelter. The ore bins are placed beyond this and a rock house stands south-east of the smelter and over the lower tracks. A semi-circular track leads from beneath the ore bins to the charging floor of the smelter building. It is carried over the slag tracks on steel trestles resting on concrete piers.



New Smelter of Mond Nickel Co., Coniston, Ont.

Converting.—The furnace matte, containing about 33 per cent. copper and nickel, is collected in the settlers, which are tapped at intervals. From the settlers furnace matte is run into pots, which are lifted by the travelling crane and charged directly into the converters. Matte from No. 1 converter is blown up to about 60 per cent. copper-nickel. It is then skimmed and the slag is sent to the furnace settler while still hot and liquid. The matte from converter No. 1 is then charged to converter No. 2, and blown to about 80 per cent. copper-nickel. The slag from this converter also goes to the furnace settler, and the matte is run into a pot, from which it is poured on a matte bed to cool. There are four of these matte beds, each 4′ × 15′. It is customary to draw matte from the settlers at the same time as converter slag is being poured, thus preventing the overloading of the granulating streams.

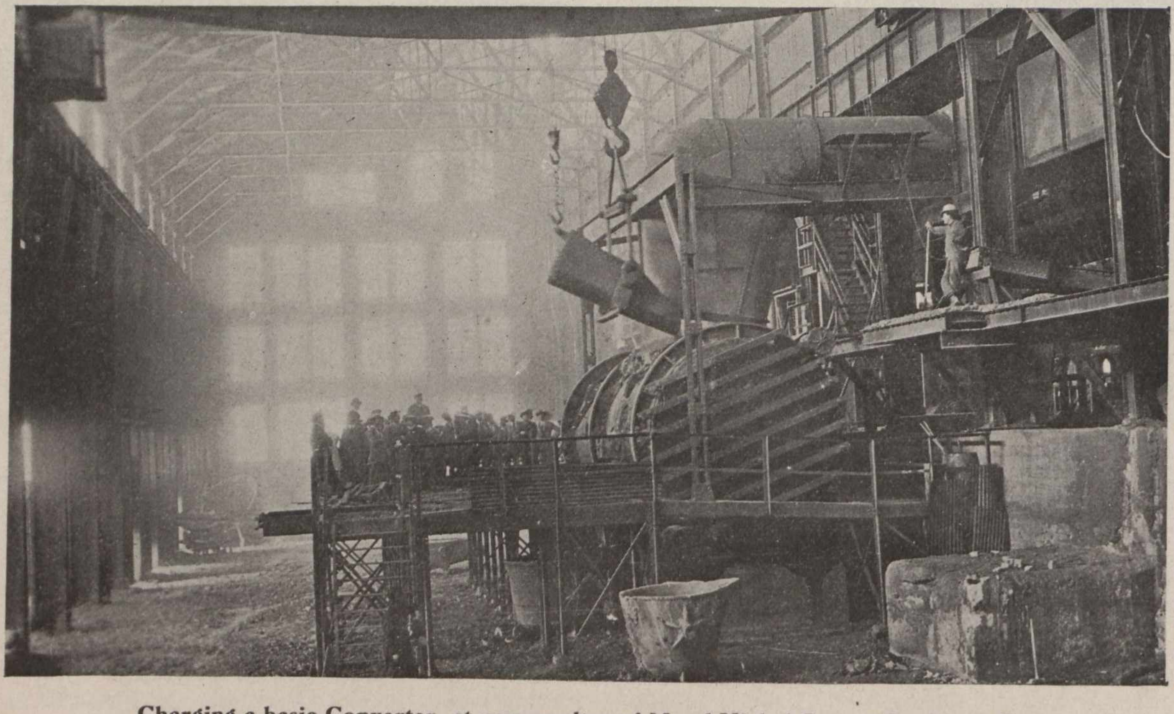
The final Bessemer matte produced contains about 38 per cent. copper and 42 per cent. nickel, and about 15 per cent. iron, the balance being sulphur and other impurities. It is broken up on the beds, put into barrels, and shipped to the Mond company's refining works at Swansea, Wales.

Receiving Ores.—Spur lines have been built connecting both the Canadian Pacific and the Canadian Northern Railways with the roast yards, the smelter yards and the smelter ore bins. Ores from the mines to the north will come into the roast yards over the tracks of the Canadian Northern Railway and can be delivered directly to the yards, or shunted over the company's spur line to the smelter bins. Ores from the west will be diverted to the Mond Nickel Company's spur line at Coniston station, and can be run either to the smelter bins or to the roast yards. Ore from the roast yards can also be conveyed over the spur line to the smelter bins on the high line above the smelter.

Power.—Power to operate the plant is entirely electric and will be obtained from the power lines of the Wahnapitae Power Co. This corporation has two power stations on the Wanapitei river not far from Coniston.

Buildings.—The main smelter building is of steel construction with a concrete substructure, 90′ × 360′, resting upon solid rock; there is a monitor on the roof running the length of the building. A lean-to shed, 21′ × 240′, on the north-west side, houses the converter plant; a similar lean-to, on the south-east, about 30′ × 210′, covers the slag track and the main flue.

A slag cut on the south-east side is provided with a standard gauge track. The tapping floor is 14 ft. higher, and the charging floor 24 ft. 2.5 in. above this. The furnace platform is 24 ft. in width and 210 ft. in length. The matte floor on the north-west side is 10 ft. below the level of the furnace floor and about 56 ft. in width.



Charging a basic Converter, at new smelter of Mond Nickel Co., at Coniston, Ont.

The power house built on the hill south-east of the smelter, is a brick and steel structure with concrete foundation and a tile roof.

Flue System and Stacks.—The main flue is rectangular in cross-section 10′ × 15′, built of sheet steel. It leads to a dust chamber 30′ × 50′, built of stack brick, which connects the base of the stack. The main stack rests on bed-rock; the lower 25 ft. of the stack is square in section and is built of red brick, the upper cylindrical portion, about 16 ft. in diameter, is built of Custodis stack brick. The height is about 175 ft.

The main flue is provided with 27 hoppers, placed at 7.5 ft. centres, in sets of two, between the main bents of the supporting structural steel work. There are also four large hoppers placed between the main flue and the brick dust chamber. The bottom of the dust chamber is fitted with 6 rows of steel hoppers, 9 to a row, the distance from centre to centre being 56 in. Each hopper is provided with a circular discharge gate 13 in. in diameter, closed by a lever operated slide. The hopper chutes beneath the dust chamber deliver to a common space so arranged that the flue dust can be run into a V-shaped auxiliary hopper of sheet steel hanging above a standard gauge track in the slag cut. Six chutes deliver from this hopper to a car placed beneath.

Blast Furnaces.—There are two Allis-Chalmers rectangular water-jacketed copper blast furnaces, 50″ × 240″, each furnace being provided with a brick lined steel crucible and a brick top above the single tier of jackets. The height of the furnace is 32ft. 2.5 in. to the base of the hood; the hood measures 12 ft. 6 in., giving a total height of 44 ft. 8.5 in. A goose neck, 7 ft. 6 in. in diameter, connects each furnace with the main flue, and a straight stack, closed by a damper, rises 15 ft. above the hood.

Each furnace is carried on structural steel columns, the jackets being hung from I beams. The crucible rests on three rows of nine supporting columns each 5 ft. in height. It consists of a rectangular steel frame about 6 ft. in width, 21 ft. 9 in. in length, and 25 ft. in depth, made of I beams; the sole plate is of cast-iron in four sections. This crucible box is lined with chrome brick around the sides, ends and bottom, reducing the internal width to 4 ft. 2 in.

Above the crucible there is a single tier of water-jackets, eight on each side, each 8 ft. 2 in. in height. The width of the furnace is 4 ft. 2 in. at the tuyeres, at the top of the water-jackets it is 5 ft. 9 in.

The throat of the furnace above the water-jackets is built of ordinary brick and lined with firebrick, forming a jacket 12 in. in thickness, the top being 3 ft. 7 in. below the charging floor. The space between the charging floor and the top of the brickwork is bridged by inclined apron plates.

At the ends of the furnace the brickwork is carried to the top of the furnace 8 ft. above the charging floor. The charge doors along the sides of the furnace are operated by counter weights.

The settlers are about 15 ft. in diameter. They are placed beside the furnaces and discharge matte and slag from opposite sides.

The furnaces are placed parallel to the length of the building and may be charged from either side. Space has been provided for three, but only two are being installed at the present time.

Converters.—The converters installed in the new plant are of the Peirce-Smith type of basic converter with shells 10 ft. in diameter and 25 ft. 10 in. in length. Two have been installed in the building.

The lining of each shell consists of 16 in. silica brick and 9 in. magnesite brick at the bottom, and 9 in. magnesite brick at the top. At the tuyeres special 18 in. magnesite brick is employed.

Each shell is provided with 30 tuyeres placed 14 on one side of the stack and 16 on the other, none coming directly below it.

The blowing stack is 3 ft. 7 in. in diameter, but the lining reduces the free space to 2 ft. 9 in. It is placed near the median riding track, its centre being 11 ft. 2 in. from the end of the shell opposite the bustle pipe. The pouring spout is placed 7 ft. 7.5 in. from the same end and about 77 degrees of arc below the stack.

The ends of the shell serve as annular tracks upon which it may be rotated, and a third riding track placed 7.5 in. to one side of the middle of the length of the shell has also been provided. The track rests on rollers carried on cast-iron bearing plates, bolted to a concrete foundation.

The shells are turned by steel ropes, pulled by a sliding gear operated by an electric motor and a worm screw, with an 8 ft. stroke.

The converter floor is served by two 50 ton Whiting cranes.

Wabagishik Power Plant.

The hydro-electric plant belonging to the company is located at Wabagishik falls, on the Vermilion river, 8.5 miles from Victoria Mines station on the Canadian Pacific Railway.

The power house is a concrete block structure, 46′ × 90′. It is equipped with an overhead travelling crane of sufficient capacity to lift the heaviest single piece of the turbine unit.

The steel pipe line leading from the dam to the power house is 450 ft. in length and 8 ft. in diameter.

The main turbine is of the horizontal twin type, with a pair of cast-iron runners secured to the main shaft, all enclosed in a steel housing arranged so that the water enters parallel to the shaft, and discharges into a common draft chest. The top part of the housing is made in removable sections to facilitate quick inspection of all internal parts. The regulating gates consist of two sets of movable guide vanes, operated between two rings moved by short links and regulating rings that are connected to the regulating shafts by rods and levers.

The machine is governed by an hydraulic cylinder with piston connected by rods to the gates and operated by a geared pump and pressure cylinder. This pressure cylinder is provided with a fly ball governor, driven by belt from the main shaft, by which oil, under pressure, is admitted to either end of the oily cylinders, as required.

The turbine is designed to operate with 500 cubic ft. of water per second under a 50 ft. head, when running 300 revolutions per minute at a power factor at 80 per cent. It is direct connected to a 1,200 kw. 60 cycle, 3 phase, 2,200 volt, alternating current generator. This machine, when running under load, generates from 800 to 1,300 kw., the latter being the peak load when the mine hoist is suddenly thrown into action.

The exciter unit consists of one single horizontal shaft turbine, mounted in a cast-iron casing, with regulating gate made up of guide vanes pivoted on pins between two heads, and operated by means of a split regulating ring on the front head, connected by links to the governor. The generator is direct connected to the shaft, and is a 60 kw., 120 volt machine. It is designed to operate on 27 cubic ft. of water per second, at 50 ft. head, when running 857 r.p.m.

The switchboard apparatus at this power plant consists of one panel for control of the exciter, one panel for control of the generator, and one line panel provided with 16,500 volt lightning arrester and accessories.

The generator voltage is 2,200. This is stepped up to 16,500 volts for transmission over the power lines. The transformer equipment at the power house consists of one bank of transformers (three) of 800 kw. capacity each. Power is transmitted over a line of No. 6 copper wire.

The smelter sub-station was equipped with three 350 kw., oil insulated water cooled transformers, which stepped the power down from 15,000 to 600 volts.

The Victoria mine sub-station is equipped with three 200 kw. transformers, 15,000 to 600 volts.

MINING SOCIETY OF NOVA SCOTIA.

The Canadian Mining Institute has made a proposal of union to the Mining Society of Nova Scotia on the following terms:

The Mining Society of Nova Scotia to preserve its name and local self-government.

The Mining Society shall have the right to apply all grants and donations received by itself from all sources to its own purposes.

The approved papers read before the Mining Society will be published in the transactions of the Canadian Mining Institute and the name of the Mining Society of Nova Scotia will appear on the cover and title page of the volume.

Authors of papers will receive fifty complimentary copies free of cost.

Every member of the Mining Society will receive the regular monthly bulletin of the Institute, a copy of the Transactions, and any other publications of the Institute.

All members of the Mining Society, as classified by themselves, will enjoy the full rights and privileges of the Canadian Mining Institute.

In order to take advantage of these privileges an annual contribution of $5.00, in addition to the regular dues, will be collected from each member of the Mining Society of Nova Scotia.

Regarding the proposed amalgamation, President F. H. Sexton says:

"The union or affiliation of the two societies cannot be effected until the whole proposition has been voted upon by our members at a regular meeting. It will be impossible to bring it about unless the members of the Mining Society of Nova Scotia are willing to contribute the sum of $5.00 each toward this special purpose annually."

An unusual case came before Magistrate Atkinson in the Cobalt Police Court last week. Fred Graydon, who has a drilling contract at the Crown Reserve mine, was fined $10 and costs for drilling into an old hole, an action which constitutes a breach of the Mining Act. Graydon had commenced drilling a short distance below the old hole, and, when a few feet in the rock, ran into the latter. The offence was quite unintentional, and the magistrate, taking this into consideration, imposed the minimum penalty. The case is supposed to be the first of its kind in Cobalt.

THE IRON ORE DEPOSITS OF EASTERN AND WESTERN FRANCE*

By Paul Nicou, Mining Engineer, Paris.

Now that France has become—during the last few years and owing chiefly to the development of the calcareous ores of the Briey ore field—one of the principal ore exporting countries, it will soon become a matter almost of necessity for the leading ore importing countries to arrange to secure a share of the output, in proportion to their respective requirements.

Belgium has become practically dependent on the Lorraine ores, and in 1912 received from Meurthe-et-Moselle 4,351,000 tons out of a total of 6,415,000 tons, or 67.8 per cent.

Within the German customs union, which includes the great industrial regions of Luxemburg, the Sarre, Westphalia and Silesia, the Lorraine ores are competing keenly with the local ores which in the first named locality have already been driven to seek their former foreign market. In the Sarre district they have arrested the progress of the imports from the annexed Lorraine province, and they are more and more firmly establishing a footing in Westphalia, whither the ores of Anjou, Normandy, and Britanny are also finding their way. The high iron percentages of the Briey minettes should, likewise, cause them to be sought after in the near future by works in annexed Lorraine which have hitherto contented themselves with ores produced in the immediate vicinity, but which will have to follow the example of Luxemburg, and even distant Silesia, with its rapidly diminishing local production of ore and heavy existing imports of Swedish ores, is contemplating obtaining supplies from certain French deposits in proximity with the sea coast.

Whatever the future may, however, bring forth, the imports of French ores into the Zollverein have now actually almost attained to an equality with those from Sweden, and have exceeded those from Spain, the two countries which, for a long time past have shared the German market. In 1913 they reached 3,810,887 tons, as against 4,558,362 tons and 3,632,058 tons from these countries respectively. The large interests acquired, more or less recently, by powerful German or Luxemburg companies in the Lorraine and Normandy ore fields; the reduction from frontier stations onwards, of the freight charges for the conveyance of ores towards Westphalia; and the possibility of employing in the latter route both rail and canal transport, with transhipment at Givet, cannot fail to increase the part played by France in the supply of the works in the Zollverein.

Side by side, however, with these two important customers of the French mines, there are other consumers who have hitherto availed themselves to but a very limited extent of these resources, and who may later on find on the French mainland the supplies they need.

