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EIGHTEENTH YEAR OF PUBLICATION

The CANADIAN MINING REVIEW

Established 1882

Vol. XIX—No. VI. OTTAWA, JUNE 30th, 1900. Vol. XIX—No. VI.

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Magdeburg-Buckau (Germany)

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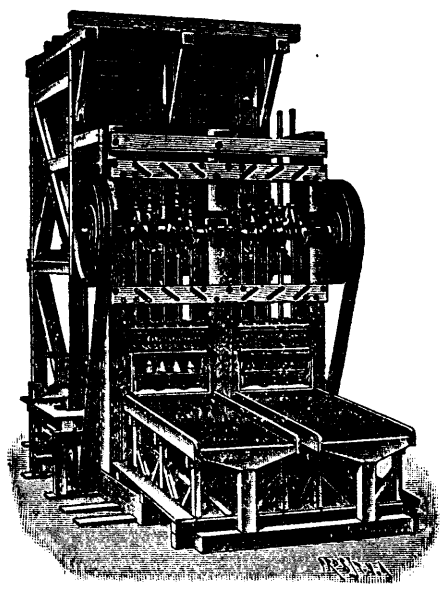

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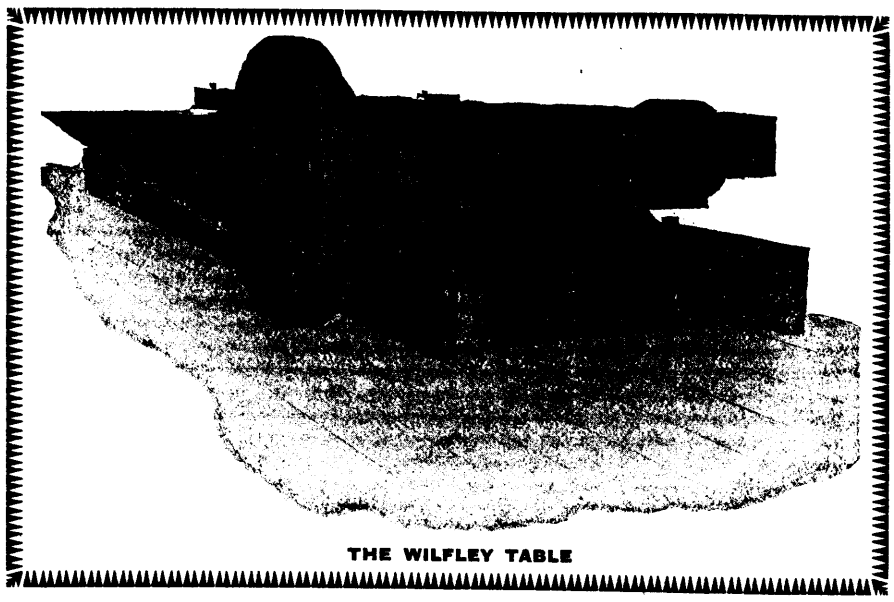

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VOL. XIX., No. 6. JUNE, 1900. VOL. XIX., No. 6.

The Late James King.

With profound sorrow we chronicle in these columns the death of our good friend Mr. James King, of Quebec, in a deplorable boating accident on the afternoon of the 20th inst. It appears that while visiting his extensive timber limits at Cedar Hall Mr. King went fishing on Lake Metapedia, and that a sudden squall upset the boat, drowning Mr. King and the five other persons who comprised the party. Mr. King, who was the senior partner of the well-known firm of King Bros., large timber merchants, and the owners of the King asbestos mines at Thetford and Black Lake, was the youngest son of the late Charles King, of Sylvester, Megantic County, Que. He was born in St. Antoine de Tilley, on 18th February, 1848, and educated at Bishop's College University, where he took his M.A degree in 1873. In 1892, Mr. King was elected to the local Legislature for the county of Megantic, but at the last election he refused to be a candidate, and has since devoted his entire time to his extensive mining and timber interests He was one of the founders and a vice-president of the Quebec Mining Association. A gentleman in every sense, Mr. King was greatly liked and respected, and his unfortunate death is greatly deplored by a very wide circle of friends in Canada, and by none more deeply than by the editor of the *Review*.

Mine Sampling.

In our May issue we discussed Mr. Pearce's paper on mill sampling, which leads to our offering its natural complement, a review of methods of mine sampling Two very distinct cases arise here, the methods to be pursued varying accordingly. One case is that of regular daily sampling of a mine in operation, and the other is that of sampling a whole mine at once as part of a mine examination.

In the first case, if a mine is being properly conducted, the bulk of the samples will come from those workings which are being driven for development of new ground in advance of the producing blocks or stopes. Thus the new ore bodies revealed will leave their values determined, so that the average metalliferous contents of any block which is being worked will be approximately known without extensive sampling at the time of production. We say approximately, for it is rare indeed that any ore body will be so uniform in value that the results obtained from sampling can be regarded as absolute. It is a good practice to take samples from every working face daily, and, after instruction of the miners in regard to the importance of taking samples at random so as to avoid selecting rich specimens, to allow them to do this work, turning in their sample after each shift. Though such samples may not be taken with great care, their relatively large number, and the elimination of the error due to the "personal equation," are so largely compensatory that they serve as a valuable check on the original samples taken during development work. Any one who has not tried this system will be surprised at the uniformly correct results obtained on taking weekly averages. The practice of saving drillings is of doubtful importance. Their chief merit is that they rarely give excessive values, due in part to the relatively large proportion of steel chippings which they contain. On the other hand, unless all the drillings from each hole are saved, which rarely can be accomplished, the sample is no more representative of the whole cut from a blast than fragments taken from the rock after blasting.

The ore reserves shown up by development work should receive the special attention of the manager, or of the mine superintendent if he happens to be competent for so delicate a task, since the future prospects of the mine are here at stake. Daily samples of rock broken should be taken from each breast or working face. These may be saved by the miners themselves, or by the foremen. They are only taken as indices of the value of the new ground being entered, but will not vary to any great extent from the truth after the men have received some drilling in the proper method of sampling. This will be quickly learnd, since in well managed mines the best and most intelligent miners are put upon the development work, where costs may otherwise soon prove excessive. After each block of ore has been opened up so as to reveal three dimensions, the superintendent or manager should personally sample it with care. The average value of the whole block will be pretty well known from the miners' samples. The point now to be determined is the proportion of pay ore to low grade or waste rock, if the vein yields grades of such different values as to render sorting profitable. Trial samples must first be taken of the various parts of the vein, where there is any marked difference in its character, or on opposite sides of any seam or persistent joint through ore of the same structure and mineralogical composition. Wide differences in value often occur on the opposite sides of a seam in ore having the same general appearance Having thus determined and marked out the boundaries of pay ore and lean rock, which for future reference should be sketched with appropriate designations on a separate mine map prepared for a permanent record of valuation, it is only necessary to sample each of these exposed areas separately. This is precisely the procedure required for the valuation of ore bodies in mine examination.

In regard to the method of taking the samples it must be insisted upon that no royal road exists. It is laborious and difficult, and entails preparation and scrupulous care which to the average miner

seems the height of foolishness. We believe that it is fear of the derision of the common miner that restrains many a man who knows better than to go through a mine with a sack, knocking off chunks into it from roof and walls, from taking the pains necessary to secure accuracy. But there are only two ways to reach a reliable result, either to take relatively large samples in the way to be described, or to take such a huge number of small samples (which must be assayed separately to obtain figures for a correct average) as to practically swamp his assay office. The large sample is best, if properly taken.