The United Kingdom is amongst these. Her iron industry imports annually large tonnages of various ores, and statistics of the trade for 1911 and 1912, represented in metric tons, and compiled from the official sources, are given below:

Iron ores produced in the	1911.	1912.
United Kingdom	15,767,735	14,011,037
Imported ores	6,448,145	6,708,122
Purple ore	647,640	691,154
Total	22,863,520	21,410,413
Ore exported or re-exported	6,742	7,563
Total available supply	22,856,777	21,402,850

The imported ores amount therefore to 28.21 and 31.34 per cent. of the total available supply.

Besides this, the home production no longer increases in the United Kingdom. It was about 15,578,000 a year between 1906 to 1911; it reached 15,984,000 tons in 1907, and fell to 14,011,037 tons in 1912, the year of the general coal strike. The production of pig iron likewise remains almost stationary, oscillating between 9,201,000 and 10,346,000 tons during the period of 1905 to 1911 (average 9,875,000 tons), and attaining only 8,891,000 tons in 1912, which was an exceptional year. It results from this that Great Britain is a fairly constant customer abroad, and in those same years, 1905 to 1912, the tonnages of iron ore received varied only between 6,155,000 tons and 7,950,000 tons (average 7,066,000 tons).

Whence does the United Kingdom derive these tonnages? The following table gives the imports by countries of origin for the three last years for which statistics are available. The figures for 1913 have been estimated:*

	1910.	1911.	1912.	1913.
Spain	4,932,280	4,008,735	4,358,629	4,598,256
Algeria	683,730	721,537	759,853	771,612
Sweden	381,779	433,721	362,449	372,558
Norway	252,572	270,476	408,540	495,604
Greece	326,456	267,584	197,013	206,901
Tunis	185,036	233,987	242,734	283,536
France	124,851	201,770	173,428	332,470
Various countries	246,428	310,335	205,475	208,858
Total	7,133,132	6,448,145	6,708,122	7,969,795

Whilst therefore Tunis and Algeria furnish considerable quantities of rich, pure iron ores, the percentages of the total being, for 1910, 2.59 and 9.58 respectively; for 1911, 3.66 and 11.10; for 1912, 3.62 and 11.33; and those for 1913, 3.89 and 10.62 per cent., continental France only contributes 1.75, 3.12, 2.55 and 4.57 per cent. Her proportion has nearly tripled itself in three years, but still remains very small.

Normandy, Anjou and Brittany.

Of all the French deposits which can actually supply the British iron trade with the ore it requires, those of the west—that is to say, of Normandy, Brittany and Anjou—are, from a geographical point of view, the most favorably situated.

The mines are, as a matter of fact, but a short distance from the sea, and even those which, as in the Segre district, are the furthest removed from the ports of embarkation, are but 85 and 135 kilometres distant by rail from Nantes and from Saint Nazaire respectively. The Norman mines of La Ferriere and Halzouze, which are the most southerly mines worked, are from 75 to 80 kilometres from Caen. The ports of

*All the figures quoted in this paper are expressed in metric tons and are derived from the official returns. Those of 1913 are provisional only, and have been kindly made for the author by competent authorities.

*(Extracts from paper prepared for the Autumn Session, 1914, Iron and Steel Institute.)

landing, even, if not as yet quite up to the standard of modern requirements, will undergo within the next few years considerable improvements, which will not only facilitate the arrival at their quays of steamers of the highest tonnage, but will also permit of more rapid loading of the ore. Even the question of freights presents itself in a most favorable aspect, as all these western districts of France, far removed as they are from the home resources of fuel, have to draw upon foreign coal supplies—for the most part British—and the ore can the more readily be shipped as return cargoes, inasmuch as hitherto the colliers have generally made their return journeys in ballast.

Shipments from Caen recently have rapidly increased, more than doubling in a period of five years. The increase would have been even more rapid but for strikes (which at Caen stopped all production at some of the mines during 1912 and 1913), and had the handling appliances of the harbor been better. Secondly, the powerful interests acquired in a number of mining concessions in Normandy by German iron works, have had, as a first effect, the diversion of the exported ores towards Westphalia, yet a very marked increase to be noted during the two years towards Great Britain shows that the mines working independently have sought more particularly in this direction for an outlet for their shipments.

On the Anjou and Brittany coasts Nantes and St. Nazaire shipped respectively 135,423 tons and 138,151 tons in 1913, all of which went either to Great Britain or Germany.

Normandy Iron Deposits.

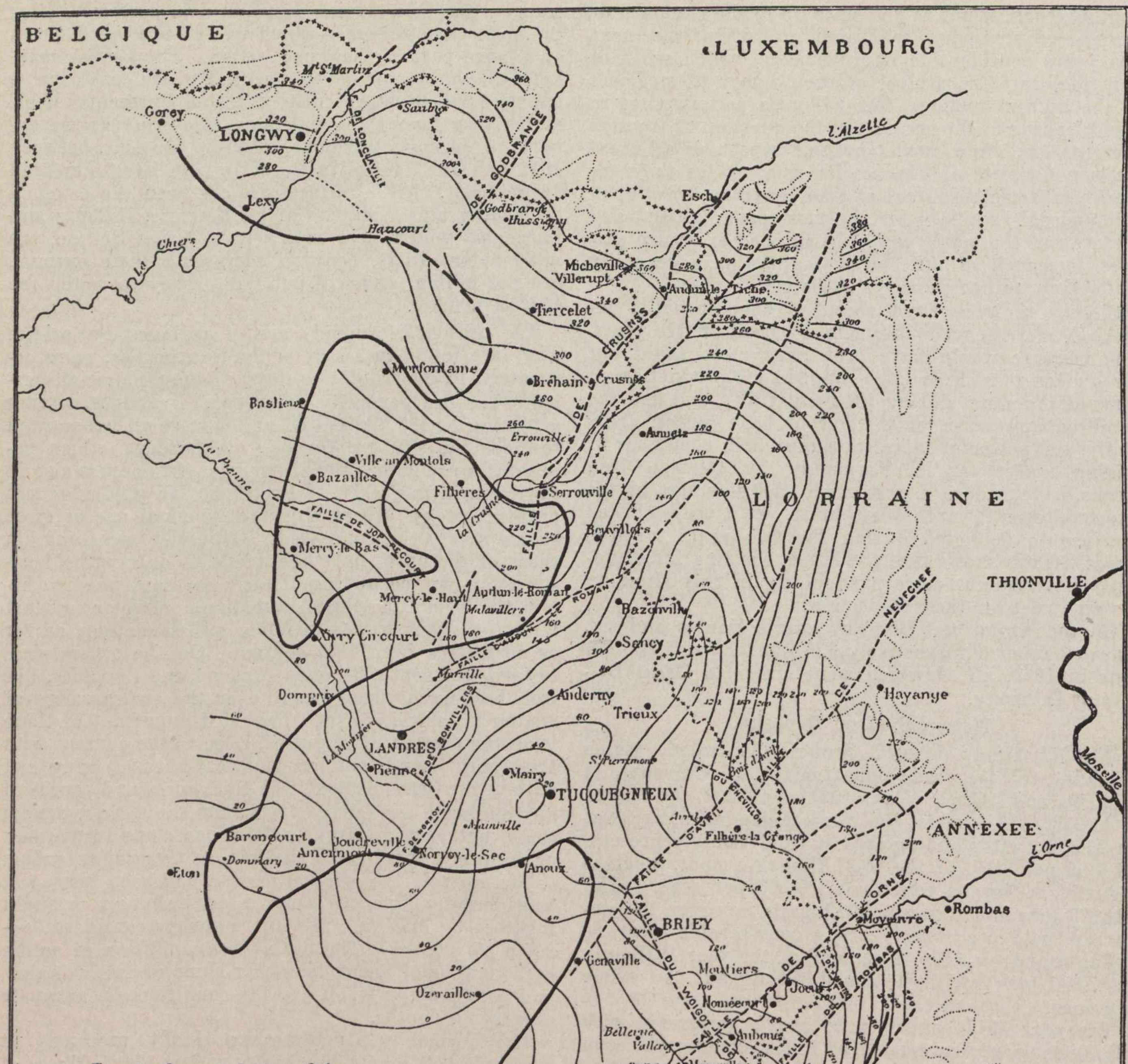
The Normandy deposit, properly so-called, which spreads over the three departments of Calvados, la Manche, and l'Orne, is, as a matter of fact, the second in importance amongst the iron ore producing areas of France, notwithstanding that in 1912 it only represented 4.08 per cent. of the total French output, whereas Meurthe-et-Moselle contributed 90.66 per cent. The 784,977 tons mined during 1912 mark, however, in comparison with preceding years, a considerable increase, seeing that from 1870 to the end of the year 1912 only 5,567,000 tons had been mined throughout the whole province.

The year 1913 continued to mark progress, with 861,000 tons, and an output of 1,000,000 tons will soon be attained, while the large plants laid down during the latter years, and those in course of construction at different mines, such as Soumont, Saint-Andre, Barbery, etc., justify the hope that in the near future even this million tons may be greatly exceeded.

Where does all this go to? An appreciable portion is even now consumed in the works in the North of France; Halouze and La Ferriere furnish the blast furnaces of Isbergues and Denain with rich siliceous ores; the Nord-et-Tst steel works at Valanciennes receive ore from Larchamp, and these three concessions worked on the syncline of La Ferriere yielded to these works alone 373,900 tons of merchantable ore, or nearly one-half of the total production. The new works under construction, such as those at Pont-a-Vendin, can similarly obtain from Normandy a considerable proportion of their ore burdens. Blast furnaces are also in course of erection at Calvados itself, in the immediate vicinity of Caen, and the mine in process of development at Soumont will find a market for its output in these works, the residue being sent to the Thyssen works in Westphalia. Other concessions, on the other hand, are being developed only for the purpose of exporting their ores, while others have concluded contracts with their leading metallurgical customers—for the most part German—which will ensure the disposal of a large part of their production. The British market, however, to the development of which considerable efforts have been recently directed, presents itself under very favorable conditions; and whereas the exports to Germany have only risen 36 per cent. between 1911 and 1913, those to Great Britain have increased 75 per cent. While hitherto it has been the calcined carbonates and hematites of La Ferriere, Halouze and Larchamp which have been sent to Great Britain, the new undertakings, bent on increasing their outputs, are not failing, and will not fail, closely to watch the British market.

The ores of Normandy are of sedimentary origin. They are found in seams in the Silurian, or, more accurately, in the trilobitic schists of the Ordovician period. The ore generally outcrops in synclines, having a bearing N. 115 degrees E., and is more or less marked towards the east by Jurassic overburdens, which necessitates preliminary trial borings. Ore occurs also in the west, in the midst of Pre-Cambrian phyllades and eruptive rocks. Traversing the synclines one or more seams may be encountered. Generally speaking, in those of the north only one available or existing horizon is known, occupying a fairly constant position below the trilobitic schists, sometimes at their contact with the Armorican sandstone, and sometimes as far as 40 metres from that contact. On the other hand, towards the south, between Alencon and Bagnoles, five iron bearing horizons occur over the entire range of similar trilobitic schists. The most important of these is on the summit of Bagnoles, close to the contact with the "May" sandstone, an identical horizon being met with in the Sees ore field. The thicknuess and profile of any one seam are fairly constant on the same synclinal slope, but vary apparently from one slope to another, or from one syncline to another, as though, according to Mr. Barrois, the original deposit had been formed at considerable distances apart, and had been brought together by folding. The dip is always considerable—30 to 85 degrees. The ore is in a condition of oolitic carbonate or of hematite, either alone or intermingled, and both passing wholly to the condition of carbonate at varying depths.

The Normandy hematites are chiefly produced, at present, at St. Remy, St. Andre and at May. Those of Remy are the finest known, from the point of view of their iron contents: 52 to 55 per cent. of iron, 10 to 12 per cent. of silica, 3 per cent. of aluminum, 2.5 per cent. of lime and magnesia, 0.6 to 0.7 per cent. of phosphorus and 3 per cent. of water. At St. Andre and at May the iron percentage is, generally speaking, 46 to 51, with 14 to 16 per cent. of silica and 0.6 to 0.7 per cent. of phosphorus, the remaining constituents being present in the same proportions as in the St. Remy ores. The rest of the concessions yield chiefly carbonates, which are calcined before transportation, the calcination being carried out in kilns with a consumption of 12 to 15 kilogrammes of lean coal per ton of raw ore. The yield on calcination varies, at La Ferriere, Halouze and Larchamp between 75 and 79 per cent. and the calcined ore of these mines contains, finally, 48 to 50 per cent. of iron, 13 to 14 per cent. of silica, 4 to 7 per cent. of alumina, 3.5 to 4.5 per cent. of lime and magnesia, and invariably, 0.6 to 0.7 per cent. of phosphorus. Other mines do not yield such rich ores; at Soumont the ore contains 44 per cent. of iron, and 20 to 22 per cent. of silica. At Mortain, Bourberouze and Jurques, the ores range about the same. Although the ores are,



LORRAINE IRON ORE FIELD

therefore, generally speaking, fairly siliceous, they are also fairly rich in iron. They are suitable not only for the manufacture of basic pig iron for the Bessemer process, but they form excellent ores for mixing; and, with the addition of the necessary fluxes, can yield basic pig with 1.4 to 1.5 per cent, of phosphorus for foundry purposes or for the open hearth furnace. In addition, the calcined carbonates are, generally speaking, porous, which is an advantage in reducing them in the furnace; a ton of the raw material, weighed loose, only weighs 1,600 to 1,650 kilogrammes after passing through the calcining kilns.

To estimate the resources of the Normandy deposit would be a fairly difficult task. Not only are there numerous portions as yet incompletely known, but the exploratory work carried out recently, and still being carried out on the various synclines, has lead to the recognition of fresh mineralized areas, in continuity with the earlier concessions, while, except at St. Remy (where it appears to have been approached), the bottom of the formation has nowhere as yet been encountered. Confining oneself to the known deposits, and basing the estimates (except for St. Remy) on the 400 metre bore-hole at Soumont, there would be 220,000,000 tons. If, as some believe, the synclines do not meet, as a general rule, before a depth of 1,200 metres or more is attained, it may be that these tonnages will be very greatly exceeded.

Anjou and Brittany Iron Deposits.

If the resources of the Normandy deposits are difficult to estimate, it would be even more premature to make any definite statement with regard to the Angevin-Breton deposit.

From a geological point of view, this deposit presents considerable analogy with the former; the series of south-east to north-west synclines containing several seams of ore of variable number and thickness, which are found interstratified in the Silurian, and sometimes in the Cambrian formations. Up to the present time work on the concessions granted in the extreme south-east near Angers and Segre has not progressed beyond the phase of trial borings. Numerous investigations carried out to the west beyond Chateaubriant have done little more than skim the formation while the ore bodies and rocks scattered about the Loire Inferieure, Ille-et-Vilaine, and Marbihan have not always led to the discovery of the original sources whence they are derived. The nine concessions near Angers and Segre, as yet the only ones made on a deposit of exceedingly large area, cover 10,996 hectares. The production, which was but small during 1881-1883, and again from 1889 to 1892, was only seriously recommenced at the beginning of 1907. Prior to this date only 35,455 tons had been obtained in all. At the present day, the annual production exceeds 700,000 tons, and is according to the owners, rapidly growing.

The ores, part of which are used at works in the Lower-Loire at Trignac, are also partly exported to England and Germany. They consist of oolitic iron ore, hematite or magnetite, either intermixed or separate, the color varying from dark grey to yellowish red, and the percentage of iron attaining at times 61, but usually amounting to 52 to 55 per cent. They are highly siliceous, and contain for the most part from 13 to 20 per cent. of silica. They are slightly calcareous (1 per cent. lime), slightly clayey (2 to 4 per cent. alumina), and contain a proportion of phosphorus which varies from 0.6 to 0.7 per cent. With regard to the two most important elements, iron and silica, the percentages given in the official report to the Bureau of Mines in 1912 were as follows: Oudon (where two seams of magnetite of 1.20 to 4 and 5 metres in thickness respectively were worked) 48 to 50 per cent. of iron and 15 to 17 per cent. of silica; La Ferriere (a seam of magnetite from 3 to 4½ metres in thickness) 48 per cent. of iron and 18 per cent. of silica; and Pavillon (two seams of magnetite of 1.20 and 2.10 metres in thickness) 52 per cent or iron and 12 per cent. of silica.

In 1913 Saint-Nazaire and Nantes, which ship almost the whole of the ores exported from Anjou and Brittany, loaded 138,151 and 135,423 tons respectively.

Taken as a whole, the Normandy-Anjou-Brittany ore field yields annually over a million tons of ore. Of this tonnage nearly two-thirds is exported, the ore having a fair percentage of iron, but, on the other hand, being somewhat siliceous and moderately phosphoric. The favorable situation of the field in respect to the ports of embarkation, and the ease with which colliers can transport the ore at cheap freights, should lead to a rapid increase in the trade with Great Britain, particularly with the impending development of mining in the various districts.

French Lorraine Iron Deposits.

Although a later arrival in the British market, the French Lorraine ore field, which commenced its exports in 1912 with 28,014 tons (which rose in 1913 to 69,224 tons), may easily become, in the near future, one of the largest contributors of iron ore to the United Kingdom. No doubt the mines are in a less favorable condition from the point of view of transport facilities than those or Normandy, seeing that Homecourt, the centre of the ore field, is about 400 kilometres by rail from the harbor of Dunkerque and that no other navigable waterway exists which can at present replace this method of transport, at least so far as the portion of the ore field in the vicinity of Briey, from which alone exports to England are possible, is concerned. Schemes have from time to time been put forward for many years past of a "north-east" canal, which by connecting up with the already existing canals, would allow of the ores from the northern region of the department of Meurthe-et-Moselle being transported under the most favorable freightage conditions to the port of embarkation. The realization of such a scheme would appear, however, to be very far off, and it could only be by means of special tariffs on the railway, by the use of automatically unloading wagons of large tonnage, and by the improvement of the methods of loading that this serious difficulty could be surmounted. The problem might, however, be connected with the converse problem of the importation of British coal and coke into Meurthe-et-Moselle, which would supply the special wagons with a valuable return freight and would facilitate the obtaining of important concessions, just as the colliers loading up at Dunkerque would find in the iron ore an excellent cargo.

We have hitherto spoken only of Dunkerque as the harbor for the shipment of the Lorraine ores to Great Britain, but there are other harbors which would be equally interested in the trade. So far as distance is concerned, Calais is in a somewhat similar position. In Belgium, Antwerp, Ghent and Bruges, particularly the two latter, which are endeavoring to develop their trade, would have to be taken into consideration, and have already, as a matter of fact, made some shipments to the United Kingdom. These shipments have indeed already led to a highly interesting degree of competition between the different French and Belgian harbors, and it may be that, as the outcome of this competition, a very favorable future may be secured for shipments to England.

What are these Lorraine ores, and what, more particularly, are the Briey ores? They belong to the great metalliferous formation which has been found on French territory and in the annexed portion of Lorraine, in Luxemburg, and, incidentally, in Belgium. The production of iron ore from this formation corresponded in 1912 to 28 per cent. of the world's production. The only ore field which exceeded it was that of Lake Superior in the United States, which contributed a slightly higher proportion, namely, 29.8 per cent. Of the three principal producing countries on this Lorraine ore field, France is in process of becoming the most important; whereas in 1905 Luxemburg yielded 6,596,000 tons, the annexed portion of Lorraine 11,968,000, and France 7,395,000, the outputs for 1912, the latest year for which official statistics have appeared, were 6,553,900, 20,050,200 and 17,379,900 tons. This reveals stagnation so far as Luxemberg is concerned, but for the annexed portion of Lorraine an increase equal to 67.5 per cent., and for France an increase of 134.9 per cent. The French progress was maintained in 1913, the provisional figures showing an extraction of 19,928,000 tons, or 169.4 per cent. more than that of 1905, while the annexed portion of Lorraine will attain only 21,136,000, or 76.6 per cent.

This large increase in the French Lorraine ore production relates almost exclusively to the opening up in 1894 of the new ore field of Briey, discovered a few years before as the result of systematic trial borings, starting from the new Franco-German frontier between Batilly and Audun-le-Roman and proceeding regularly westwards to the borders of the department of the Meuse and even a little beyond. The new ore field, with its rich calcareous ores, not only enables the French iron industry, which up to then had been supplied chiefly with the siliceous ores of the original ore fields formerly discovered around Longwy and Nancy, to free itself of the necessity of importing heavy tonnage of calcareous ores from Luxemburg and from the ore fields of annexed Lorraine, but also allows the mining industry to assume a leading part in supplying the markets formerly supplied from these latter sources. Belgium has become practically dependent on the new supply! Luxemburg, met by the competition of these ores, finds her production stationary despite the installation of large works; annexed Lorraine is seeking foreign markets for her own ores, and the Sarre and Westphalian districts are depending more and more upon supplies from Briey, while everything leads to the hope that this situation will develop still more strongly in the future.

A few figures relating to the last few years will better serve to show the important position the Lorraine ore outputs, more particularly the Briey ore field, occupy in relation to the ore-supply of France as a whole.

In 1894 the total French production was 3,772,000 tons, Meurthe-et-Moselle contributing 3,062 tons, or 81.1 per cent. of the total, but the Briey field only producing 9,000 tons, or 0.3 per cent. Ten years later the total French production had nearly doubled, and was 7,023,000 tons, the Meurthe-et-Moselle contribution being 5,954,000 tons, or 84.7 per cent., and the output of the Briey ore field having risen to 1,647,000 tons, or 27.6 per cent. In 1907, when the total production had reached 10,008,000 tons, Briey was producing 4,167,000 tons, or 47.2 per cent., and in the following year attained to 52.1 per cent. in a total of 10,057,000 tons. In 1912 the total production of iron ore in France was 19,160,000 tons, 90.7 per cent. of which was produced in Meurthe-et-Moselle (17,371,000 tons), while the proportion contributed by Briey was 73.1 per cent., or 12,699,000 tons. Last year the Meurthe-et-Moselle output was 19,928,000 tons, and the Briey output 15,107,000 tons, or 75.8 per cent. of the total. Of this quantity 4, 416,000 tons were exported to Belgium, 2,609,000 tons to countries in the German Customs Union, and only 69,000 tons to Great Britain The rest was consumed by French works. Thus France has, owing to this new ore field, become one of the great iron ore exporting countries, and the balance, which for many years was on the wrong side, so far as exports of ore were concerned, is now well on the right side. Thus in 1912 there were exported 8,324,000 tons of ore, or 4.34 per cent. of the total production, while the imports only amounted to 1,454,000 tons. Last year the imports fell still lower, they having amounted only to 1,417,000 tons, while the exports rose to 9,746,000 tons.

Geographical position.—The French Lorraine ore field comprises at the present time (June, 1914) 68,356 hectares of concessions distributed among 114 claims. Some thousands of hectares appear still concedable in the siliceous district of La Crusnes, or beneath the forest of Haye, amounting from 72,000 to 75,000 hectares of the iron-bearing zone. In the annexed province of Lorraine the available surface amounts only to about 43,000 hectares, while that in Luxemburg is 3,600 hectares. The total area of the minette deposits is therefore some 120,000 hectares (296,540 acres).

From a geographical point of view the French area can be divided into two portions, one to the south of Nancy with 18,000 hectares of concessions, while the other, sharply separated from the former by a sterile zone, situated between Diuelouard and Mars-la-Tour, extends to the west of the frontier over the department of Meurthe-et-Moselle, and partly over the department of the Meuse. The recognized available industrial area of this second part with its three subsidiary ore fields of Longwy, La Crusnes and Briey, is practically defined by the districts of Jouaville, Bruville, Brainville, Conflans, Ozerailles, Anoux, Norroy-le-Sec, Eton, Domprix, Xivry-Circourt, Baslieux, Harcourt, Lexy and Gorcy.

The iron-bearing horizon recurs a long distance away, towards the west, but under unworkable conditions, as has been shown by the borings made near Etain and Verdun. At the last-named place in particular, the formation has been ascertained to occur at a depth of 580 metres.

Geology of Lorraine iron deposits.—From a geological point of view the minette deposits are a portion of the deposit of the great Parisian bowl, bounded on the north-east by the primary rocks of the Ardennes, the Eifel, and the Vosges. In beaches roughly concentric in shape and distributed over the whole area of this bowl, beds of various ages outcrop, becoming of more and more recent formation the nearer Paris is approached. In the Meurthe-et-Moselle these beds belong to the Callovian, Bathovian and Toarcian systems, and it is in the latter that ferruginous formation occurs, with a fairly uniform dip towards the west of 10 to 15 millimetres per metre.

The iron-bearing formation comprises a certain number of seams, which do not, however, occur throughout the formation, and the distribution of which varies, in the opinion of geologists, in the different levels. In France they are ordinarily arranged in three groups and the complete formation from footwall to roof comprises the upper stratum with the ferruginous chalks and the seam of red ore; the middle stratum with the yellow and grey seams; and the lower stratum with the brown, black and green seams. The foot-wall of the mineralized zone, which is always well defined, is composed of sandy and pyritic green marl, and the roof of micaceous bajocian marls; the vertical thickness as thus defined varies considerably at different points, pinching out as the boundaries of the deposits are approached, and varying on the average between 25 and 50 metres, except in the Nancy ore field, where it is thinner, and varies between 6 and 10 metres. The different seams are not, generally speaking, sharply separated from the surrounding country rock. There is a gradual transition from the mineralized to the sterile rock, although in some instances they are sharply separated, as in the sub-basin of Landres, where the grey seam has a hanging wall composed of a special type of shell-bearing chalk.

The Ores.—The ore is hydrated hematite. It is oolitic, that is to say, it is composed of a number of small round grains or oolites formed in concentric layers and of variable dimensions, so that the grain is sometimes only visible under the microscope, while others attain to the size of a pinhead or of a grain of millet seed. The binding material between the grains is clayey or calcareous. The ore is much more resistant to crushing in proportion as the percentage of lime becomes higher.

In some regions, and more particularly in the grey seam, the chalk is concentrated in lumps, or rather in flattened lenses, forming nodules naturally lower in iron, which can be screened off when present in too large proportion. The color of the ore varies from dull yellow to grey, red, green and blue-black. Iron pyrites are met with throughout the deposits, particularly in the brown, green or black seams. Generally speaking, it does not give any trouble.

The characteristic element is the phosphorus, which for many years hindered the progress of production, but which nowadays constitutes one of the most valuable qualities of the mineral. The ratio of phosphorus to iron is always such that typical grades of basic iron containing 1.7 to 1.9 per cent. of phosphorus can be obtained direct, and with such regularity that it is never necessary to make routine analyses for phosphorus at the works using the ores.

The amount of iron seldom exceeds 42 per cent. in the ore dried at 110 degrees C., and is generally between 33 and 40 per cent. in the zones worked. It falls to below 30 per cent. in some ferruginous limestones employed as fluxes, and in some parts of Nancy basin, whereas in others and, generally speaking, in Briey, it ordinarily runs between 36 and 40 per cent. The composition is not always uniform within the same seam. A section often reveals several bands of varying percentages in juxtaposition.

The ore contains moisture and carbonates, hence there is an appreciable loss on drying and roasting. This loss is 8 to 12 per cent. at 110 degrees, and 14 to 24 per cent. at red heat. Attempts have been made to enrich the ores intended for transport to distant destinations by roasting, but the resulting product, although frequently attaining, and sometimes exceeding, 50 per cent. of iron, is exceedingly hygroscopic and easily falls to pieces.

Methods of Working in the Briey Ore Field.—Few mining districts have been opened up so rapidly as the Briey ore field; not but that there were numerous difficulties to overcome. The grey seam and the other seams (when they occur) can only be reached by shafts, and inflows of water amounting to five cubic metres were met with in several cases of sinking.

Some shafts, such as those first sunk on the Joeuf and Homecourt concessions, had even to be abandoned, permanently or temporarily, owing to the inadequacy of the provision made for unwatering. Shaft sinking by freezing, and by cementation, was practised at Auboue, Saint-Pierremont, Giraumont, but generally it was necessary to remain content with powerful suction pumps or suspended steam or electrical pumps.

The depths of the shafts increase in each ore field from east to west owing to the dip of the strata. Thus, in the Orne field the shafts are 61 and 69 metres in depth at Joeuf, 73 and 114 at the two Homecourt pits, 90 metres at Moutiers, 120 at Auboue, 165 at Valleroy and 207 to 212 metres at Jarny and Droitaumont. In the Landres ore field they are 192 metres deep at Murville, 223 at Landres, 220 at Pienne, 235 at la Mouriere, 225 at Joudreville and 245 at Amermont. In the Tucquegnieux ore field the shaft at Saint-Pierremont is 179 metres in depth, at Andernay 204 metres in depth, and at Sancy and Tucquegnieux 240 metres.

If shaft sinking has often been a matter of difficulty owing to the inflow of water, actual working has been no less difficult, and in some of the mines of annexed Lorraine as much as 30 cubic metres per minute has had to be dealt with, necessitating the installation of powerful pumping stations. Besides this, although no mine so far succeeds in extracting its full proportion of ore from the pillars, and some have not even yet progressed beyond the phase of making crosscuts, Auboue has already experienced an inflow of over 13 cubic metres per minute, Landres a flow of 6 to 11 cubic metres, Jarnby 6 cubic metres, and Murville 5 cubic metres.

At the most of the mines there have therefore been powerful underground pumps installed capable of pumping 40 to 50 cubic metres of water per minute. As a further consequence, and in order to reduce as far as possible the influence of the cost of mining on the selling price, it is necessary to make huge outputs, a necessity which is inculcated by other considerations.

Labor being already scarce in the Lorraine district when the new mines of Briey were opened, recourse was had to foreign labor, chiefly Italian, and it became more and more necessary to have recourse to such labor the further the deposits were opened up. The installation of pits in a district which was essentially an agricultural one, necessitated at the same time the creation of large workmen's colonies in the vicinity of the pits. Thus, in 1912, whereas the ore mines in the Nancy and Longwy ore fields only provided housing accommodation for 5.2 and 28.4 per cent. of their workmen, the proportion in the Briey district rose to 62.8 per cent. All this increased the capital cost of the undertakings. Therefore taking into consideration the high wages of the miners and the low cost of the products obtained, very heavy outputs must be made to pay the dividends on, and redeem the capital sunk. Some of the mines are equipped for outputs of upwards of 2,000,000 tons yearly, and the Auboue mine anticipates an output of 3,000,000, while almost all the mines can easily exceed 1,000,000. Hence outlays of 10 to 15 millions of francs ($2,400,000 to $3,000,000) are not uncommon for mines fully equipped with their surrounding land, their two concrete lined shafts and their workmen's colonies.

Resources of the French Lorraine Ore Field.—Recapitulating the estimates for the different ore fields, it may be seen that reserve remaining at the end of 1913 is 200 millions of tons for the Nancy ore field, 275 millions of tons for the Longwy field, 2,000 millions of tons for the Briey field, and for the Crusnes ore field 500 millions of tons, or a total of nearly 3,000 millions of tons. According to another estimate, made by Mr. Leprince Ringuet, chief mining engineer at Nancy, there was on January 1, 1913, in the concessions then granted, 254,000,000 tons in the Longwy ore field, 177,000,000 tons in the Nancy ore field and 2,389,000,000 tons in the Briey-Crusnes ore field, making a total of 2,820,000,000 tons. The other portions of the ore field contain, according to Dondelinger, chief of the staff of the Luxemburg mines, 250,000,000 tons in Luxemburg, and 1,750,000,000 in annexed Lorraine (the estimate of Mr. Kohlmann, staff engineer at the Thionville mines). We thus get a total for the whole of the Lorraine deposits of nearly 5,000,000,000 tons, of which France possesses 60 per cent. This total becomes reduced to 4,500,000,000 tons by leaving the less well known Crusnes ore field out of consideration, in which case the proportion owned by France will be about 56 per cent.

Up to 1912 there had been mined an aggregate of 583,163,000 tons, which is further increased to about 631,000,000 tons by the addition of provisional estimates relating to the output during 1913.

In the foregoing estimates there have not been included the Belgian portions of the deposit, now of greatly diminished importance and almost exhausted, from which, since 1832, some 4,000,000 tons have been extracted, nor the tonnages mined prior to 1860, or between that year and 1868, which may be estimated at 8,000,000 tons, derived mainly from detached portions of the ore field.