Mark off the several areas into portions of approximately equal size, as nearly rectangular in form as possible. Then take the sample on a single diagonal across each parallelogram, where the ore is soft enough to enable a V cut to be made. Even where the ore is hard the V cut may prove the best, because most reliable, in which case a series of ½ inch drill holes are bored about 18 inches long with a line of least resistance of not more than 7 inches. It is best to blast these with black powder, using expansion tamping. A large canvas, specially made for this purpose, should be placed underneath the V cut so as to catch every fragment. Loose boards laid over the canvas will protect it from injury in either case. The volume of such a sample is not excessive. In a rectangle 4 ft. x 6 ft. a V cut 6 inches deep on the diagonal will yield about 170 lbs. of rock of the specific gravity of quartz. If this method is not employed, the alternative is to take very much larger samples, blasting out a portion, with a deeper set charge, from each parallelogram. This will soon run into tons and will become costly to reduce. It can not be caught on canvas, and hence is not as accurate as the other. Only in very difficult cases, where quantities of 25 to 50 tons are taken, is this procedure to be recommended. The sample should be crushed and reduced by the ordinary methods, for assay.

The V cut is to be preferred when carefully done. The material from groups of parallelograms may be combined into single samples for assay, if the area represented by each group has its longest dimension less than 25 ft. This is arbitrary, and is only offered as a guide. Of course this sampling must be carried out over the whole exposed surface on three sides of an ore block, if accuracy is required. Special care is requisite in winzes to secure close contact of the canvas against the wall to prevent the loss of fine particles, and the ore should be caught on temporary stagings, and not allowed to fall to the level at the bottom of the winze as losses will occur by lodgment of particles on irregularities of the walls.

Samples from the floor of a level are usually of very little value, being in most cases enriched. Where such samples are taken, the floor should be scrupulously cleaned, and blasted to a depth of 2 to 3 feet. After all, these are not true samples, but are more properly indicators of probable values underfoot.

For the benefit of those who wish to investigate mine sampling methods further we would suggest the perusal of a paper on "The Sampling and Measurement of Bodies in Mine Examinations" by Edmund B. Kirby, read before the Colorado Scientific Society in Denver, Dec. 3, 1895. While we differ from him in many important particulars, we know of no more exhaustive discussion on this subject, nor one which more fully emphasizes the need of elaborate care and caution in determining the value of a mine.

The Dufferin Gold Mine owned by the Montreal and London Gold and Silver Dev. Co. has been acquired and is being worked on on a two-year option by an English syndicate.

Reservations for the excursion to Nova Scotia and Newfoundland of The Canadian Mining Institute are rapidly being taken up.

The Progress of Mining in British Columbia.

The Annual Report of the Minister of Mines for British Columbia, covering the year 1899, is to hand, somewhat later than usual, but containing a mass of serviceable information respecting the progress of mining and the operations of the various companies. Mr. Robertson's summary reviews the work done in the various industries so well that we quote it in full. He says:—

In reviewing the progress that has been made in the mining industry of the Province during the past year, in order to fully realize the advance that has been made it is necessary to look at the question from several standpoints.

The first, and probably the most important to the investing public, is the increase that has been made in the actual output of the mines.

This is shown in the preceding tables, and is conclusive evidence of our actual growth being in a certain sense a measure of the same.

These figures speak for themselves, and they speak the truth as far as they go, but on certain points they are silent. What they leave unsaid requires to be said for them, and possibly they need some interpretation and explanation. They say nothing of the preparations for shipment, of the development work done, nor of the shutting down of many of those mines—for no cause inherent to themselves—which in previous years have been our largest producers.

The total mineral output of the Province for the year 1899 amounts to $12,393,131, as against $10,906,861 for the previous year, an increase of $1,486,270, equivalent to an increase of 13⅔ per cent. over last year.

This is in itself a very creditable showing, but is much more so when it is taken into consideration that it is made in spite of the fact that the temporary shutting down of certain of the mines caused a deficit of $910,844 in silver and lead values alone. There is every reason to believe that but for this shutting down we would have had from these same mines an increase of $500,000 in place of the present deficit, which would have brought our year's increase to $2,863,159, or about 27 per cent. over last year.

Coal.

The coal mines of the Province have again this year, as they did last, broken all previous records, with an output of 1,306,324 tons of coal and 34,251 tons of coke, an increase in coal production over last year's of 170,459 tons with a small decrease of some 750 tons in the production of coke, occasioned by slackness of work at the smelters.

The Vancouver Island Collieries alone broke all the past records, without the assistance of the Crow's Nest Colliery, with a total output of 1,203,200 tons of coal, but the greater part of the coke trade, *i.e.*, some 29,600 tons, has gone to the Crow's Nest, which is so much nearer to the points of consumption as to command the business.

Coal this year again holds the first place in our table of production—if we regard gold placer and lode mining as separate branches of the industry—with a total valuation of 4,090,727, a large percentage of which represents coal and coke exported.

As a by-product the Wellington Colliery Co. of Union, V.I., produces from its coal mines a very fair quality of fire-clay, for which a good market is found, as it is the only deposit of fire-clay worked on the coast, and the increasing demand for fire-brick seems to insure a regular and growing market.

The company has already entered into the manufacture of fire-brick at Union Bay, burning the brick with the waste gases from the coke ovens. So far, practically, all the output has been used at the Company's various plants.

Gold.

The gold production for the year 1899—including both placer and lode gold—amounts to the large sum of $4,202,473, thoroughly substantiating the claim of British Columbia to the title of the Golden Province. Never before in the history of the Province has the gold production reached the four million mark. The nearest approach thereto was in 1863, when the production was $3,913,563, and this year consequently leads any previous year by $288,910.

The yield of placer gold was $1,344,900, an amount not equalled within the last twelve years. This increase is due to the Atlin District, which this year first enters the lists as a serious producer, and, despite the disadvantage of a late first season and innumerable disputes as to the ownership of claims, has yielded about $800,000 in gold.

Placer mining in other parts of the Province has, on the whole, not been very successful this past year, largely owing to an excessively wet season, which kept the rivers so constantly in flood that but few of them could be worked by the usual placer methods.

Gold obtained by hydraulicing has been included under placer gold, and forms the chief part of the product of the Cariboo District.

Dredging for gold has not as yet become a factor in the yield. Many companies are at work building and experimenting with different classes of dredges and machinery, but the problem of saving the fine flake gold, which unquestionably exists in the bed of the Fraser and other rivers, is a complicated one and requires time to solve.

The output of gold obtained from lode mining was $2,857,573, an increase over last year of some $656,356. This increase is due chiefly to the greatly increased tonnage of the Rossland Camp and the operations of the Ymir mines in the Nelson Mining Division.

Lillooet Mining Division this year has also contributed some $27,000 worth of gold, the product of stamp mills, whereas in the Osoyoos District there has been a decrease of about 30 per cent. from the previous year's production, which is accounted for by the fact that most of the producing mines confined themselves largely to development work, in anticipation of the railway facilities expected in the near future and the consequent cheapening of freights and supplies.

The production of gold from lode mining has been obtained approximately as follows:—

From direct smelting	$2,156,000
From combined amalgamation and concentrating	600,000
From cyanide process	91,000
Total	$2,857,000

Copper.

The amount of fine copper produced in the Province during 1899 was 7,722,591 lbs., an increase of about 6 per cent. over last year. While this increase in the actual output is comparatively slight, the exceedingly good market prices ruling throughout the year caused the value of such production to amount to an increase of about 55 per cent. over that of 1898. As yet the copper producing districts are practically limited to three—Rossland, Nelson and the Coast.

Rossland produced about 75 per cent. of our total copper output this past year, with a tonnage of 172,665 tons, an increase of some 55 per cent. over 1898. The increase in the amount of fine copper produced was about 9 per cent., but the increase in the value of such production was about 58 per cent.