On the 1st of January, 1914, therefore, approximately 650,000,000 tons may be regarded as having been mined in Lorraine, or a little over one-eighth of what still remains.

The foregoing figures show the large tonnages which still remain in reserve in the French Lorraine ore basin. As has already been said, the primary ore field of Briey, which is the most considerable, is the only one from which exports to Great Britain would be feasible, and such exports have already commenced. The Longwy and Nancy ore fields do not, as a matter of fact, contain sufficient reserve to enable even the local works greatly to increase their outputs, besides which their more highly siliceous and friable ores containing, as they do, less iron, are less suitable for shipments to distant destinations.

EXPRESS CO. RAISES RATES.

Cobalt, Oct. 5.

The insurance rates upon bullion for trans-Atlantic shipment have been boosted to double their previous figure, but at the moment it is not possible to give the exact figures.

The local express companies and the mines are without details on this most important point, but it is expected that definite information will be forthcoming within a few days.

The old rate, which was fixed under a twelve months agreement, and which covered all risks, expired on Wednesday last, and the express companies, having in mind the extra risks attached to the Atlantic passage are reported to have doubled the rate. The great European war is, of course, the reason for the hoist.

There was only one shipment of bullion from the camp last week, the O'Brien sending out 26 bars on Thursday. Eleven cars of ore left the Northern mining field during the week, of which nine came from Cobalt and one each from the Casey Cobalt and the Tough Oakes. La Rose headed the local tonnage, with Coniagas strong on the list.

The ore shipments for the week were as follows: Coniagas, 165,010 lb.; La Rose, 166,070; McKinley, 87,570; Nipissing, 86,580; Townsite, 87,700; City of Cobalt, 87,730; Casey Cobalt, 40 529. Total, 721189 lb. Gold ore from Swastika, Tough-Oakes, 60,560. The local bullion shipments for the week were O'Brien, 26 bars, 26,614 oz.; value, $14,105.

KERR LAKE MINING.

Kerr Lake Mining Co. operated at a profit of $620,786, during its fiscal year ended August 31, according to the report presented at the annual stockholders' meeting. Previous year's profit amounted to $769,176.

Silver yield totalled 1,828,424 oz., against 1,855,495 oz. The average cost of production was 24.86 cents an oz., comparing with 18.30 cents in the preceding year. The cost was apportioned as follows (cents an oz.):

	1914.	1913.
Mining and development	12.49	12.10
Shipment and treatment	11.61	5.55
Administration.	0.76	0.65
Total.	24.86	18.30

Manager Robert Livermore places ore reserves at 5,698,700, against his estimate of 6,660,091 tons at the end of the 1913 period. Mr. Livermore states that his estimate has been kept purposely low because of difficulty in getting accurate results in the very variable ground which furnishes mill rock. It is safe to say, he adds, that the present estimate will be exceeded.

Of the total production, 1,828,424 oz., 1,196,401 oz. came from shipping ore and 632,023 oz. from low grade milling ores. Development work slightly exceeds last year's rate, the total being 5,399 ft., against 4,984 ft. Discoveries included new veins and extensions to known ore bodies.

The Kerr Lake Co. of New York, the holding company, received from the operating company in dividends, $614,000, and disbursed to stockholders $600,000.

Operating and profit and loss account of Kerr Lake (operating company) shows:

	1914.	1913.
Proceeds sale ore	$1,036,952	$1,028,343
Net proceeds sale ore	952,144	1,034,881
Interest.	23,743	9,536
Production shipment admin. charges.	355,101	275,242
Balance profit	620,786	769,176

Balance sheet shows cash of $93,333 short term bonds, $256, 598; call loans secured, $350,000; ore sold but unsettled for, $108,180; surplus August 31 was $961,094, against $716,993 at end of preceding year. The holding company had a profit and loss balance of $98,597.

At the annual meeting the retiring directors were re-elected.

MARQUETTE IRON RANGE.

The cut in the mining forces on this range, which was bound to take place this fall, came on October 1, when three of the operators closed mines or reduced the working hours. About 500 men were thrown out of employment and several hundred more will only be employed four days a week.

In addition to reducing its working force, the Cleveland-Cliffs Iron company, the largest employer of labor on the range, announced a cut in wages of 10 per cent, to take effect October 1. The order applies to every person in the employ of the company, from the president down. The following announcement was posted at all of the company's mines and offices. "We regret to announce that, owing to the extreme depression in the iron business brought on largely by the European war, it is necessary to make a 10 per cent reduction in wages to take effect October 1, 1914."

CENTRIFUGAL COMPRESSORS

By Louis C. Loewenstein.*

The rapid substitution of rotating for reciprocating machinery has been one of the most striking engineering developments of recent years. The marked success of the steam turbine no doubt stimulated the development and introduction of the centrifugal pump and more recently the centrifugal compressor. The centrifugal compressor to-day stands in the same relation to other compressors as the steam turbine stood fifteen years ago to the reciprocating engine, or as the centrifugal pump stood five years ago to other pumping apparatus. Although the initial development of the centrifugal compressor was first begun in Europe, the General Electric Co. started about three or four years ago to develop and introduce it in America; and the marked success attained is well substantiated by the large number of successful units in commercial operation.

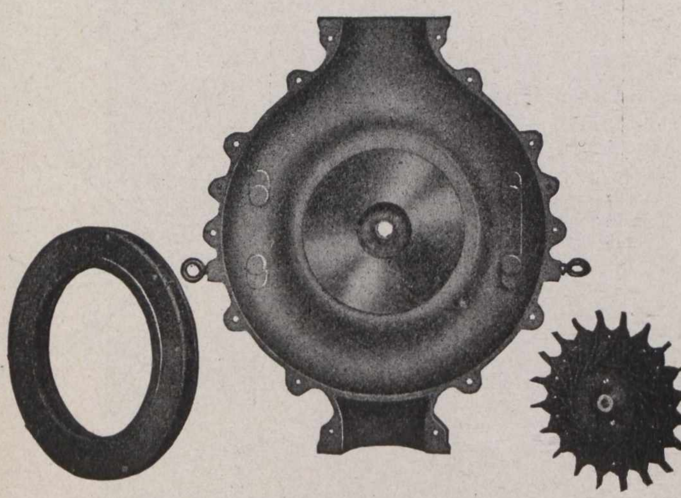


Fig. 1. Impeller, discharge vanes, and half casing of Single Stage Compressor

A centrifugal compressor resembles a centrifugal pump, except that in the former elastic fluids are compressed and in the latter fluids comparatively inelastic are pumped. A centrifugal compressor consists of a revolving impeller mounted on a shaft supported in suitable bearings and surrounded by a stationary set of discharge vanes supported in a suitable casing. If the desired amount of compression is small, a single impeller suffices and the appartus is known as a single stage compressor; if the compression desired is larger a multi-stage compressor is used, which consists of two or more single stage units mounted on the same shaft and operating in series within a common casing.

As the name centrifugal compressor indicates, centrifugal force plays an important part in its operation. When set revolving, the impeller will, by centrifugal force, entrain a fluid, say air, at its inner circumference and will discharge it at its outer circumference at an increased pressure. This pressure can be called centrifugal pressure. Besides this the impeller has set the air into motion; and at its outer circumference, or discharge end of the impeller, the air is moving at practically the same velocity as the peripheral speed of the impeller. Hence the work delivered by the driver to the impeller of the centrifugal compressor appears in the air discharged from the impeller in two forms of energy, pressure energy and velocity energy. It is the function of the stationary set of discharge vanes to convert the velocity energy into pressure energy. The discharge vanes are so designed that the air in flowing through the passages between the vanes is gradually reduced in speed and the velocity energy recovered in the form of an increase of pressure energy. Roughly speaking, about 95 per cent. of the energy supplied by the driver to the compressor appears as pressure energy and velocity energy in the air leaving the rotating impeller. About one-half of the available energy is in the form of centrifugal pressure, while the other half is in the form of velocity. In an ordinary fan or blower this high velocity of the air is allowed to dissipate itself chiefly into eddy currents, and finally exists in the air in the form of heat. In the centrifugal compressor this velocity energy is largely recovered in the form of increased pressure. Hence the vital difference between an ordinary fan or blower and a centrifugal compressor lies in the fact that the former does not recover any of the velocity energy generated by the rotating impeller, whereas the latter recovers the larger part of the velocity energy so produced. It can be readily seen why the centrifugal compressor is so highly efficient and why this recent type of air compressor is replacing all older types.

Besides its high efficiency there are other advantages which aided in the introduction of the centrifugal compressor. On account of its operating at high speeds this compressor is much smaller in size than any other compressor delivering the same work; and further, because it can run at high speeds it can be direct connected to high speed drivers, which are in themselves smaller and more efficient than those which must operate at low speeds. This is especially true of the steam turbine, and a turbine driven centrifugal compressor forms an ideal arrangement. Ample clearances can be provided about the impeller, and if the bearings are properly designed and provided with efficient lubrication, no rubbing parts exists; so that the original efficiency of the unit is maintained after years of service. Compare this to the performance of displacement or positive pressure blowers where frequent renewals are necessary to maintain somewhere near the original efficiency and output; or compare this compressor to the inefficient and large fans or blowers, and it then does not seem strange that the centrifugal compressor has made such great strides commercially and is supplanting other forms of compressors in almost all fields of service.

The efficiency of centrifugal compressors will be steadily improved as we gain more theoretical knowledge of the laws governing air flow, but the fundamental principles involved are well understood and are quite simple. Fig. 2 represents diagrammatically a centrifugal compressor. The air particles enter the impeller at a Diameter De and leave it at a greater diameter Da. The impeller is rotated by a motor at an angular velocity o; the air particles are thrown outward by centrifugal force and thus exert a pressure which can be expressed by the equation

$$\frac{\left(\frac{D_a}{2}\right)^2-\left(\frac{D_e}{2}\right)^2}{2g} o = \frac{u_{a^2}-u_{e^2}}{2g} = \frac{p}{r} \quad (1)$$

*Engineer, Turbine Department, General Electric Company.

in which *ua* and *ue*, Fig 2a, represent the peripheral velocities at the diameters *Da* and *De* respectively; *p* the pressure rise; and *r* the density of the air.

Air enters the impeller in a radial direction. If the air is not to enter the impeller radially some sort of guide vanes should be provided to properly direct the air; but if the air is to enter radially, only radial ribs are provided to prevent churning of the air before entrance to the impeller. In high speed impellers the blades of the impellers are radial at exit. If they are not radial, great care must be exercised in designing them so that the ensuing centrifugal forces exerted on the blades do not bend or break them.

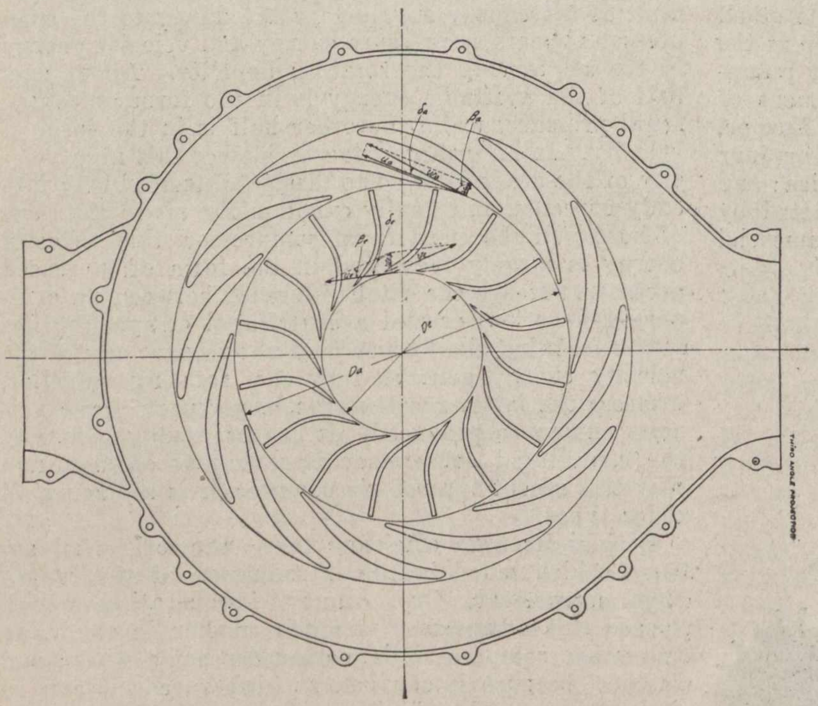


Fig. 2. Centrifugal Compressor shown diagramatically

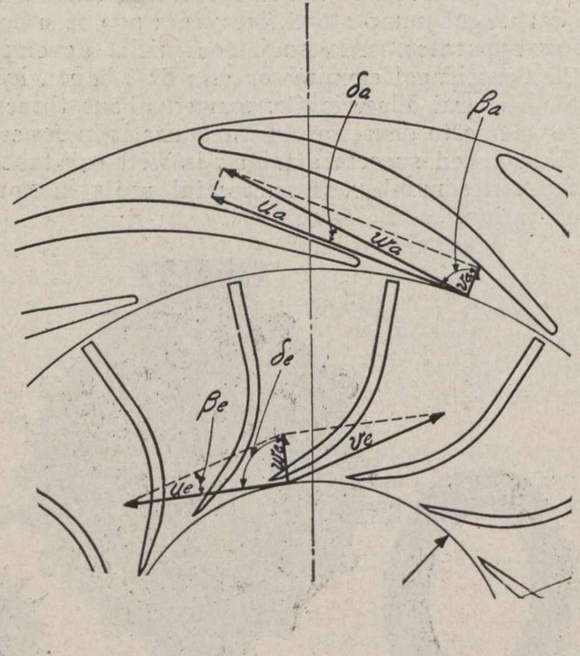


Fig. 2a

The actual efficiencies of single stage air compressors vary somewhat with the capacity of the unit, but generally speaking the shaft efficiency is usually over 70 per cent. and the hydraulic efficiency is usually over 75 per cent. The shaft efficiency is the ratio of the theoretical power required to compress a given volume of air to a given pressure to the actual power which must be applied to the shaft of the compressor. The hydraulic efficiency is the ratio of that same theoretical power to the power represented by the fluid input. The hydraulic efficiency does not include any rotation losses or short circuit losses, but includes losses along impeller blades and along the discharge vanes.

Centrifugal compressors can be used wherever any compressible fluid is to be compressed or pumped. The various forms of compressing apparatus, besides centrifugal compressors, may be classified as follows: fans or blowers; positive pressure blowers; and reciprocating compressors.

Fans or blowers, such as are shown diagrammatically in Fig. 4, are chiefly used when the desired compression is very small and where efficiency is of less importance than first cost. It has already been shown that the ordinary fan or blower delivers simply a pressure approximately equal to the centrifugal pressure generated by the revolving impeller or runner. The velocity energy existing in the air at impeller exit is lost in the form of heat. Hence the centrifugal compressor, which recovers the larger part of this velocity energy in the form of pressure, must necessarily be much more efficient than the ordinary fan or blower. A good practical dividing line between the field of usefulness of ordinary fans and centrifugal compressors may be said to be at about ¾ lb. pressure. This dividing line, however, is not a sharp distinction, as in some cases it is advisable to use a centrifugal compressor even for a pressure of half a pound, while in other cases, when efficiency plays no important part whatever, fans and blowers can be used to give pressures of almost a pound.

Positive pressure blowers are machines in which the rotating part consists of one or more drums with lobes running with close clearances to the casing, as is shown in Fig. 5. These lobes form pockets in which the air or gas is pocketed on the intake side of the compressor and carried in this pocket over to the outlet side of the compressor. If there is no resistance on the outlet or discharge end, the air is simply moved from inlet to outlet. If, however, a higher pressure exists at the discharge end, then the air delivered will be raised to the pressure of air existing on the discharge side. In other words, these machines are pure displacement machines and displace at every revolution a certain volume of air.

Reciprocating compressors are efficiently used when the desired pressure is 15 lb. per square inch or higher. There is a great deal of difference in design between various makes of reciprocating compressors which influence the commercial efficiency of this type greatly. The rating of reciprocating compressors (and also positive pressure blowers) is usually expressed in displacement air, that is, the volume swept through per minute by the reciprocating compressor piston. This displacement air is about 15 to 20 per cent. higher than the actual air delivered by the compressor. This can be easily understood if we remember that in a reciprocating compressor the pressure in the clearance spaces between the piston and the cylinder and in the ports up to the discharge valve is equal to the discharged air pressure when the piston reaches the end of its stroke. When the piston returns the air in the clearance space must expand to atmospheric pressure before any air from the atmosphere can be drawn into the cylinder; hence only part of the volume swept through by the piston represents air admitted to the cylinder, and the actual air delivered is usually less than the displacement of the reciprocating piston. The ratio between actual air delivered and displacement air is called volumetric efficiency.

Some designers have attempted to increase the volumetric efficiency of reciprocating compressors by increasing the velocity of the air at intake, that is, a high velocity of air is established when the piston is drawing air from the suction end. If this velocity is high enough there will be an actual compression of intake air when the piston reaches the end of its stroke and before it starts compression, due to this high velocity head. It is possible to bring the volumetric efficiency up to 100 per cent. and even above, but this is done at a sacrifice in energy efficiency, and the power loss due to establishing a high velocity of intake air more than counteracts the gain achieved by increasing the volumetric efficiency. The best that can be done is to make the clearance spaces as small as possible, and with good design the difference between displacement air and actual air delivered need not be over 12 to 15 per cent., if all valves are tight. In order to have low resistances to air flow, the intake and discharge valves of the reciprocating compressor should be large in area. The falling off in the efficiency of the compressor after running for some time is generally due to leakages past these valves, and good attention is necessary and periodical renewals should be made in order to maintain good efficiency on reciprocating compressors.

Centrifugal compressors have the great advantages of not having any close clearance to produce wear by rubbing, and of having no valves that can leak. A centrifugal compressor will have the same efficiency after years of service as it had when new. Besides this there is a decided saving in the cost of operation and maintenance of the centrifugal compressor over that of a reciprocating compressor. There is a decided difference in size between a centrifugal compressor and a reciprocating compressor of the same rating, and therefore the cost of foundations is very greatly reduced when centrifugal compressors are used.

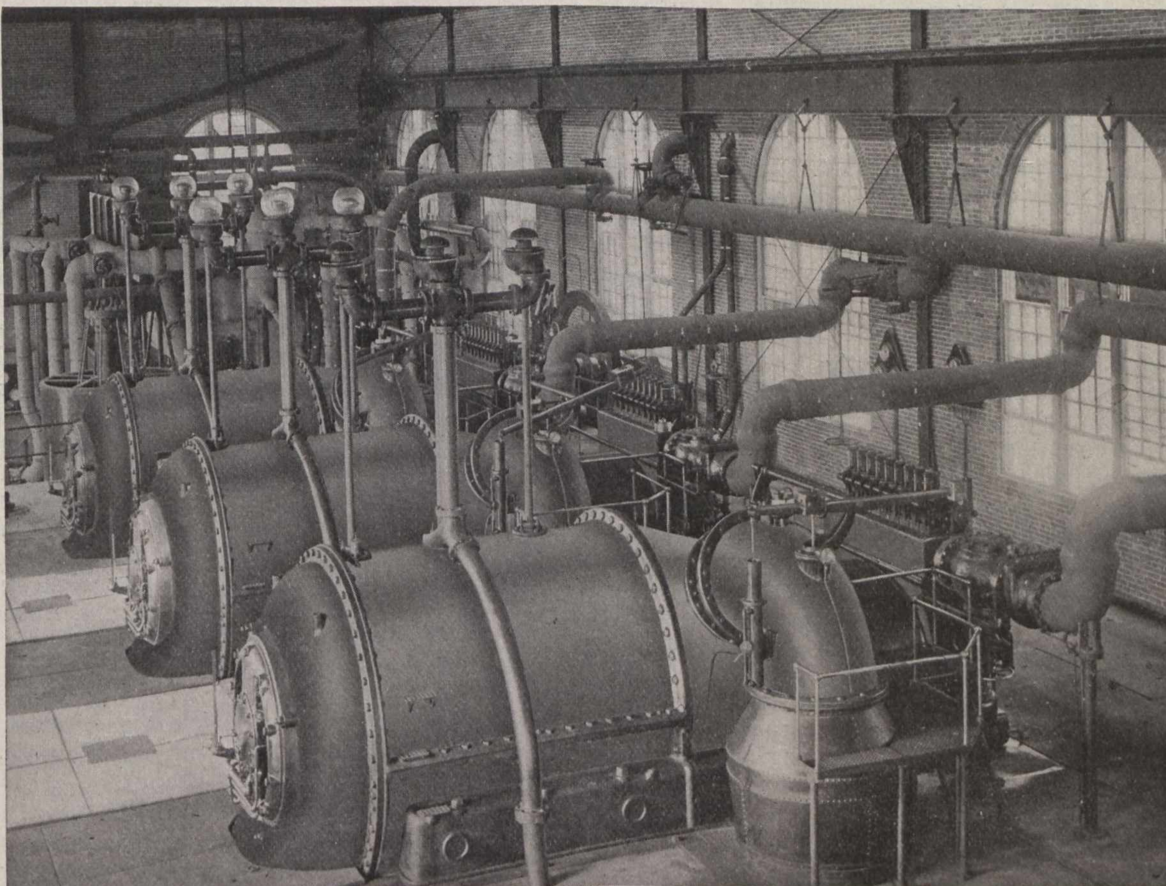


Fig. 3. Three Type T-3-40,0000-15/30-2500/3250 R.P.M. Air Compressors driven by 2900/5200 H.P. Curtis Turbines, installed at Iroquois Iron Company, So. Chicago, Ill., for blowing 500-ton blast furnace

PORCUPINE CROWN AND NORTH THOMPSON.

Timmins, Ont., Oct. 3.

A consolidation of the Porcupine Crown and North Thompson properties at Timmins is under consideration. At present the Engineers of the Porcupine Crown are examining the North Thompson property, and those of the Huronian Belt Company, which is operating the North Thompson, are investigating the Crown mine. The object in each case is to ascertain whether the respective properties will warrant an amalgamation on a basis satisfactory to both parties. The two properties adjoin the Hollinger on its southern boundary.

CHARACTERISTICS OF GOLD DEPOSITS OF KEWAGAMA LAKE DISTRICT, QUEBEC

The Geological Survey of Canada has published a report by Mr. M. E. Wilson on the geology and economic possibilities of a region in northwestern Quebec, lying immediately east of the Ontario boundary and south of the National Transcontinental Railway.

Mr. Wilson states that within the region described in this report there are no producing mines and only one property in which a mining plant has been installed. The district, however, has not been prospected except in a very superficial way, so that the fact that no important discoveries have as yet been made has little bearing on its future possibilities. The deposits which have up to the present attracted attention are the molybdenite bearing pegmatite dykes and quartz veins, and the auriferous quartz veins or veinlets in ferruginous dolomite, aplite and quartz porphyry.

Gold.—Practically all the rocks of the region are traversed by veins or veinlets of quartz which are more or less auriferous, but the most important by far are those occurring in the rocks of the Abitibi volcanic complex, and more especially in the ferruginous dolomite, aplite and quartz porphyry. These are believed to be genetically related to one another and will, therefore, be described in a group by themselves.

Veins or veinlets of quartz containing gold are now known to occur in the region described in this report, in the Larder Lake district, at Porcupine, and in numerous other localities throughout the northern part of the Timiskaming region. As will be shown later. there are certain features associated with these occurrences which point to a similar origin for all.

In a number of localities throughout the region, a rock consisting largely or in part of ferruginous dolomite occurs, which is cut by intersecting veinlets or veins of quartz. These veinlets and veins appear to occur in definite systems, a feature which is well developed in a ridge of the dolomite occurring on the north side of the Cascade rapids on the Kinojevis river. This ridge has a width of 100 yards and a length of one-fourth mile, and throughout its whole extent is traversed by the veinlets and veins of quartz.

The veinlets and veins occur mainly in two systems which strike approximately at right angles to one another, and are inclined at about 45 degrees to the trend of the dolomitic ridge.

In the Larder Lake district, quartz veinlets traversing the dolomite are also generally inclined to the structural trend of the enclosing rock.

In the Porcupine district, according to Mr. A. G. Burrows, the strike of the gold quartz veins is generally inclined to that of the enclosing rock, and while the dip of the schist is to the north at a high angle, the veins commonly dip to the south across the schistosity.

Origin.—The foregoing comparative study of the distribution of the gold bearing quartz veins of the northern part of the Timiskaming region shows in a very striking manner that the fissures along which the gold bearing solutions percolated were arranged in systems having a definite discordant relationship to the structure of the enclosing rocks. The uniformity of this relationship points to a cause which operated throughout the whole region, while the inclination of the fissures at an angle of approximately 45 degrees or less to the structural trend of the enclosing rock suggests that the fracturing owes its origin to compressive stresses acting in the same direction as the stresses which folded the rocks of the region. That such stresses were present at the time the fissures were formed is probable from the evidence that the vein filling material is derived in part at least from acidic rocks and that the intrusion of these acidic rocks accompanied the folding of the rocks of the region.

If the rocks in which the gold bearing veins of the Timiskaming region occur were fractured by compressive stresses acting in the same direction as the stresses by which they were foliated, then, in the case of an irrotational strain, if the relief of pressure were greatest in a horizontal direction at right angles to the regional stresses two systems of fissures would be developed, which, on a flat erosion surface, would cut across the trend of the enclosing rock an an angle of approximately 45 degrees, but, on a vertical surface, would appear parallel, that is the discordant relationship would be in strike. If, on the other hand, the relief of pressure were greatest in a vertical direction at right angles to the regional stresses, two systems of fissures would develop which would conform in strike to that of the enclosing rock, but would cut across the dip at an angle of approximately 45 degrees. In the case of a rotational strain two systems of fissures having a discordant relationship to the foliation would tend to form, as in the special cases just cited, but the fissures in the plane at right angles to the direction of elongation would develop by crevicing. Thus where rocks undergo fracture as a result of regional compressive stresses the fractures may indicate their mode of origin (1) by their discordant relationship to the foliation (provided the stresses act in the same direction as those by which the foliation was developed), and (2) by their occurrence in two intersecting systems. Both of these features are conspicuous in the case of the fissures along which the quartz veins occurring in the Pre-Cambrian volcanic complex of the Timiskaming region were developed.

Character of Deposits.

Those deposits which occur in association with the ferruginous dolomite consist for the most part of innumerable small anastamosing veinlets of quartz from 1 in. to 6 in. in width. In some places these are bordered by a zone of dolomite which when dissolved away leaves the quartz with a denticulated surface. In other places the veinlets have no definite walls, the junction of the quartz and the wall rock being gradational. In such localities the country rock may be almost entirely replaced by quartz.

The larger veins occurring in these rocks of the Abitibi group are very similar in character and in form regardless of whether they occur in the ferruginous dolomite or any other member of the volcanic complex. They vary greatly in width from less than a foot to several feet in short distances, and many expand abruptly to a large mass of quartz 30 feet or more in width, such as the mass occurring in the ferruginous dolomite north of the Cascade rapids on the Kinojevis river. The essential similarity of the form of these deposits to those of the Porcupine district is shown by the following quotation from Mr. Burrows' report on that area. "The irregular fissuring has produced a great variety of quartz structures, varying from the tabular, though often irregular or lenticular, vein which may be traced several hundred feet, to mere veinlets, often only a fraction of an inch in width and a few feet in length, which ramify through a rock which has been subjected to small irregular fissuring. This latter variety is well illustrated in the fissuring of ankerite bands, so characteristic of many of the gold deposits of Porcupine. Irregular and lenticular bodies of quartz often occur which may have a width of 10 or 20 ft., but which die away in a distance of 50 ft. Again there are dome-like masses of quartz which are elliptical or oval in surface outline, but whose underground extension has not been examined closely. . . . The most conspicuous dome masses are those of the Dome property, where the two largest are about 125 ft. by 100 ft."

The mineralogy of these deposits is comparatively simple for they consist almost entirely of milk-white quartz. Ferruginous dolomite is usually present in some abundance, but all the other mineral constituents occur in exceedingly small quantities. The most abundant of these are pyrite, chalcopyrite, galena, and gold. Mr. Burrows also notes the occurrence of zinc blende, pyrrhotite, argentite, feldspar and tourmaline in the quartz veins at Porcupine, and since the publication of his report, the silver telluride, hessite, and the calcium tungstate, scheelite, have also been reported. In the region here described tourmaline was observed in quartz veinlets in the dolomite occurring on Mackenzie lake, and chrome mica in veinlets in porphyry on the property of the Union Abitibi Mining Co., between Renauld and Fortune lake. The presence of the gold telluride, petzite, in the veinlets in the porphyry on the latter property has also been described by Mr. R. Harvey.

GRANBY.

New York, Oct. 6.

Stockholders of the Granby Consolidated Mining, Smelting and Power Co. voted at their annual meeting here to-day to reduce the board of directors from fourteen to thirteen, and the vacancy caused by the death of George M. Luther was not filled. A bare majority of the stock was represented at the meeting, 79,531 shares, or 53 per cent. of the total, being voted.

President W. H. Nichols said that metallurgical difficulties in connection with the smelting of ores at the Anyox property had been encountered, but had been solved, and he predicted that the Anyox, in full operation, would produce at a cost as low as any mining company in the world.

"There is less copper in the world now than for some years," said Mr. Nichols, "but there is less being used. When the war clouds roll over I do not believe there will be enough metal to go around for a time."

The stockholders approved an issue of $960,000 Series A convertible six per cent. bonds, to take care of the unsecured notes which fell due last year.

The annual report, which was submitted at the meeting in New York, compares as follows:

	1913-14.	1912-13.
Copper production (lbs.)	23,320,997	22,688,614
Gross earnings	$4,504,766	$4,782,691
Net profits	936,674	1,214,599
Profit and loss surplus	2,606,742	3,199,270

McKINLEY-DARRAGH-SAVAGE.

Cobalt, Sept. 30.—A strike of prospective rather than actual importance has been made on the Savage mine, the Cart Lake property of the McKinley-Darragh-Savage Mining Co. At a distance of 450 to 500 ft. from the shaft in the direction of the diabase mountain a crosscut encountered a very rich but very short shoot of ore. At the 110-ft. level in the top of the drift the vein is calcite. At the bottom it is excellent ore. A winze will be sunk on the vein to discover if it goes down.

MANGANESE ORE FROM RUSSIA AND BRAZIL.

New York, Sept. 29.

Arrivals at eastern ports of about 18,000 tons of manganese ore from Russia and Brazil, which represent deliveries upon recent purchases by domestic steel makers, have been recorded during the past few days. At Baltimore, the steamers Gowanburn and Liv, with 11,000 tons of Russian ore, which was diverted to this country while afloat, has been delivered to the Pennsylvania Steel Company. This company plans to make ferro-manganese from this ore at Steelton, but has not yet announced when one of its furnaces will be put upon this manufacture. The steamer American, with 7,000 tons of ore from Brazil for the Carnegie Steel Company also has arrived at eastern ports.

Cable advices were received in this country Monday to the effect that the Russian Government had removed the embargo on manganese ore which was imposed about a month ago. The significance of this announcement is uncertain, owing to doubt whether shipments may be made from the Black Sea through the Bosphorus and the Dardanelles.

Shipments of ferro-manganese from England continue to come forward in quantity. The steamer Swanmore arrived at Baltimore in the week with about 2,000 tons. The Rapidan is now afloat with some tonnage. The market for ferro-manganese is very quiet, and sales almost entirely are lacking. English makers still are asking $80, seaboard, and recent offers of resale lots by merchants at $75, but with special conditions attached, do not seem seriously to have affected the market. Further small sales of domestic, 19 to 21 per cent. spiegeleisen. have been made at $31.50 at the producer's plant in Eastern Pennsylvania.

U. S. IRON AND STEEL TRADE.

During September about 75,000 tons of rails were ordered, 400 cars and 35 locomotives, about the same rate as in August, and the smallest monthly in 15 years. The last two weeks' orders for iron have been at the rate of less than 1,000,000 tons per year. Last year the United States produced nearly 31,000,000 tons.