The copper production of the Nelson camp fell off this year some 600,000 lbs. in fine copper; however, the increase in the market price obtained brought the value of the 1899 product up to about the same as that of 1898.

Relatively, the copper production of the Coast District has not as yet reached any very important figure. The output this year was some 654,972 lbs. fine copper produced from some 5,200 tons of ore the product of mines on Texada Island on Mt. Sicker on the east coast and near Alberni on the west coast of Vancouver Island.

Silver-Lead.

While it is a pleasure to note the material increase in other quarters, it is with regret that I have to report so poor a showing from our silver-lead producers, chiefly of the Slocan. If taken as they stand, the statistical figures in themselves are not encouraging as to the growth of the industry, so I feel obliged to offer an explanation of our poor showing in this quarter.

The fact is, that many of our largest producers in the Slocan have been shut down, either partially or entirely, for the greater part of the producing year, *i.e.*, since June or July, owing to a question between owners of the mines and their workmen.

The list of producing mines in the Slocan has altered very little since last year, a few new names only appearing on the list. But the total yearly tonnage of the district has dropped from 30,691 tons in 1898 to 21,507 tons in 1899, according to the returns of ore treated or shipped. The tonnage of ore actually mined in 1899 would be somewhat less, as some of the mines having concentrators utilized the period of enforced idleness underground in running through their mills dumps of second grade ore which had accumulated, which has helped to swell the tonnage of ore shipped, and accounts for the greater proportionate decrease in the silver and lead contents of the ore, there having been no appreciable decrease in the value of the ores mined. This decrease in production is in no way attributable to any failure or depreciation in the mines themselves, but solely to the fact that they have been worked only a portion of the year.

The total silver production for the year amounts to 2,939,413 ounces, valued at $1,663,708, a decrease from the production in 1898 of 1,357,619 ounces fine silver and of $712,133.

The total lead production for 1899 amounts to 21,862,436 lbs., valued at $878,870, as against 31,693,559 lbs., valued at $1,077,581, for 1898, a decrease of 9,831,123 lbs. of lead and of $198,711 in value.

Iron Ore.

Some 2,000 tons of iron ore was mined in the Province last year—near Kamloops and on Texada Island—which was used for fluxing purposes by the smelters. Whereas several extensive deposits of good iron ore (magnetite) are known to exist, it does not appear that the time has yet come when they can be treated for the manufacture of iron.

Platinum.

The returns of platinum produced are very incomplete. It is known that some has been secured at Quesnelle at North Bend and other places, of which no record has been obtained. The only return of production we have is from the Similkameen Mining Division, and that is only 55 ounces. It appears that many of the placer miners do not know its value, and throw it away as so much "black sand." I might state that the valne of the crude platinum sand, as washed out, will vary from $12 to $15 per ounce Troy. It must be further remembered by placer miners that this sand is often highly magnetic and consequently that the magnet will not effect a separation between this and the iron sand.

In confirmation of this statement, I would quote from a paper in the Report of the Geological Survey of Canada by G. C. Hoffman, chemist to the Survey. Mr. Hoffman investigated a sample of 17.89 grammes of native platinum from Granite Creek, a branch of North Fork of Similkameen. "The ore was separated by means of a magnet into two distinct portions, a non-magnetic and a magnetic; the latter

constituted 37.88 per cent., by weight of the whole." The following analyses were obtained by him on these portions:—

	(1) Non-Magnetic.	(2) Magnetic.
Platinum	68.19	78 43
Palladium	.26	.09
Rhodium	3.10	1.70
Iridium	1.21	1.04
Osmium	—	—
Copper	3.09	3.89
Iron	7.87	9.78
Osmiridium	14.62	3.77
Gangue (imbedded chromite)	1.95	1.27
	100.29	99.97

While actual production must be the ultimate measure of the value of a mine or mineral district, still with a Province such as ours only beginning to be developed, where lode mining has been prosecuted for practically less than ten years, and where railways are only commencing to give those transportation facilities necessary for the mining of all except unusually high grade ores, it is not to be expected that production alone will as yet give the full measure of our progress in mining.

This last year there has been an exceedingly large amount of development done in several districts, notably in Cariboo, the Boundary District, and on the West Coast of Vancouver Island.

For the particulars of such development, attention is therefore directed to the detailed reports of the various districts.

The Canadian Copper Company.

In our illustrated supplement this month we reproduce some very excellent views of the extensive plant and works of The Canadian Copper Company at Sudbury, Ontario, and in this connection the following notes on the operations of the Company give an intelligent idea of the large nickel mining and smelting industry carried on in that district:—

The properties owned and controlled by the Canadian Copper Co. stretch across the Sudbury nickel district from Lake Wahnapitae to the mouth of the Vermillion river and cover some 17,000 acres of the richest mineral lands in the province of Ontario.

Since the organization of the company in 1886, its history has been one of continuous progress. At the present time there are seven mines in active operation, producing, during the hoisting season, about six hundred tons of ore per day. To consume this ore eight furnaces are continuously in blast, making on an average 70 tons of copper nickel matte per day.

The ore consists of a mixture of nickeliferous pyrrhotite, pentlandite, chalcopyrite and diorite. The nickel occurs in two forms; first, as the true nickel ore, pentlandite, a bronze colored mineral carrying about 35 per cent. nickel, 35 per cent. sulphur, and 30 per cent. iron. This constitutes the larger portion of the nickel ore. The second form of nickel is as an impurity or foreign element in pyrrhotite, in which mineral nickel often replaces about 3 per cent of the iron. Copper occurs in the form of copper pyrites. The ore contains no arsenic or antimony and but small traces of gold, platinum and palladium.

Owing to the fact that the pentlandite is non-magnetic, it is impossible to separate these minerals by magnetic concentration. Also owing to the fact that sulphide of iron or pyrrhotite is present in much greater amount than diorite, it follows, that no hydraulic classification can be used to separate the copper-nickel mineral from the pyrrhotite, which really constitutes the gangue. The ore must therefore be treated in mass as it comes from the mines. This precludes the use of the mechanical roasters and open hearth smelters, which form so conspicuous a feature of the metallurgy of western copper ores.

As the ore is mixed from the various mines it contains about 2.10 per cent. copper and 2.24 per cent. nickel. The ore does not occur in true veins, but rather in pockets, if such large masses can be termed pockets, in which the mineral has concentrated out of the diorite matrix, which is everywhere penetrated by spots and stringers of ore. The distinction between ore and rock is therefore more an economic than a geologic problem.

The ore is broken down by overhead stoping, no timbering being necessary, on account of the extraordinary solidity of the surrounding rock. After blockholing to a convenient size the ore is hoisted to the rockhouse, where each mine crushes and screens its own ore.

At the rockhouses the ore is broken in Blake crushers to fragments about three inches in diameter. After passing through rotary screeners, where the fine dust and small fragments are placed in separate bins, the coarse ore is run over picking tables on which the rock is sorted out, while the ore passes forward to pockets, from which it falls on to flat cars for delivery to the roastyards.

These roastyards constitute a very important, though very disagreeable feature, of the metallurgy of nickel. The yards are about half a mile long and one hundred to one hundred and fifty feet wide. On a previously prepared bed of cordwood about eighteen inches thick the ore is unloaded from the cars and built up in rectangular beds about 100 ft. long, 20 ft. wide and 8 ft. high. These beds are then covered with small broken and fine ore from the crusher screen, and and the cordwood is ignited in several places. An ore pile will, if well covered, burn for nine months; but three months is perhaps the average time allowed for roasting. During this period sulphur burns to sulphurous acid, giving off dense white clouds of smoke, which make the work of roasting difficult, if not dangerous.

If the character of the ore permitted magnetic or hydraulic classification, it would be quite feasible to concentrate the ores and use rotating calciners to remove the sulphur.

Numerous plans have been considered by the company for utilizing the sulphur fumes for making sulphuric acid; but owing to the peculiar mineralogical composition of the ore, this does not seem possible; and the use of the present system of roast heaps seems destined to remain a nuisance until some fortunate inventor discovers an available method of abatement.

The roasted ore contains about 7 per cent. of sulphur; and a large amount of the iron present has been changed from sulphide to oxide, in which form it can combine with the rock present to form a fluid slag. This ore is broken down and taken to the smelters to be separated into matte and slag.

The smelters are of the Hereshoff pattern; of boiler iron, water-jacketted, of oval section, 6 ft. 6 in. by 3 ft. 3 in. at the tuyeres, with a 3 in. water space; and are about 9 ft. in height. The ore requires about one-sixth its weight in coke for smelting The melted mass flows into a forehearth where the matte sinks to the bottom and is tapped off into conical iron pots, holding about 500 lbs.; while the slag flows continuously over a lip into a stream of water, whereby it is broken up and carried away to the slag elevators.

The slag thus broken to pea size is piled in large stock piles, from which it is taken by the Canadian Pacific Railway for ballast.

The matte contains about 17½ per cent. copper, 17½ nickel, 25 to 35 per cent. iron and 20 to 30 per cent. sulphur. After cooling in pots, this is dumped upon the shipping docks, broken to convenient size for handling, and loaded in box cars for shipment.

All the matte produced by the Canadian Copper Co. is bought by the Orford Copper Co. of New York, which owns the patent for the only method of separation of copper and nickel which has thus far been feasible.

For the last ten years the Canadian Copper Co. has been seeking

a process which was practicable, economical and capable of being worked in Ontario, and during that time has expended at least $250,000 for that purpose. To this end they have purchased a large water power at Nickel City, with the intention to use this power in the refining of nickel

In 1891, this company brought from France, M. Jules Garnier, the eminent metallurgist, who has established the nickel industry of France. Mr. Garnier assured the Company that he could refine this metal. He was given carte blanche in the matter of expense. He erected a large refinery at Copper Cliff to remove the iron from the matte, and a corresponding refinery in Cleveland to remove the sulphur and make a saleable metal. He and his assistants worked for two years and the Canadian Copper Co. spent over $150,000 on this problem, but without sucess. M. Garnier could treat the nickel ores of New Caledonia, which contain simply a silicate of nickel uncontaminated with any deleterious ingredients, but he could not eliminate the copper, sulphur and iron which render the Sudbury ores one of the most difficult smelting problems of modern times.

In 1893 Dr. Hoepfner, the well known German inventor, represented to the Canadian Copper Co. that he had solved this riddle. He also came to Cleveland. For his process the company built a refinery where he and his assistants worked during a part of the years 1893 and 1894, and spent about $15,000 of the company's money, and at last retired baffled.

In 1896, Dr. Mond, of London, endeavored to reach an agreement with the Canadian Copper Co. for the use of the Mond process for refining nickel. The company's representative went in 1896 to examine this process, and in order to make a thorough test, returned to England in 1897 with 60 tons of matte, which was treated in Mond's plant in Birmingham during the years 1897 and 1898. This process proved more satisfactory than any yet tried, but the fact that the sum of $2,000,000 would be required to purchase the patents and erect a refinery on this plan, as well as the point that this process could not economically be worked in Ontario, caused the Canadian Copper Co. to break off negotiations with Dr Mond. The Mond process calculates to use coal costing $1.50 and acid costing $6.50 per ton in England. These items would cost $5.40 and $35.00 per ton respectively at Sudbury. Furthur, the Mond process makes all the copper into copper sulphate, which has a very limited market in Canada, and on which there is a duty of one half cent per pound on going into the United States.

Dr. Mond has since purchased nickel land at Sudbury, and is preparing to erect furnaces to produce matte for shipment to England.

Notwithstanding the fact that the Canadian Copper Co. has expended at least $250,000 in unsuccessful attempts to acquire a refining process, it does not propose to give up the struggle unless its investment at Sadbury be destroyed by legislation. It will never discontinue its efforts in this line until it reaches its goal: a process for refining the Sudbury matte which can be successfully and economically worked in Canada. To this end it is now erecting a fourth experimental plant in Cleveland at the cost of about $25,000, to test another process on a commercial scale. The location of this experimental plant at Cleveland was necessary in order that its erection and trial should be under constant personal supervision of the officers of the company. It is the intention of the Canadian Copper Co. when it shall have found a suitable process, to refine in the United States only that portion of its matte which is necessary to supply the American market, and to refine in Canada the rest of its matte for the European trade.

Nickel is the chief ingredient in German silver, which forms the base of all plated silverware. As an electrical deposit, impervious to moisture and rust, nickel furnishes a valuable coating for innumerable small articles in brass and iron. Nickel forms also, when alloyed with copper, a silver white alloy largely used in Europe and in the United States for subsidiary coins. Finally as an alloy with steel and iron, nickel furnishes a metal so superior in toughness and ductility to ordinary steel, that it is rapidly displacing the latter metal in every position where extraordinary strength and reliability are demanded. The once despised "Kupfer nickel" or "Devil's copper," which gave the German miners so much trouble at the beginning of the nineteenth century, has at the beginning of the twentieth century become one of the chief sources of Canada's wealth and one of the largest industries in the province of Ontario.

Arrested Rust and Decay.*

In coal pits it is often found that wood rapidly decays, even a year or two may see the strength of the timbers gone; and as for tools, if left unused for a time, they are soon coated with rust. A year or two ago specimens of what once were metal rails in the Hub pit at Glace Bay were carried over the country as curiosities, immersion for some 20 years had rusted them through but left the form only of the rail in iron oxide, carbon and silica. To find an exception to this all but universal experience occasions comment and it may be even surprise when the conditions underground are not fully considered. The circumstances that appear now of equal interest reverse this experience, and 20 years disuse of some tools in the Cage pit at the Albion Mines disclose them not only serviceable but in working order for immediate use.

A few days ago, on the 7th inst., small openings were made near the face of levels that were lost when the Cage pit took fire in 1880—a scale of air was admitted and as the foul gases were replaced by fresh air exploration followed and entrance effected to a distance of ten chains. The usual effects of blackdamp were experienced by those of the party that ventured ahead of the air but not to a serious extent. safety lamps of several makes were carried and it was noted that some lost their light more readily than others, the make that gave the best light in the various mixtures that were entered was Ashworth's Hipple-white Gray.

On entering it was soon seen that all the old timbers were sound, even the 5/8" brattice boards were good; brattice cloth that hung as doors would not tear, nor indeed would a piece that was found on the roadway; a bunch of hay was still springy under foot; a set of picks still had their points and their handles being sound they were at once put in use. Mine cars were in order and a set of harness was found pliable; but what occasioned most surprise was finding a crosscut saw which on being wiped showed a semi-bright surface in parts the rest of its surface being only stained. It must have been nearly new at the time the pit was closed.

In this exploratory work as in previous instances at the same colliery, a portable electric lamp proved a valuable adjunct to the ordinary safety lamps. The latter, as we all know, cannot be done without, as they gauge the limit of black damp that can be safely breathed. The lamp used was Davis' primary battery miners' lamp and experience has shewn that with careful handling an excellent light can be maintained for about 4 hours, when it becomes necessary to renew the solution.

In workings entered on this occasion, originally 13 feet high, now in places very materially increased by falls of roof and sides, no difficulty was experienced in throwing a good light on the ground ahead for a distance of about 40 to 50 feet; at the latter distance a set of picks was observed at a working face, while with the ordinary lamp the scope of vision would be reduced fully one-half.