The Steel Corporation is operating at about 55 per cent. Its export business is showing good signs, although actual orders are considerably below normal. Russia has been negotiating for large quantities of barbed wire with the Steel Corporation and some special sheets are understood to have been sold by Pittsburg to one of the allies.

COLORADO STRIKE.

Washington, Sept. 30.—Senator Thomas, who has just returned from conferences with Colorado coal operators and striking miners, told President Wilson to-day he believed the plan for settlement, already accepted by the miners but rejected in part by the operators, would have to be materially modified before the latter would agree to it.

The President does not intend to keep Federal troops in the Colorado fields indefinitely, and is pressing for a speedy adjustment.

Denver, Colo., Sept. 30.—The Colorado coal operators have refused to accept President Wilson's proposition for a three-year truce.

NIPISSING MINES CO.

The August net profit of Nipissing Mines Co. was $136,778 on a yield of 401,820 oz. of silver, valued at $212,965. With two exceptions the production was the largest this year.

THE ELECTRIC FURNACE FOR STEEL MAKING*

By Walter N. Craft.

At the present time the art of steel making is developed to such a point that there is no question as to the possibility of making good, and even excellent steel products for all commercial purposes at a cost which is now considered reasonable. Therefore, with the crucible, Bessemer and open hearth processes in such general use and producing steel of good quality at low costs, it will be necessary for the advocates of any new methods or processes to show some real commercial advantages of a new process, as compared with one of the older methods of steel making. So it is the author's purpose to point out some of the advantages and disadvantages of the electric steel furnace, comparing it with the old and well known processes of steel making. He wishes to say at the outset, however, that he does not think the electric furnace is a universal panacea for "all the ills that steel is heir to."

The development of electric steel making, like many other new methods and processes, is suffering from too great enthusiasm on the part of its friends. In the development of the gas engine, for instance, there was a time when the capacities of the engines, as well as their engineers, were enormously overrated, but now the ratings have settled down to a safe and sane basis, and the engineers are no longer advocating the gas engine in season and out of season regardless of conditions. In the same way, the electric furnace has suffered and claims have been made for electric steel and electric furnaces that cannot be substantiated in commercial operating conditions. So, while the author feels that there is a large field for the electric furnace, he does not feel that it is destined to displace the Bessemer or the open hearth, at least for a great many years, possibly a lifetime. It is well to remember that there was a time when such a thing as the open hearth displacing the Bessemer was hardly considered a possibility. As statements concerning what is possible and what is not possible nowadays are very unsafe, the author will avoid prediction and endeavor to present merely a few considerations, which seem to be facts, concerning electric steel and electric furnaces.

The underlying principle of all electric steel furnaces is merely that of heating and melting by the use of electric current. Alternating current is a necessity for commercial operation. So far as is known there is no chemical or electrolytic action of the current such as is the case in the reduction of aluminum or the deposition of copper. The heating of the steel is accomplished in two different ways according to the type of furnace, so that there is a natural division into arc and resistance furnaces. In describing the different furnaces briefly, as is necessary in such a paper as this, the author will be compelled to omit reference to many variations, and confine himself to the three or four types which thus far seem to have had the most general recognition and adoption in actual commercial practice in this country and Europe.

The Stassano furnace.—There are three best known types of arm furnaces, namely, Stassano, Girod and Heroult, all in use in Europe, and in this country. The Stassano is purely a radiation furnace. The furnace body consists of a cylinder which stands normally in a position slightly inclined from the vertical and is arranged so that it can be rotated in order thoroughly to mix the steel. The heating is done by carbon electrodes which enter the furnace body on the sides and go into the centre of the furnace over the bath of steel. The electric current arcs from one electrode to another, and the heat of this arc radiates downward causing the bath of steel to melt. This furnace is adaptable to small sizes, but has not been successful in the larger units. The mechanical rotation of the entire furnace in order to obtain proper mixture of the steel is liable to introduce difficulties in operation. The size of the electrodes is also limited on account of their horizontal position and the great tendency to break if the weight becomes too great; hence the current input is limited by the size of the electrode. The current consumption is high on account of the small size of the furnaces. This furnace has the great advantage that it can use single or polyphase current of any frequency, which is not true of all furnaces.

The thermal efficiency of the Stassano furnace is fairly high, since the furnace body is entirely closed and there is a comparatively small opportunity for heat to escape through openings. It will naturally result that the refractory lining wears out quite fast and the cost for repairs is correspondingly high. The current consumption in this furnace, using cold scrap and refining to the quality or ordinary steel castings, is 800 to 1,000 kw., hours per ton of steel. In this connection it should be noted that in giving the current consumption for electric furnaces there is always opportunity for a wide variation, since the current consumption will depend upon the nature of the scrap charged, both physically and chemically, as well as upon the extent to which the refining of the steel is carried. It will be appreciated that if steel scrap is simply to be melted and poured into molds the current consumption will be much less than will be the case if the steel scrap is to be melted and then given a further refining to the analysis of high grade open hearth steel or even to the analysis of the best crucible tool steel. This consideration with regard to current consumption applies equally to all electric furnaces.

Returning to the Stassano furnace, it may be said that several of these furnaces are in use in Europe and possibly three or four have been built in this country, of which one or two have been abandoned and other furnaces substituted.

The Girod furnace.—The next arc furnace in point of extent of use is the Girod. This type is a combination arc and resistance furnace. There are electrodes entering through the top of the furnace and reaching to the surface of the molten bath. Arranged in the bottom lining of the furnace, directly under the bath, are iron or steel plugs, which are water cooled. The current connection from the generator is made with the top electrodes and the returning connection to the generator through the bottom electrodes, that is, one pole is above and one below, and the current arcs from the top electrode to the slag or metal of the bath and passes through the bath to the bottom plugs or electrodes. The heating thus comes in part from the arc at the surface of the metal and in part from resistance offered by the bath to the passage of the current. Probably every one who has ever had anything to do with an open hearth furnace will immediately feel an instinctive prejudice against these bottom electrodes, especially when he considers that they are water

(*A paper written for the Cleveland Engineering Society, April, 1914.)

cooled. To an open hearth advocate a hole in the bottom is a nightmare, and if that hole is filled with molten metal with flowing water immediately below it, the nightmare is liable to change to delirium tremens. As a matter of fact, however, these plugs, when taken out at the end of a run, show signs of having been melted down only four or five inches from the top, and the superintendents in Ugine, France, where the furnaces were first put into service, say that while they have had heats go through the bottom, they have never had any explosions due to the water cooling of the plugs. It is said, however, that in the operation of this furnace there is some difficulty in the making of bottom and holding up of the plugs to the desirable bottom level. There seems to be a difference in statements concerning the wear and life of bottoms in the Girod furnace. Some say that the bottoms wear away gradually and cannot be repaired or built up, as is the case in open hearth practice, and, further, that the bottoms are built of an unusual thickness at the outset in order that there may be opportunity for this wearing away before the furnace must be shut down on account of the bottom becoming too thin. They also say that in consequence a Girod furnace may start out as a five or six ton furnace and end up as a seven or eight, or even a ten ton furnace, on account of this extreme wearing away of the hearth. Others say that there is no difficulty of this kind, and that the bottoms can be repaired and built up between heats, as much as desired. The life of these bottoms is said to be from one hundred to one hundred and twenty heats when cold stock is being melted. Putting in a new bottom requires three days. In this connection it should be mentioned that in arc furnaces the wearing on the furnace walls and the furnace roofs is much more severe than is the case with induction furnaces. In the case of the Girod furnace, the life of the roof is in such great dispute that the author prefers to make no statement concerning it more than to say that it may vary all the way from eight or ten heats up to twenty or thirty heats, and possibly in some cases longer. At the Girod plant in Ugine, France, for 1913, the charge per ton of steel for refractories and linings was $2.00, while actual cost for the first four months of 1913 was running somewhat lower, and the management expected to be able for the year 1914 to adopt a charge for refractories and lining of $1.60 to $1.70. The electrode consumption is continuous, due to the wearing away of the electrode at the arc, and also to breakage. Electrode consumption runs from forty to fifty pounds per ton. The usual practice is to use amorphous carbon electrodes, which cost at Ugine, in France, about 3 cents to 3¼ cents per pound. It will thus be seen that the electrode cost per ton is from $1.20 to $1.65. In addition to the ordinary wearing away of the electrode there is a loss due to breakage of the electrodes in service, and this loss is very difficult to determine, since one lot of electrodes may be very free from breakage and another lot made at another time under different conditions may be subject to breakage and cause a very considerable loss of electrodes, and also furnace delay. This is a difficulty which is common to all arc furnaces, and which will be discussed a little more at length in connection with the Heroult furnace.

The current consumption of the Girod furnace, as given to the author by Mr. Stephan, at Ugine, varies considerably for different kinds of steels, both according to degree of refinement and to the alloys which were made. The Girod plant doubtless keeps its current consumption accurately and distributes it in a very satisfactory manner, according to the following general plan: A record is kept over an entire year of the amount of current used in making, for instance, high carbon tool steels, as one item; as another item, would be kept the current consumption in the production of nickel steels; another item would be the current consumption of tungsten steels, and so on. It can he said in general that at the Girod plant the current consumption will vary from 900 to 1,200 kw. hours per ton, according to the quality and kind of steel that is being made. While this current consumption seems high, it should be borne in mind that all of their steel is melted from the cold and the figures given cover a year's operation, which is a much fairer basis of comparison than where figures are given for current consumption during a single week or even a month.

The product that is being made at Ugine goes largely into steel castings for the general trade in France, and into forgings. They make many tons of tool steel. When the author was there they were working on an order of 1,000 tons of tool steel for Sheffield. The plant at Ugine also has a very nice business in projectile steel for the French Government, and certain of their processes are supposed to be kept quite secret. Suffice it to say that the following analysis is one said to be used for projectiles by the French Government:

	Per cent.
Carbon	0.36
Manganese	0.48
Phosphorus	0.010
Sulphur	0.009
Silicon	0.12
Nickel	4.10
Chromium	1.06

It is needless to say that this analysis was not obtained in France, nor from any Frenchman. The Girod furnace, under proper handling and metallurgical management, will make most excellent steel, and in this connection it might be well to mention that the Krupp Steel Works at Essen, Germany, has had in operation a ten-ton Girod furnace for some years. The Bethlehem Steel Company is now building a ten ton furnace of this type, and, from current report, is planning to use it for the making of high grade alloy steels as well as for certain Government work.

It should be understood that the cost of conversion in different kinds of electric furnaces will vary, and for given conditions one type of furnace may show advantages in cost of operation over other types. For this reason, and on account of the author's acquaintance and friendship with the inventors of several of the electric furnaces described, he will refrain from saying anything as to cost of producing steel in any particular type of furnace. It should also be borne in mind that where the amount of current consumption per ton is given for different kinds of furnaces, it is not a basis for the conclusion that the cost of making steel is in proportion to the current consumption. While one furnace may have a high current consumption, its costs in other respects may be lower, and vice versa, a low kilowatt consumption per ton on another furnace may offset the higher costs in other items that enter into the cost of steel making.

The Heroult furnace.—The third principal arc furnace is the Heroult, which is probably better known in this country than is any of the others. This furnace was invented by Dr. Heroult, of France, and has now reached a state of very high development. In the United States the patents are owned by the United

States Steel Corporation, and in their hands this furnace has probably attained its best efficiency. It is purely an arc furnace and heats the steel simply by the arcing from the electrodes to the bath. The furnace can be operated on single, two or three-phase current. Connection is made at the top of the electrode with one wire of the single-phase circuit. The current passes down the electrode and arcs to the slag or metal of the bath, passes through the bath and arcs up from the metal to the other electrode, at the top of which the returning connection is made to the generating source. The regulation of the arc is accomplished by raising or lowering the electrode, which is carried on an overhanging crane. This regulation can be done by hand, or by a very ingenious electrical device which operates a motor, which in turn raises or lowers the crane slightly, according to the resistance at the arc.

All kinds of electrodes have been used in the United States. The first electrode used by the United States Steel Corporation in its fifteen ton furnace at South Chicago was 24 in. square and 10 ft. long. These electrodes were made from amorphous carbon. The current density was about 25 amperes per square inch. Great difficulty was experienced from these electrodes breaking off in the furnace on account of the high heat near the arc and the excessive weight hanging at an angle when the furnace was tilted. Frequently chunks 3 ft. long and 2 ft. square would break off and drop into the bath. These chunks sometimes were so large that they had to be broken up by bars and sledges into smaller pieces before they could be gotten out through the doors of the furnace. The Steel Corporation went through a long period of investigating and experimenting, before it obtained electrodes that were satisfactory. For a time they used graphitic carbon electrodes, which, of course, will carry a much higher current density, and consequently can be made smaller, but which in turn cost about three times as much per pound as the amorphous electrodes. Within the last year or two, amorphous electrodes have been made in this country and thus far they are giving much better results than was formerly considered possible either in this country or in European practice. In Europe the electrode-using furnaces are still having trouble from the breakage of electrodes. Formerly the electrode consumption in the Heroult furnace would average 35 to 40 lb. per ton; then it was reduced to 30 lb., and the author has lately heard of one furnace that is averaging only 22 lb. per ton. The cost of amorphous electrodes is now 3½ cents per lb. in this country, so that with cold melting there is an average electrode cost of about $1.00 to $1.25 per ton of steel. In the case of refining hot metal, the electrode consumption will vary according to the degree of refinement, but will be on the average from 5 to 12 lb. per ton. The current consumption in the Heroult furnace will vary greatly for cold melting and according to the size of the furnace. In a well-known English steel plant, which has a small sized Heroult furnace, melting from the cold and making high quality steel, generally for the British Government, the current consumption covering a period of one year was decidedly less than 700 kilowatt hours per ton. This is a remarkably good record, especially in view of the kind of steel that was being made and the fact that the furnace was of less than three tons capacity. It speaks very well for the operators and superintendent of the furnace. However, it should be recognized that such a low current consumption on so small a furnace is only possible when commercial conditions permit continuous operation of the furnace.

It might perhaps be fair to say that on a five-ton Heroult furnace, operating for steel castings on the day turn only, a much higher current consumption should be expected. If, however, a continuous operation of a five ton furnace could be had, the current consumption in the production of steel casting quality of steel should be brought down nearly to 600 kw. hours per ton.

In the Heroult furnace, as in the Girod, the cost of roof and side walls is a considerable item in the cost of steel. In the Heroult furnace the roof is made removable in order to avoid delay of the furnace. It is common to have several roofs bricked up and ready for service, so that when a roof gives out it may be removed and another put in its place. This is accomplished in several steel plants with a delay of only one or two hours. With proper care and attention the hearth or furnace bottom will last almost indefinitely.

Induction Furnaces.

The induction furnace is really a large transformer for alternating current of either one, two or three phases.

The first form of induction furnace was a single phase, single ring secondary or bath, known as Kjellin. Kjellin was the first to develop commercial electric furnaces and even to-day there are several old Kjellin furnaces still in use.

The next development was the Frick arrangement of the coils, which has the advantage that the surface of the bath is kept more nearly level.

The greatest single step in the development of induction furnaces was the design of the Rochling-Rodenhauser furnace at the Rochling Eisen and Stahlwerke, at Saarbrucken, Germany, by J. Schoenawa, general superintendent of the plant and a metallurgical engineer, and Rodenhauser, an electrical engineer. In this furnace there is an iron magnetic core of rectangular shape, on two legs, on which are wound coils of copper wire which carry the primary current. The secondary of the transformer is the steel bath itself, and it is in the secondary that the heat is generated which melts and refines the steel. The secondary circuit around each primary winding consists merely of one ring of metal, so that it is really a single turn circuit short-circuited on itself. The cross-section of the heating channels on the outsides is very small as compared with the main hearth of the furnace in the middle. Therefore the narrow portions at the outside of the furnace are the places where the greatest amount of heat is generated, and the circulation of the steel in these heating channels carries the steel at very high temperatures from the longer channels into the middle or hearth of the furnace. In the operation of these furnaces, the unskilled workmen have an idea that the heat is generated at the point where the channels join the main hearth, and it certainly looks as if this were the case, as the steel at a white heat comes flowing out from the longer channels into the main hearth, and by contrast with the comparatively cold hearth, the steel coming from the channel looks enormously hot. You can get a little idea of the resistance that is being overcome in these channels when you understand that the voltage in this bath is only from five to ten, while the amperage varies from fifteen to thirty thousand, and sometimes much higher. The voltage on the primary side of some furnaces may be as low as 450 volts, while other furnaces are designed for 5,000 volts, and there is one furnace being built now that will receive its primary current at 11,000 volts.