But perhaps in the confidence created in the explorers lies its greatest merit. When the ordinary lamp is suddenly extinguished, as frequently happens, men are naturally inclined to become panicky and in the confusion timber, overhanging rock und coal may be disturbed to the imminent danger of the party

*Contributed by H. S. Poole, M.A., Assoc. R.S.M., and J. G. Rutherford, M.E. to the proceedings of the April Meeting of The Mining Society.

The Gold Gravels of the Yukon.

By R. G. McConnell, Ottawa.*

Gold in paying quantities occurs in the stream-gravels, the terrace gravels and the quartz-drift, but so far has not been found in the old valley-gravels overlying the quartz-drift or in the gravels here designated as river-gravels.

Gold is found in the stream-gravels everywhere, but in productive quantities only along portions of the valleys. The richest stretches usually occur about midway in the length of the streams. The distribution is, however, irregular, and no fixed rule can be formulated in regard to it. The total length of the paying portions of the different creeks, including some intervening barren parts, aggregate about fifty miles. It is impossible to give even an approximate estimate of the value of this great stretch of pay-gravels, owing to the irregularity of the concentration and the difficulty in obtaining trustworthy returns from most of the mines. It may be stated, however, that the product of a few of the 500-foot claims on Eldorado and Bonanza Creeks will exceed a million dollars each; while a considerable number on the same two creeks (in fact, the majority of the lower Eldorado claims and a few on Hunker Creek) will yield over half a million each, and claims running from a quarter to half-a-million are common on all these creeks, and also on Dominion and Sulphur Creeks. Assuming a quarter of a million as the average, and that three-quarters of the claims in the distance given above are rich enough to work, the total value approaches $95,000,000, a figure which is well within the mark. In this rough estimate, no account has been taken of long stretches of gravel on all the creeks, that is too low in grade to work at present, but will eventually become payable with improved conditions and cheaper methods of working, nor does it include probable further discoveries along the numerous gulches and small streams of the district, few of which have so far been carefully prospected.

The terrace-gravels on Eldorado, Bonanza, Hunker and Dominion Creeks include a few rich claims, and a large number that pay fairly well, but statistics of production are entirely wanting.

The extensive deposits of quartz-drift along Bonanza, Hunker, Eldorado and Quartz Creeks almost rival in importance the creek gravels themselves. They are everywhere more or less auriferous, and are very rich over wide stretches. They suffer, however, from the scarcity of water on the hill-sides, and the ruinous methods the miners are forced to adopt, when operating on a small scale, prevent any but rich claims from being worked.

Methods of Working.

Creek claims are worked either by sinking and drifting, or by opencuts. The former method was the one first employed, and is still very generally used, as operations can thus be carried on during the winter. The ground is frozen everywhere, and, except where the muck is free from sand or gravel and can be picked out, thawing is always necessary. This is done either by wood fires, heating the water at the bottom of the shafts with hot stones, or by steam thawers. The latter method is gradually superseding the two former, and is a very simple one. A small boiler is generally used, from which the steam is passed through rubber hose, to the ends of which pointed steel tubes about four feet in length are affixed. The latter are driven into the frozen gravel, and steam is forced through them for six or eight hours. They are then withdrawn, and the thawed material removed. The points require steam equal to about one horse power each, and thaw from one to three cubic yards of gravel at a shift. The introduction of the steam thawer is of recent date, and marks a great advance in the mining methods of the district. It thaws more rapidly than wood fires, requires at least a third less wood to do the same work, and can be used in summer as well as in winter. It has also the further great advantage over wood fires of purifying the air in place of fouling it.

The material drifted out from around the foot of the shaft is piled up in dumps, when the work is done in winter, and washed during the spring floods. In summer work the two operations of drifting and washing the excavated pay-gravels are carried on at the same time, if water can be obtained.

Timbering is seldom required in summer and never in winter, as the bed of frozen muck that overlies the gravel forms an extremely tenacious roof, and chambers of astonishing size can be excavated beneath it in winter without danger. In one case on Dominion Creek, a muck roof, unsupported by pillars, covered a vault said to measure 140 feet by 230 feet which remained unbroken until midsummer. It then sank slowly down in one block, until it rested on some piles of waste material which had been heaped up to prevent accidents in case of a collapse. Examples of muck roofs spanning vaults over a hundred feet in width are common on all the principal creeks.

In working claims by the second method, that of opencuts, the first object is to get rid of the muck covering. This is easily done in early spring by taking advantage of the spring floods and leading the water by several channels across the claim. The muck thaws readily, the streams soon cut down to the gravel, and the channels then gradually widen until they meet. In some cases the process is hastened by blowing the walls of the channel down into the stream with powder. When the muck covering is removed, the gravels soon thaw to bedrock. The upper portion, if barren, is then removed, usually by hand, and the underlying pay-gravel is sluiced in the ordinary way.

The open-cut method of working claims leads to a more complete extraction of the gold, and is the one generally preferred whenever the muck covering does not exceed ten or fifteen feet in thickness, a condition which obtains along the greater part of the principal producing creeks, with the exception of Sulphur Creek.

The terrace-gravels are usually comparatively thin, and where uncovered by muck, are worked by open-cuts, where covered, by drifts. The pay-gravels in a few cases are sluiced in the valley-bottom, but as a rule are washed in rockers.

The quartz-drift, like the terrace-gravels, suffers from the scarcity of water, and rockers are employed for washing the pay-gravel at nearly all the working claims. A few of the principal mines have gravity trams, and when arrangements can be made with the owners of the creek claims, the creek water is used for sluicing purposes. The extent and richness of this great deposit appears to fully warrant capital in undertaking the construction of some comprehensive scheme for delivering water along the principal hills, and until this is done the greater part of the deposit must remain unworked.

Machinery.

The employment of machinery in the working of Klondyke claims is gradually increasing, but is still insignificant, a fact due largely to the absence of roads and the consequent impossibility of transporting heavy pieces up the creeks. Steam thawers are largely used, and steam pumps are gradually replacing hand pumps, Chinese pumps and water-wheels for draining the pits. Steam hoists are employed at a few mines, but are not in general use. The greater part of the work of the camp is still done by hand, and this, notwithstanding the fact that, taking into consideration the high price of labor, nowhere in the world could machinery be more profitably employed.

Production of District.

The gold production of the district can only be given approximately, but the following figures are probably nearly correct.

* From the Summary Report of the Geological Survey of Canada, 1899.

1897	$2,500,000
1898	10,000,000
1899	16,000,000
	$28,500,000

It is unlikely that the rapid increase in production of the last two years will be continued, as serious inroads have already been made on the rich portions of Eldorado and Bonanza Creeks, and to a less extent on Hunker and Dominion Creeks, but the amounts remaining, with the long stretches of medium and low grade gravels still untouched on all the creeks, ensure a high production for a number of years.

The Treatment of Low Grade Siliceous Ore of the Rossland Camp, by Cyanide of Potassium.

By GERALD V. HOPKINS, M. Inst. North of England, etc.

Under this rather pretentious heading, I will endeavor to describe a process for the treatment of the low grade siliceous ore of the Rossland Camp, containing only a low percentage of sulphide, as carried out at the British Columbia Bullion Extracting Works, at Silica, B.C.

The mill was built to treat this class of ore by the Pelatan Clerici process, and is situated at Silica, B. C., on the Red Mountain railway, some three miles southwest of the town of Rossland. The mill is in many respects admirably adapted for the treatment of ore gravimetrically with a minimum amount of hand labor, so I consider it would be interesting to describe it somewhat in detail.

The mill, for description, may be divided into two sections, namely, the upper or crushing and sampling section, and the lower or treatment section. The general arrangement will be seen by accompanying tracings, showing a sectional and plan view. The ore is delivered at the works in cars which are side tracked, passing over a Guernsey track scale where they are weighed, to the receiving bins which are under cover. The cars, returning, are again weighed. This is necessary, as in the winter months the snow on the cars alters the light weight to an appreciable extent.

The motive power at this mill is electric and is obtained from the West Kootenay Power & Light Company. The current, as delivered, is 2080 volts to two motors A. 50 h.p. An induction motor drives the crushing and sampling machine in the upper section. A 75 K. W. Synchronous motor, furnishing power for the lower or treatment section. The mill is lighted throughout with electricity by the use of two lighting transformers taking the current from the power mains. All current consumed at the mill is paid for on the meter basis.

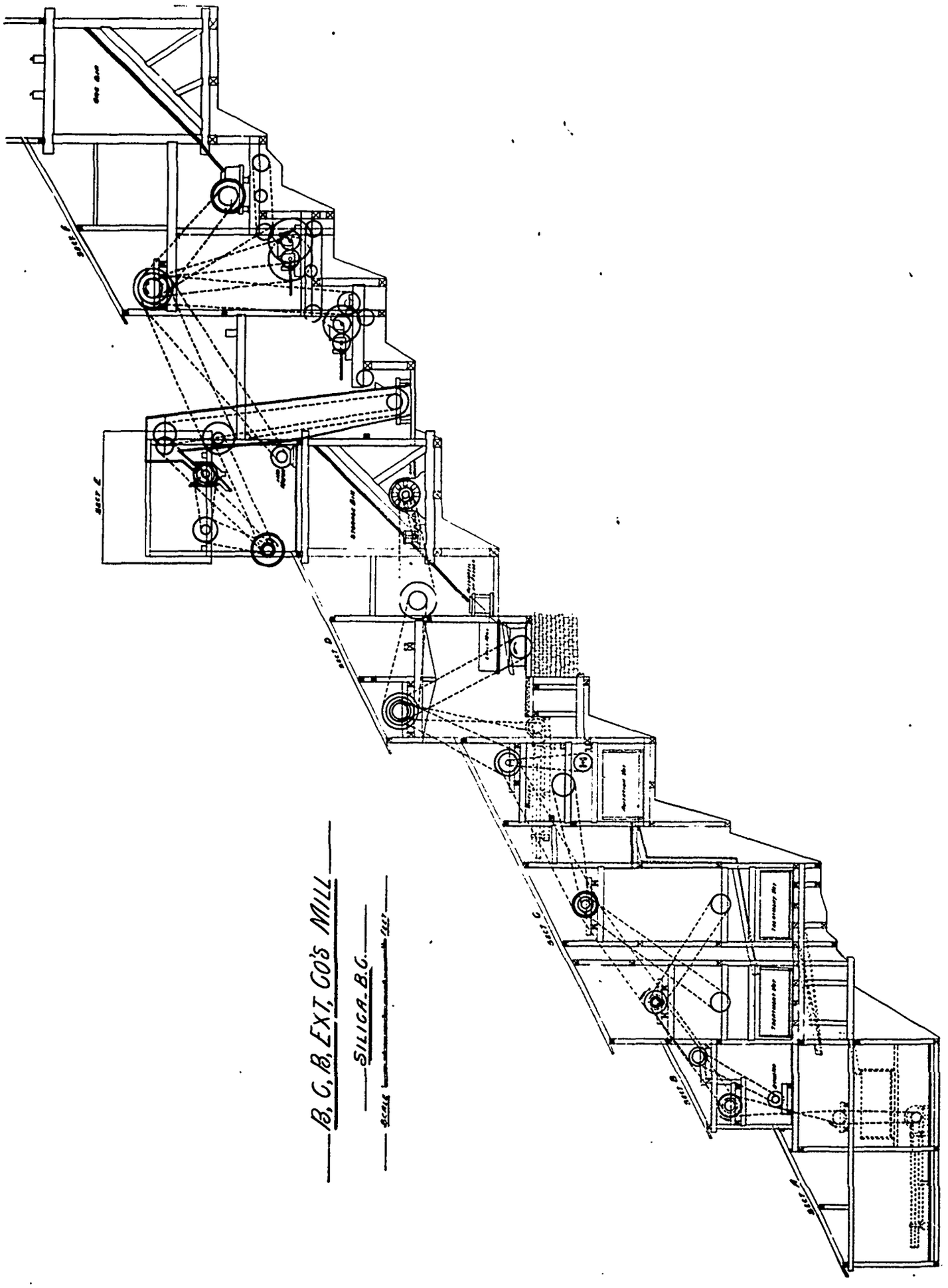
The treatment the ore receives in the first section is dry crushing. It is fed gravimetrically to a 9 by 15 Blake's crusher, thence by means of a carrying belt to a 30 x 16 Cornish roll belted, thence it is carried by a second carrying belt to another 30 x 16 Cornish roll geared, thence by a third carrying belt to a bucket elevator, where it is raised 40 feet for sampling. The material leaving the last set of rolls will all pass a ¼-inch mesh screen, and a third of it a 30 mesh screen. The elevator delivers the material direct to a Constant sampler, which is so set that one-sixteenth of the whole is retained. This is further reduced by passing it through a Brunton sampler, where one-sixth is cut out, giving a sample of exactly one-ninety-sixth of the whole. This is designated the floor sample, which is quartered down by what is known as a corno. This method, I find, is quicker and equally exact, as the method of heaping the ore in form of a cone, converting it into a low frustrum of a cone, and then quartering.

The ore rejected from the Constant and Brunton samplers falls gravimetrically from a hopper through three 6-inch iron pipes to three storage bins by a simple service fitted to the hopper. The whole of the ore is easily converted to either of the three bins. The ore from the storage bins now enters what I have christened the treatment section of the mill, and is fed by two James automatic feeders to two 6-foot Bradley Chilian Mills driven from underneath. This pulverizer performs good work where fine crushing is required without the formation of excessive slimes. I will mention the principal parts, the crushing taking place on a steel ring inside, diameter 4 feet and 6 inches, outside 5 feet and 10 inches with three rotary wheels, diameter 4 feet 7 inches, face surface 8 feet, weight 6,475 lbs., making 30 revolutions per minute. Depth of discharge 5 inches, screen area 2,730 square inches, the tires being of prepared steel. The crushed product discharged varies considerably, depending not only on the character of the ore, but also on the ratio of water to ore during crushing, when using a 60 mesh screen and crushing a siliceous ore containing from 4 to 6 per cent. of sulphide with such a quantity of water that the resulting sludge shall contain 50 per cent. of water. Ninety per cent. of the ore will pass a 150 mesh screen, the remaining 10 per cent. a 100 mesh screen, but on the other hand increasing the quantity of water used so that the sludge shall contain 4 times of water, 17 per cent. passed the 150 mesh screen, 12 per cent. the 100 mesh screen and 40 per cent. the 80 mesh screen, the remaining 31 per cent. remaining on the 80 mesh screen. I am aware that generally, in stamp mill practice, all that passes the 120 mesh screen is considered slimes; this, however, I find not to be the case with ore crushed by this mill, as when a resource to wet separation is had, 40 per cent. of the product passing the 100 mesh seive is a good leachable product. The crushed material from the Chili mill passes direct to the four vats 9 x 15, where it was kept agitated until the P. C. vats were ready to receive a charge which consisted of 2½ tons of dry material with 3¾ tons of water which gave fairly thin pulp. The current for electrolysis used in the Pelatan Clerici vats is a direct current generated by two dynamos, each having a capacity of 12 volts by 750 amperes. The switch board was so arranged that every one of the 12 vats was on its own independent circuit, and in such a manner that the current generated by either of the dynamos could be connected with anyone of the 12 vats. For the erection of the Pelatan Clerici vats no care was exercised to insulate the vats, they simply stood on a dry floor.