The induction furnace has no electrodes and, consequently, is free from electrode troubles. On the other hand, the shape of the bath is much more complicated than is the case in arc furnaces, and the slag line is probably at least twice as long as that of the open hearth or arc furnace of the same capacity. The result is that the scorification at the slag line is much greater than in the case of the arc furnace, and this is accentuated by the fact that the slag action is concentrated at certain points along the extended slag line, on account of certain magnetic and electrical conditions in the furnace. This scorification difficulty is further increased because the banks of the furnace are of necessity so straight up and down that repairs between heats are almost impossible. The result is that after a certain number of heats the furnace must be shut down, the magnetic core taken apart, the roof and a portion of the lining torn out, and a new lining put in to take the place of the wear that has occurred due to the scorification of the slag line. The result is that in European practice after every fifteen days the furnace must be shut down, new lining put in, and the furnace then re-heated. On an average this requires sixty hours, or two and one-half days of furnace delay. To an American steel man, a two and one-half days' shut down out of each eighteen days seems ridiculous, and it would be impossible under American conditions of steel plant operation, but in Europe such a delay does not seem to be prohibitive or even serious.

The current consumption on the induction furnace varies, of course, with the size of the furnace and the quality of the metal being turned out, but in general it can be said that it will run from 650 to 900 kw., hours per ton. This, of course, includes the current required for drying out and heating up the furnace after the necessary shut downs for repairs. The present types of induction furnaces all have the common disadvantage that a portion of the molten charge, varying from ¼ to ⅓, must always be retained in the furnace after pouring a heat, in order to maintain the metallic circuit for the secondary on the next charge. However, if hot metal from a Bessemer or open hearth is being used, the induction furnace can be emptied entirely, since the hot metal will immediately flow around in the heating channels and constitute the metallic circuit.

Notwithstanding the fact that the wear on the lining is a distinct advantage, nevertheless the induction furnace has certain advantages which weigh against this great disadvantage. The current demand of the induction furnace is much more uniform and the consequent load on the generating plant is much more desirable than is the case with the arc furnace. Furthermore, the total kilowatt capacity used by the two furnaces is quite different. The fifteen ton Heroult furnace at South Chicago has a total of 2,250 kw. transformer capacity available. This furnace has a power factor of 0.89 to 0.90. A certain five ton arc furnace is operating at the present time with a 900 kw. transformer capacity with a power factor of 0.93 to 0.94. On the other hand, a five ton induction furnace would require only about 600 kw. It would operate, however, with a power factor of about 0.6, and to obtain even that a low frequency would be necessary.

This means that for the induction furnace a very much larger generator would be required, but that the prime mover for the generator need be of only 600 kw. capacity. The result is that the installation cost for the induction furnace is somewhat more than is the case with the arc furnace. The induction furnace requires in addition, in order to obtain a power factor of even 0.6, a source of current of very low frequency. For instance, a two ton furnace should have a frequency of not more than twenty-five cycles per second; a five ton furnace should have fifteen cycles, and one of the largest furnaces now operating in Europe is supplied by an alternator with a frequency of only five cycles.

However, the disadvantages are not all on the side of the induction furnace. It has certain advantages which, to a person who has had experience with open hearth practice, are very great. The process of melting and refining a heat of steel in the induction furnace is simplicity itself, and the action of the furnace in operation is fascinating. In Norway the writer saw a four ton furnace charged with cold scrap that apparently had been accumulated from the four corners of the earth. The charge consisted of iron and steel borings and turnings caked and rusted, with some old horseshoes, a considerable quantity of wrought iron nuts and bolts, some scrap obtained through the dismantling of old ships, some sheet tin scrap, in fact, about as poor a lot of scrap as one can imagine, and in such form that an open hearth melter in this country would almost refuse to use it. The charge was shoveled into a furnace which had about one ton of molten steel in the bottom. After the furnace was filled full with about one-half the charge, the current was turned on by simply turning a switch and setting a rheostat so as to give the desired amount of power input to the furnace. After doing this, the melter walked away and did not come near his furnace again for an hour. The author stayed to watch the progress of the melt. There was almost no noise, there was no smoke or flame coming from the furnace, except for the first four or five minutes while the grease and volatile matter were burning out of the charge. After the first five minutes there were no fumes, gases or smoke pouring out from the furnace, and the redness gradually rose through the charge, due to the heat in the heating channels, until in the course of fifteen or twenty minutes after the charge was put in, the outside of the pieces of steel began to sweat and the molten drops began to run down into the bath. In the course of three-quarters of an hour, the entire mass had settled down into the molten bath and the furnace was ready to receive the balance of its charge of cold scrap. The same operation was repeated on the second half, and after the entire charge was melted down, a slag was made to remove the phosphorus. This particular heat was intended for some cheap tool steel and no special effort was made to reduce the phosphorus and sulphur to a low point. The analysis of the steel made on this particular heat is given below:

	Per cent.
Carbon	0.80
Manganese	0.28
Sulphur	0.027
Phosphorus	0.008
Silicon	0.20

The author feels like saying for the induction furnace that its actual operation by the metallurgist or melter is most exceedingly fascinating and attractive, as compared with the operation of an open hearth furnace.

It has been claimed by some advocates of the arc furnaces that the induction furnace will not refine because the slags are too viscous, since they are colder than the steel. Within the last three years it has become possible to refine in the induction furnace just as well as in the arc furnace, where the slag is hotter than the metal and is consequently very liquid. All the author has to say in reply is that he has never seen in any open hearth furnace more liquid slags than he saw on the induction furnaces in the Rochling plant in Germany. And as evidence that refining is possible, he gives the analysis of eight and one-half tons of basic Bessemer rail steel that he saw blown in the converter, then transferred to an electric induction furnace, and refined to an ordinary grade of tool steel. He saw both samples taken from the heats and had them analysed in this country. The rail steel charged into the electric furnace was:

	Per cent.
Carbon	0.76
Phosphorus	0.013
Sulphur	0.072

The tool steel tapped from the electric furnace was:

	Per cent.
Carbon	0.80
Phosphorus	0.006
Sulphur	0.021

After this necessarily superficial explanation of a few of the different furnaces, it will be apparent to anyone considering the installation of an electric furnace that there is at least a good variety to choose from, and a more detailed investigation will make apparent also the fact that many inter-dependent technical and commercial considerations will enter into a wise choice of a furnace. For instance, an induction furnace must have a little current kept on all the time, and is, therefore, more suited to a continuous operation, while an arc furnace will be better adapted to intermittent operation. On the other hand, if current be purchased from a central station, the cost of current per unit will be materially increased by a higher "demand." Since, for instance, a five ton Heroult furnace needs 900 kw., with even an overload capacity, its "demand" and hence its unit cost of current will probably be higher than that for a five ton induction furnace, which needs at most only 600 kw. capacity and can use current steadily up to its maximum demand. In such circumstances, an induction furnace might obtain a much lower price for current per unit and at the same time its consumption of current per ton of steel would not be materially different from the arc furnace. There are many other technical features which might be mentioned that may determine the success or failure of a given installation. It is therefore quite evident that in the choice of an electric furnace to be operated under given conditions, a very careful and detailed investigation should be made of all the technical details of the furnaces in their relation to the commercial conditions of current supply and the steel plant operations.

(To be Continued)

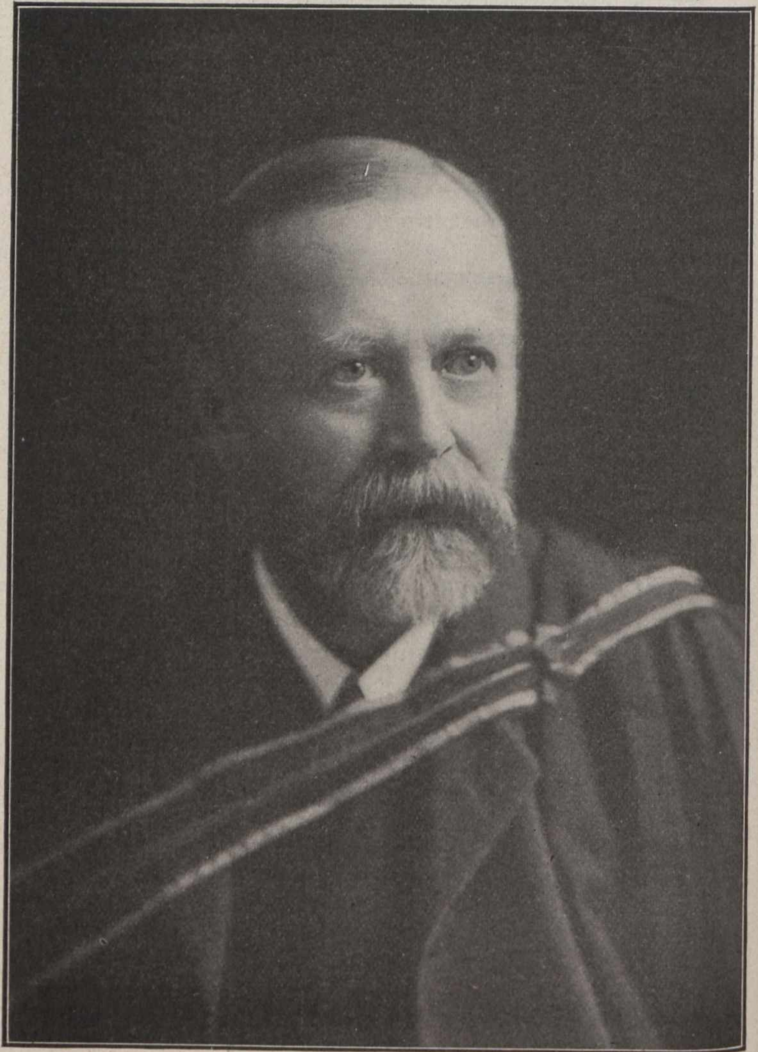
International Nickel.—Of 2,840 stockholders registered on the books of International Nickel Co. on June 30, 1914, 390 were European, holdings amounting to $849,900, of a total outstanding stock of $47,044,100. On June 30, 1913, there were $2,349 stockholders, of whom 404 were European, holdings totalling $792,800. Number of women stockholders June 30, 1914, totalled 972 as against 811 on June 30, 1913.

PERSONAL AND GENERAL

Mr. J. Parke Channing was operated on last week for appendicitis. He is reported improving steadily.

Mr. F. C. Andrews, who graduated in mining at the University of Toronto last spring, and has since been working at Porcupine, has given up his position in order to enlist for service abroad. Being too late for the first contingent he has sailed for England, hoping to be allowed to join the Canadian contingent there.

Prof. A. P. Coleman is on an extended trip abroad. He was last heard of from Ceylon. During his absence part of his work at the University of Toronto will fall on Prof. Parks and Mr. McLean, while Dr. W. G. Miller, Provincial Geologist, will give a series of lectures.



Dr. W. H. ELLIS

Acting Dean, Faculty of Applied Science, University of Toronto

Mr. R. B. Stewart was in Toronto last week after spending two months in the Beaver Lake district.

Prof. Geo. Guess, head of the department of metallurgy at the University of Toronto, is at Anyox, B.C., having been retained by the Granby Co. in connection with the operations of the new smelter. He is expected to return to Toronto shortly to assume his college duties.

Mr. R. B. Lamb has moved his office from room 703 Traders Bank Building, Toronto, to room 501 in the same building.

Judge E. H. Gary, chairman of United States Steel Corporation, has resigned as a director of all companies not affiliated with the Steel Corporation. Judge Gary began withdrawing from directorates of corporations other than United States Steel about a year ago.

Mr. Frank E. Lathe, of the staff of the Granby Consolidated Mining, Smelting and Power Company, is in Toronto.

Dr. W. H. Ellis has been appointed acting Dean of the Faculty of Applied Science, University of Toronto, pending the appointment of a successor to Dr. John Galbraith. Dr. Ellis has been a member of the staff since 1878.

Messrs. O. E. LeRoy, G. C. Mackenzie, E. Lindeman and J. McLeish, of the staff of the Department of Mines, have been appointed a committee to make an enquiry into the condition of the iron mining industry in Canada.

SPECIAL CORRESPONDENCE

PORCUPINE, SWASTIKA, KIRKLAND LAKE

Tough Oakes.—The Tough-Oakes company is now devoting attention chiefly to the erection of the 100 ton mill and the treating of dump ore in the present small mill. The foundations of the new mill are being laid with all expedition, and it is hoped to get the building ready for the machinery before the hard weather. The capacity of the small mill is being raised from 12 tons a day to 50.

Harricanaw.—Some remarkable samples are being obtained from the Harricanaw field in Northern Quebec. This is particularly the case in regard to the claims held by the Homestake Porcupine mines, which has an interest in about 800 acres. The samples from a vein on the Clark properties are particularly good.

Schumacher.—One drill is being run at the Schumacher mine, the contractors finishing their work and being allowed to go. Sinking has been stopped, but veins already found above the 300 ft. level will be developed as far as the working force maintained will allow.

Hollinger.—The first of the new compressors installed in the Canadian Mining and Finance power house on Gillies lake should be running early this month. The Fraser & Chalmers compressor has been shipped from England, and once delivery has been made it will be quickly set up. The two machines will give the Hollinger group approximately 100 extra drills. These have been badly needed for some time. Owing to the lack of compressed air for the last two months the work on the Hollinger has had to be largely curtailed. Work in several of the outlying shafts on the Hollinger and the Acme was stopped. This situation has been rendered still more acute, since the Vipond commenced underground operations, as the Hollinger up to that time had the use of the Vipond compressor.

The sinking of the main working shaft for the three Canadian and Mining Finance properties has been commenced. It is about 1,000 ft. from the present main shaft of the Hollinger. The shaft will be taken down 1,300 ft., levels being opened up at 425 and 800 ft.

There are now 900 men on the Hollinger pay roll.

Vipond.—The continuous decantation process at the Porcupine Vipond is now running smoothly at the Vipond mine, and the second clean-up from the mill has just been made.

Porcupine Pet.—The very spectacular ore shoot encountered by the Porcupine Pet at the 50 ft. level has attracted much comment in the camp. The little stamp mill at this property is running continuously and the first gold bar has been shipped out.

Dome.—The new management at the Dome mine is busily seeking economies of operation. In the rock house a bin is to be installed in which broken ore can be stored from the mine. Previously all the ten cars were dumped into the big crusher at once and the belt conveyor was full only for about half its length. Now it will be evenly distributed, with a consequent economy in power. The small dump cars underground are to be replaced by ones of much larger capacity and the ore chutes will be widened so that the rock will not jam, and dynamite will not have to be used to loosen them. The new cars can be handled with much greater economy of time.

COBALT, GOWGANDA, SOUTH LORRAINE

With the resumption of work on the Timiskaming and the Beaver there is now not a producing mine in the Cobalt camp that is shut down on account of the conditions following the war. The Beaver is putting on a full gang of men underground. The mill has been running to capacity without stop. The Timiskaming is for the present putting four drills underground. These two properties are now controlled by the same interests. The Timiskaming closed down a month or so before the war, it being understood that the ore was rapidly being depleted. Before development operations on a considerable scale can be resumed, some outlay would have to be made in timbering, although stoping and sinking could be continued. The shaft is down to the 750 ft. level. The Drummond Fraction, working the parcel of ground between the Caribou Cobalt and the Kerr Lake, and operated jointly by the Crown Reserve and the Kerr Lake, has resumed with a few men breaking ore for their contract with the Dominion Reduction Co.

Altogether it is probable that there are no more men out of work than has been normal all this year. Quite a large number of men left the camp when so many mines closed down in the first few weeks of the war and not more than half of these have returned. There are still three or four men for every job that offers, but there is not the same fear of unemployment this winter. It is also to be considered that there are not now many men employed in trenching or other surface work that stops when the snow falls, and that beyond a few men on the La Rose those employed now are permanently employed.