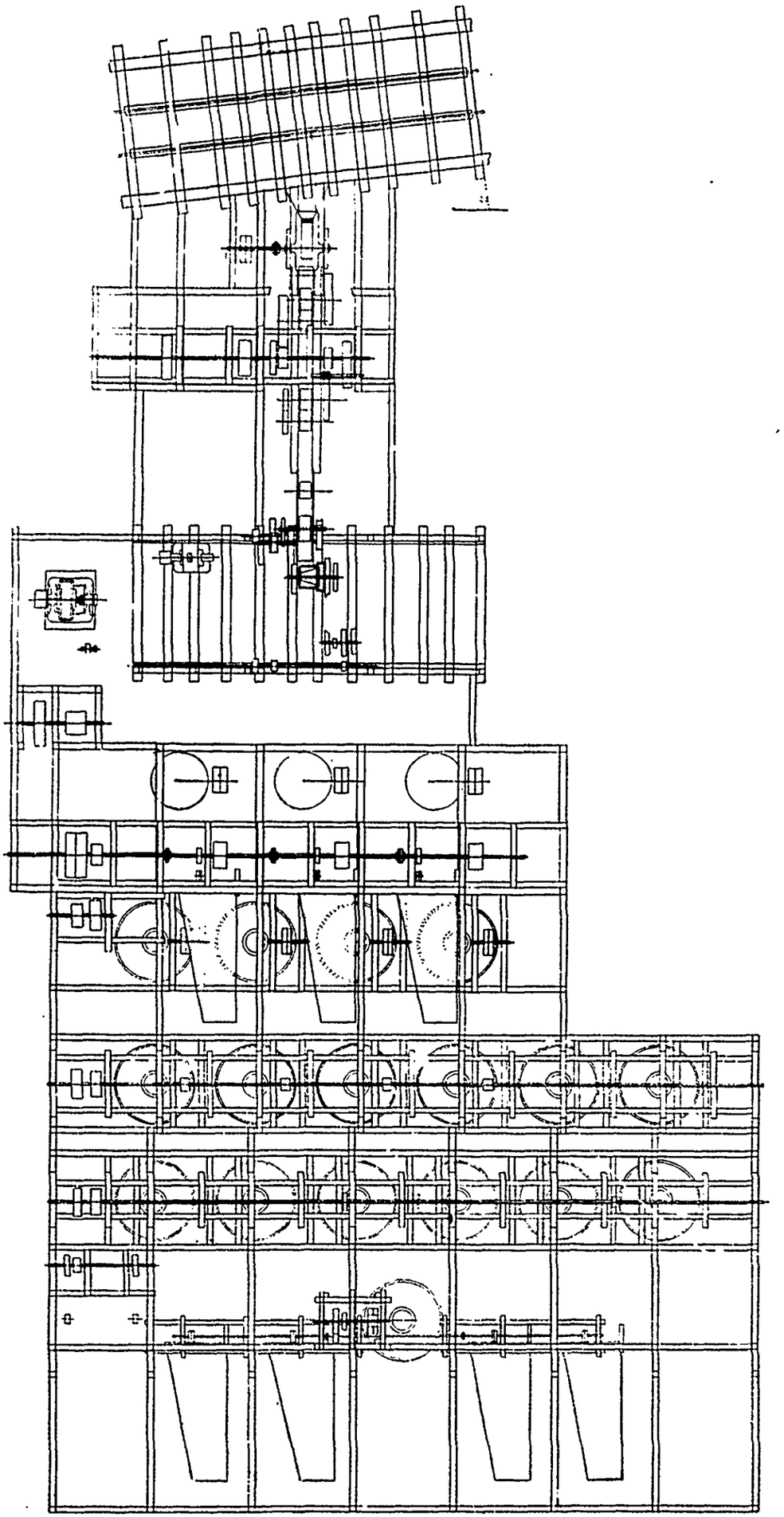
To determine if there was any loss of current in the vat, I placed an ammeter at various points of the circuit of the different vats, which are situated in two parallel lines, at right angles to the switch board, and found the ammeter invariably checked with the ammeter on the switch board, which is on the positive wire. There was, as is to be expected, a slight drop in the E. M. F., 5, the voltage at the board is from 2 to 3 volts higher than at the vat farthest away, and slightly higher than at the vat nearest the board, the drop being proportional to distance.

The particulars of a 9 ft. by 4 ft. 6 in. vat with a simple and effective device for lowering or raising the agitator will be easily seen in accompanying tracing.

The electrical chemical process which takes place in the vat, was fully described by Major-General C. E. Webber, C.B. (Ret.) R.E.M., C. E., published in the journal of the Proceedings of the Institute of Electrical Engineers, Part 132, Vol. XXVII, of which I give a few extracts. The relative degree of the pulverisation the ore has been carried to varies, the chemically, electrical and their combined effects, especially when dealing with refractory ores. During the whole time of treatment agitation is kept up with the accompanyment of an electric current. To the sludge salt is added varying between 5 per cent. to 1 per cent. of the weight of ore in the sludge by degrees, the effect of the sodium chloride being first to increase the conductivity of the solution. This expression is scientifically inaccurate. The effect that takes place on the addition of sodium chloride to water brought between an anode and a cathode is the sodium chloride in solution is disintegrated and reformed, and thus it becomes the inter-


B, C, B, EXT, Co's MILL
SILICA. B.C.

Plan of the
P.E.I. Gold Co Mill,
Lot 36, P.E.I.



mediary by which at the instant that chlorine gas and sodium are set free, the current is enabled to communicate between the electrodes.

During electrolysis, when the liquid contains only sodium chloride, the primary decomposition will be sodium at the cathode, and chloride at the anode. Now, to consider the action of these products of electrolysis as the sodium comes in contact with the mercury, a small portion will be dissolved by the mercury as amalgum, a portion with the water, giving N a O H, and H. The chlorine liberated at the anode, a small portion will attack the metal of the anode, the greater part be dissolved in the solution, some of which will reform with the N a O H sodium chloride, another portion, sodium hypochlorite Na Cl O and water. The action of the chloride liberated and not engaged as above, will to some extent attack free gold, and form A u C l 3 which is readily deposited by electrolysis on the mercury, the rest will attack the base metallic ore present in a finely divided state, when present uniting with the metallic bases, the sulphur and arsenic being oxydized by the combined action of the chlorine and sodium hypochlorite into sulphuric and arsenic acids. These will again form with the sodium, sulphate and arsenate with the consequent formation of free acids, which must be neutralized with lime, before potassium cyanide is added.

With the addition of potassium cyanide, it is advisable to have it in excess, not only to allow for oxydation, if any hypochlorite is present, but to allow of the formation of cyanogen at the anode, which, being dissolved in the solution, will readily unite with the minutest particles of gold to form with the excess of potassium, cyanide, the double cyanide of gold and potassium. At the same time chlorine and cyanogen both yielded at the anode, would form cyanogen chloride, which, in the presence of potassium cyanide, is effective in dissolving gold.

Owing to the high specific gravity of the sludge, arising from the character or the Rossland ore, this process, without some modifications, was not found to be an economical success, the process finally adopted was close classification of the ore before treating with cyanide. For this purpose Wilfley tables were placed before the Chili mills; the sludge leaving these tables contain an excess of water. This is concentrated by the use of large vats of conical form, fitted with a valve at the apex of the cone. In these a concentration is effected, the ratio of water to ore as 1 is to 1.