It must also be conceded as an evidence of fair play on the part of the mine owners that there has been no organized attempt, no thought even, of cutting wages or lengthening hours, and that in spite of the fact that there was a good deal of opposition to the Government measure of the eight-hour day which became operative only this year. In one or two instances some attempt has been made to cut wages, but it has not been with the consent of the majority of the operators.

To make work for those who cannot find employment, some of the companies have been doing odd jobs that were not absolutely necessary, and for this, of course, a minimum wage has been paid; but for all the ordinary work of a miner on surface or underground no change in pay or hours has been either attempted or made.

Cobalt Lake.—It is officially announced that Cobalt Lake will not be drained till next spring, although preparations are now being made to lower the surface of the water some six and a half feet. As a consequence of the disappearance of credit to municipal corporations, the town of Cobalt has found it impossible to raise money to carry out the laying of the sewer and the provision of sewer disposal which will have to be accomplished directly the lake is drained. In these circumstances the Cobalt Lake Mining Co. is shouldering the burden of laying the main sewer pipe as well as of pumping the lake. As soon as the lake is sufficiently low the sewer pipe will be laid and the lake will then be allowed to resume its former height until the spring, a temporary dam being cut in the rock cut near the Right of Way mine.

Good ore is being found in the conglomerate in the winze below the 226 ft. level. The vein itself, at a depth of 390 ft., is only an inch wide, but the whole of the ore being broken will be of good milling grade. It is anticipated that production from the Cobalt Lake mine this year will materially exceed that of 1913, when it was considerably over the million ounce mark.

La Rose.—Following the decision of the company to spend some of the large cash surplus in development work, the La Rose is very energetically exploring. On the main La Rose the high ground between the O'Brien and the La Rose is being cleared of overburden by a large gang of men. It will be systematically searched for small veins. Some time ago a long crosscut was run from the first level through this section of the property, but no surface work has been attempted before.

On the La Rose Extension a shaft is being sunk in order to explore this forty acres. So far nothing has been discovered on it of any importance. The formation is conglomerate and it is known to be very deep here. The shaft will be put down so that crosscuts can be run under swampy ground in order to endeavor to pick up veins.

At the University two long crosscuts are being run for exploration purposes. The one is being taken from the 180 ft. level of the Lawson to connect with the No. 1 shaft of the University, and the other to run from the University shaft to crosscut the No. 2 vein of the University. Further exploration work is also being done from the Lawson in the diabase.

The La Rose will pay its regular quarterly dividend on October 20th, amounting to $187,328.37 or 2½ per cent. Altogether this company has now paid 67 per cent or $4,825,135.

BRITISH COLUMBIA

Dividends.—The total amount of dividends declared during nine months ended September 30, 1914, by metalliferous mining companies operating in British Columbia is stated to be $1,453,219. The Consolidated Mining and Smelting Company of Canada, Ltd., has declared three dividends each of two per cent., or at the rate of eight per cent, per annum; the Granby Consolidated Mining, Smelting and Power Co., Ltd., paid two of one and one-half per cent. each, or at the rate of six per cent. per annum, but passed its dividend for the third quarter of the year; the Hedley Gold Mining Co. has made its customary distribution of five per cent. every three months, this being a quarterly dividend of three per cent. and a bonus of two per cent., together equal to a rate of 25 per cent. per annum; and the Standard Silver-Lead Mining Co. has paid eight monthly dividends and one extra, each of two and one-half cents a share, while its September distribution was only one and one-quarter cents a share, owing to the cessation of production consequent on the disorganization of the market for metals and the resultant stoppage of ore buying by the smelting companies. The several proportions of the above-mentioned total of dividends for 1914 are as follows:

	Amount of Dividend.		Total. for 1914.
Consolidated M. and S. Co., three dividends each of..	$116,088	=	$ 348,264
Granby Con. M. S. & P Co., two dividends each of ..	224,977.50	=	449,955
Hedley Gold Mining Co., three dividends each of ..	60,000	=	180,000
Stand. Silver-Lead Mng. Co., nine dividends each of ..	50,000		
and one of	25,000	=	475,000
Total of dividends for nine months......			$1,453,219

Neither the British Columbia Copper Co. nor the Le Roi No. 2, Ltd., both of which have been dividend-payers in past years, is on the list for the current calendar year. The published dividend figures for 1912 show a total of $1,224,089, and for 1913 $2,390,131. While the total for the whole of 1912 has already been passed, there is little probability of this year's total being as large as that of last year. It is expected that the Consolidated Co. will declare another two per cent. dividend before the close of 1914, and that the Hedley Co., which is steadily maintaining its production of gold on its normal scale, will in December follow the course it has adopted at the close of each of the last two years and declare dividend and bonus together fifteen per cent., equal to $180,000. The Standard Silver-Lead Co.'s dividend payments during the three closing months of the year may be determined by the decision of the company in the matter of resuming production of ore. If it shall be decided that the terms and conditions under which the smelting company will accept custom ore are such as will prove too much to the disadvantage of the seller, there will not be an immediate resumption of production at the Standard mine. It may be, though, that whether the mining and shipment of ore be shortly resumed or not, the Standard Co. will pay a monthly dividend at the reduced rate in September, in which case there will be $75,000 from this source to be added to the year's total. Assuming that these three companies shall make further dividend payments in 1914, as above indicated, the total of all metalliferous mining companies for the year will be $1,824,307, which will be $565,824 less than that of 1913. Of course there is a possibility that the Granby Consolidated Co. will pay another dividend of $224,978 before the year shall close, and, if so, the total decrease will be proportionately smaller.

East Kootenay.

While the figures to show the quantity of ore received during the last week in September at the Trail smelting works from the Sullivan lead mine, situated near Marysville, in Fort Steele mining division, have not been published in time to be included in the totals now to be given, it is known that during the third quarter of the current year more ore reached Trail from that mine during the three months, July-September, than during the six months, January-June. The figures for thirteen weeks ended April 2, were 4,363 tons, for thirteen weeks ended July 2, 5,700 tons, making a total of 10,063 tons for the first half of the year. For twelve weeks ended September 24, the total is 12,699 tons. The smeltery receipts from the St. Eugene mine for the expired part of the year to the last mentioned date have been 949 tons. Estimating receipts for the week ended October 1 at about 1,300 tons, it will be seen that the total quantity of lead ore to reach the smeltery from East Kootenay mines in nine months of 1914 was approximately 25,000 tons. No authentic information is available yet concerning the placer gold output of Fort Steele division, but this is not likely to prove to have been more than a few thousand dollars in value.

West Kootenay.

Ainsworth Division.—During four weeks ended September 24, 232 tons of lead concentrate from the Bluebell mine, Kootenay lake, and 227 tons of silver-lead ore from the Maestro in Ainsworth camp, reached the Consolidated Co.'s smelting works at Trail. None was received from the Highland and No. 1 mines, both of which were shippers every month of the year until September. Development work has been continued at the Silver Hoard mine, also in Ainsworth camp, but no ore has been shipped from this mine since last January. The Utica, near the western boundary of the division, had two cars of ore reach Trail in September, but its output thus far this year has been comparatively small. Shipment recently took place of a car of marble from the quarry north of Kootenay lake to one of the prairie cities of the West.

Slocan Division.—There was less ore shipped from Slocan mines during the month of September than in any other month of 1914. One car of silver-lead ore from the Surprise, near Cody, and 169 tons from the Rambler-Cariboo constitute the total receipts at Trail. Both these properties are being worked now, as well as several others around Sandon.

There is little change in conditions at a number of other Slocan properties that were mentioned a few weeks ago. In regard to others—the California, near New Denver, is being worked in a small way under lease, and it is reported that indications of the nearness of ore show in a raise being made; work is being continued at the Apex, where a pipe line to bring in water for power purposes is a recent addition to plant; in McGuigan basin a crosscut adit from the Rambler-Cariboo main low level working to the Best claim has been arranged for, the Rambler-Cariboo company having contracted to drive this adit for Mr. A. W. McCune and associates.

Nelson.—The Pingree Mines Co., with the management of which Mr. J. L. Stamford, of Victoria, has long been actively connected, is employing six men on its property, situated on Eagle creek, a few miles from the city of Nelson. Mr. Frank E. Pearce is in charge of development, and some showings of nice looking copper-gold ore have been opened on the property. In the same neighborhood a number of placer gold mining leases have been taken up and arrangements made to work them as a partnership property. Water was brought on to a part of the ground last season, and a little coarse gold was won, but freshets took out the water supply line, so it is probable nothing more will be done until next season.

In the southern part of Nelson mining division there has been made a change in the wages at several mines. It has been announced by advertisement in the Daily News that as from October 1 the following scale will be in effect: Miners, $3.50 a day; shovellers and trammers, $3; and surface laborers, $3. The mines affected by the reduction are the Ymir-Wilcox, near Ymir; Second Relief, in Erie camp; Emerald, H.B., and Zincton, near Salmo; and the Motherlode, on Sheep creek. For a year or more the Ymir Miners' Union has had a notice in the Daily News intimating that there is a strike on at the Queen mine, Sheep creek, at which refusal was persisted in to pay $4 a day as regular wages for miners, though it has been stated that in some parts of that mine $3.75 was paid, but now the scale is the same as decided on for the other mines abovementioned.

Work is being done, under lease, on the Golden Fawn, Sheep creek, by Anderson & Burnham, who have also leased the small stamp mill at the Nugget.

Rossland.—There has been a gradual increase in the quantity of ore shipped from Rossland mines during the three quarters of 1914. For thirteen weeks ended April 2, the total was 62,143 tons, an average of 4,780 tons a week; for thirteen weeks ended July 2, it was 65,782 tons, an average of 5,060 tons a week; for twelve weeks ended September 24, it was 71,495 tons, an average of 5,958 tons a week. The total quantity for the year to September 24 was 199,420 tons.

Trail.—The fiscal year of the Consolidated Mining and Smelting Company of Canada, Ltd., ended on September 30. Approximately 386,000 tons of ore was received at the company's smelting works at Trail during that period. This quantity gives an average of rather more than 32,000 tons a month, as compared with a little better than 27,000 tons a month for the fiscal period ended September 30, 1913. The average increase, therefore, has been about 5,000 tons a month.

A TUBULAR STEEL TRIPOD.

Several novel features have been introduced into the construction of the Morris folding tubular steel tripod, and these are described in bulletin Y17, of which a copy has been submitted to us by the Herbert Morris Crane & Hoist Co., Ltd. One feature which will appeal to users of this kind of lifting gear is the ability to fold up the tripod without removing any bolts or pins. A broad flange is provided on each foot to enable the tripod to carry a load on soft ground, and a square point gives a good "grip" on harder surfaces. Another new feature is that provision of a small pulley at the top of tripod by which a small rope can be used to haul up the heavy lifting block or to handle very light loads quickly. Every tripod is tested with a 50 per cent. overload, so that the safety of the user is always assured. It is also worthy of note that even in the one ton capacity the tripod is light enough for one man to carry on his shoulder. Those who have had experience of hauling around the home-made wooden shear-leg will be able to appreciate this feature to the full.

BYERS GALVANIZING PLANT.

The new galvanizing plant recently completed by the A. M. Byers' Company at their mills in Pittsburg contains the most modern and efficient equipment for manipulating the galvanizing process known to-day. The galvanizing specifications call for a coating of highest grade prime Western Spelter, and a deposit 100 per cent. heavier than that required in Government galvanizing specifications.

A NEW MORRIS CRANE.

An interesting new standard overhead crane has been introduced to the Canadian market by the Herbert Morris Crane & Hoist Co., Limited. A description of this crane is embodied in bulletin B9 just issued by the company.

MARKETS

STANDARD MINING EXCHANGE.

Toronto, Oct. 9, 1914.

As different mining properties continue to report favorable progress public interest in mining affairs shows a tendency to broaden. There appeared to be rather more buying orders on the Standard Exchange yesterday, but not many were filled, as buyers were not disposed to bid stocks up except in some isolated cases. The advancing movement in Hollinger, which yesterday sold at $18.10, ex-dividend, has had a tendency to strengthen the market for Dome mines. Another hundred shares of this stock sold at $6.50. Some large interests in Dome Lake were buyers of the stock again at 32. Accumulation by the Timiskaming & Hudson Bay Company is said to have reached considerable proportions during the last few months.

Transactions on Oct. 9.

	Open	High	Low	Close	Sales
Cobalt Lake	38	....	....	38	100
Dome	6.50	....	....	6.50	100
Dome Ex.	5	....	....	5	500
Dome Lake	32	....	....	32	400
Hollinger	18.10	....	....	18.10	110
Timis.	9½	10¼	9½	10¼	1200

Closing Quotations.

	Ask.	Bid.
Cobalts—		
Bailey	¾	½
Beaver	25	23
Buffalo	..	75
Chambers-Ferland	15	11
City of Cobalt	..	30
Coniagas	..	6.00
Crown Reserve	1.08	1.06
Kerr Lake	4.75	4.25
La Rose	75	..
McKinley	..	40
Nipissing	6.00	5.35
Peterson Lake	23¼	..
Timiskaming	10½	10
Wettlaufer	..	5
Porcupine—		
Dome Extension	5½	5
Dome Lake	34	31½
Dome Mines	6.70	..
Hollinger	18.20	18.00
Jupiter	7	6½
Rea	..	10

STANDARD EXCHANGE.

The minimum scale fixed by the Exchange, and below which no sales are permitted, is as follows:—

Cobalts—	
Beaver	.17
Buffalo	.75
Chambers-Ferland	.10
Canadian	.05
City of Cobalt	.30
Cobalt Lake	.30
Coniagas	6.00
Crown Reserve	1.00
Great Northern	.04
Hudson Bay	30.00
Kerr Lake	4.00
La Rose	.70
McKinley-Darragh	.40
Nipissing	4.75
Peterson Lake	.23
Seneca Superior	2.00
Timiskaming	.07
Trethewey	.12
Wettlaufer	.04½
York, Ont.	.07
Porcupines—	
Dome Extension	.05
Dome Lake	.30
Dome Mines	6.50
Foley O'Brien	.20
Hollinger	16.00
Homestake M. F.	.20
Jupiter	.04
McIntyre	.27
Pearl Lake	.02
Porcupine Crown	.75
Porcupine Peterson	.25
Porcupine Vipond	.17
Rea Consolidated	.10
Teck Hughes	.07
West Dome	.05

TORONTO MARKETS.

Oct. 8.—(Quotations from Canada Metal Co., Toronto)—
Spelter, 6 cents per lb.
Lead, 5 cents per lb.
Tin, 33 cents per lb.
Antimony, 16 cents per lb.
Copper, casting, 13½ cents per lb.
Electrolytic, 13½ cents per lb.
Ingot brass, yellow, 10c. per lb.; red, 12c. per lb.

Oct. 8.—Coal—(Quotations from Elias Rogers Co., Toronto)—
Anthracite, $7.75 per ton.
Bituminous, lump, $5.25 per ton.

GENERAL MARKETS.

Oct. 7—Connellsville coke, (f.o.b. ovens).
Furnace coke, prompt, $1.65 to $1.70 per ton.
Foundry coke, prompt, $2.25 to $2.35 per ton.

Oct. 7.—Tin, straits, 30.80 cents.
Copper, Prime Lake, 11.75 cents.
Electrolytic copper, 11.50 cents.
Copper wire, 13.00 cents.
Lead, 3.50 cents.
Spelter, 4.85 to 4.90 cents.
Sheet zinc, (f.o.b. smelter), 8.50 cents.
Antimony, Cookson's, 13.00 cents.
Aluminum, 18.00 to 18.50 cents.
Nickel, 40.00 to 45.00 cents.
Platinum, soft, $48.00 to $50.00 per ounce.
Platinum, hard, 10 p.c., $52.00 to $54.00 per ounce.
Bismuth, $2.75 to $3.00 per pound.
Quicksilver, $52.50 per 75-lb. flask.

SILVER PRICES.

	New York cents.	London pence.
September—		
25	53	24¼
26	53⅛	24¼
28	52⅝	24
29	53⅜	24¼
30	52¾	24
October—		
1	52⅜	24
2	52½	24
5	52⅝	24⅛
6	52⅜	24
7	52½	24