The concentrated sludge flows direct to the agitation vats, and on its way encounters a solution of KCN flowing in the opposite direction, and in this manner the sludge becomes well mixed with the KCN solution, of such a strength that, diluted with the water contained in the sludge, it will give, depending on the ore, a solution in the aggregation of a value of .08 per cent. to .15 per cent.

After the charge has been agitated the required number of hours, fresh slacked lime is added, the agitation being continued from 5 to 10 minutes.

The exhausted sludge, together with the gold solution, flows into concentrating vats, and on its passage it is diluted to such an extent that the sludge entering the concentrating vats is of a consistence as 3 is to 1. The discharge valve at the apex of these vats is kept shut until clear solution commences to flow into the discharge landers. The concentrated pulp is now allowed to flow to a second similar vat.

In this manner two-thirds of the gold solution is separated from the exhausted sludge by the first vat, and a further two-thirds by the second, according to the dilution that takes place between, respectively, the agitation vat and the first and second settling vats. Any desired quantity of the gold in the more or less diluted solution can be separated from the pulp.

The gold bearing solution now flows to the Pelatan Clerici vats. The time to effect this is dependent on current and richness of solution. Six hours suffices to reduce a $4.00 solution to seven cents per ton, with a current of 5 to 7 volts and 70 to 80 amperes.

The treatment of a siliceous ore assaying iron 4.3 per cent, copper .7 per cent., a trace of lime and magnesia, .3 ounces of gold, 5 ounces of silver, gave a theoretical extraction of 94 per cent. of gold and 73 per cent. of silver. A pyritic ore, gold .8 ounces, silver 1.3 ounces, copper 1.8 per cent, and iron 22 per cent., resulted in an extraction of 89.87 per cent gold and 72 per cent. silver.

The accompanying drawings, which are the property of the British Columbia Bullion Extracting Co., are kindly lent by Mr. Webber, the General Manager.

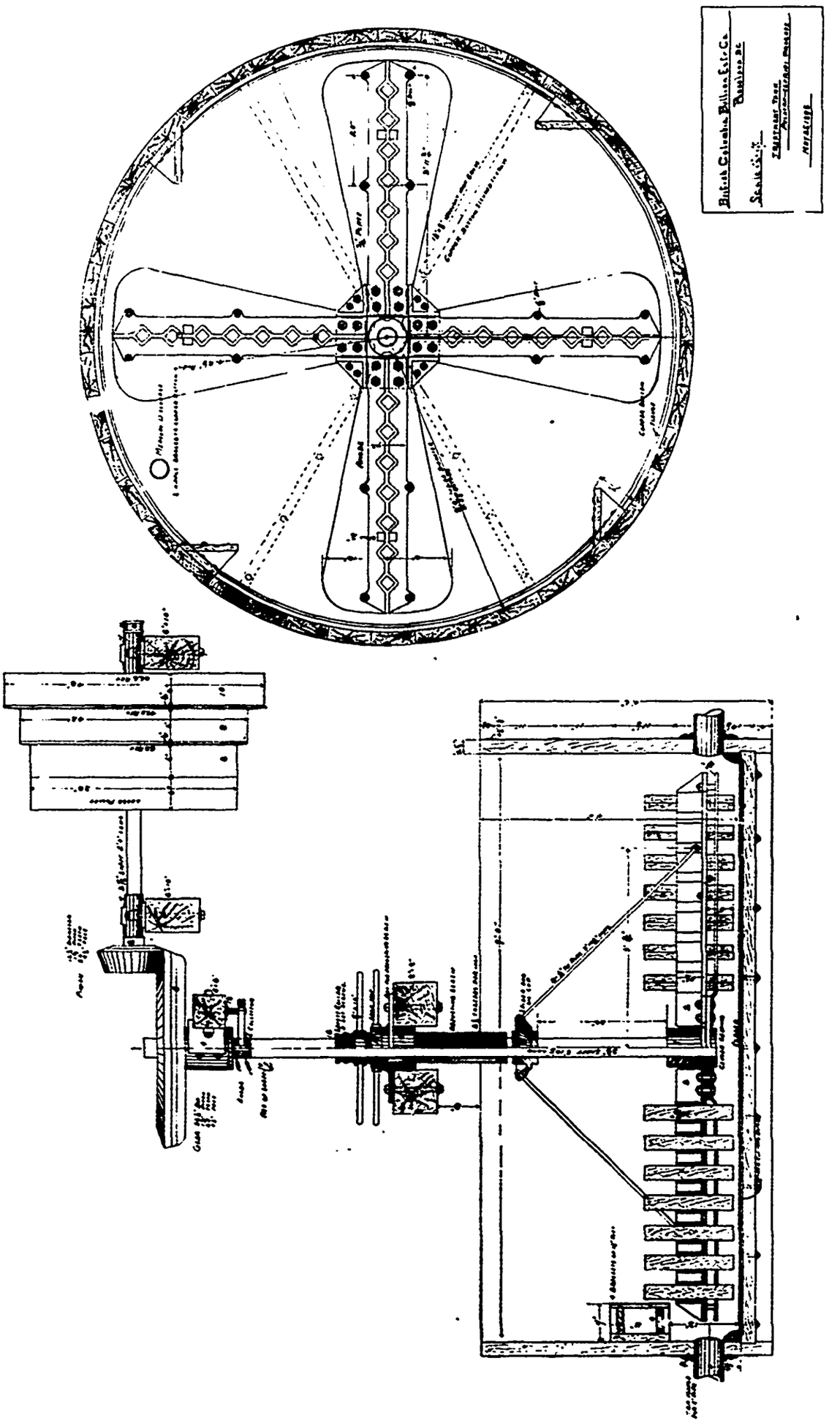
COAL MINING AND TRADE.

The Iron and Coal Trades' Review in a leading article discusses the subject of the importation of American coal into Europe, and after a brief review of the chief factors in the case dismisses the subject as not "within the range of practical politics."

Whilst arriving at the same conclusion as that canvassed by ourselves, our esteemed contemporary leaves untouched one of the most important features of the case, viz., that although it may be true that with trade in a normal condition on both sides of the Atlantic, the difference in price at the pit's mouth is only from 25 to 35 cents, and therefore insufficient to cover the cost of transportation to Europe, yet for a considerable period in each decade, certainly not less than two to three years, or nearly 30 per cent. of the time, normal conditions do not prevail, and prices in the Old Country have been so inflated that if transportation facilities had been available large quantities of American coal could have been sold in Europe at higher prices than have been realized here, and at lower prices than are being paid now on the other side. The question is whether it would pay to establish a special transport line for a trade which only exists for a third of the time. Probably it would for two reasons: the profit while it lasts would be large, and the vessels could be used for other purposes when not required for coal carrying, or possibly diverted to other routes for the same traffic.

At the present moment good semi-bituminous coal is worth in London $5 to $5.50 a ton. American coal f.o.b. is worth $2. If a regular line of suitable steamers carried this coal to Europe $2 would be a liberal allowance for freight which with dock and other charges would leave a margin of 50 cents to $1. If, however, we make the comparison with Canadian coal from Cape Breton this latter can be put on board at a cost of $1, which would leave a margin on present prices of 1.50 to $2.00. The matter may, however, be pursued further with profit. Whilst prices are abnormally high in Europe just now, it is equally true that demand is abnormally great on this side. When both conditions pass, what would be the chances of retaining any share of the European market? In a dull time of trade Cape Breton coal would yield a good profit at $1.50 f.o.b.; freight by special steamers need not exceed $1.50, allowing 25 cents for other charges this would give a total of $3.25 for the coal laid down in British ports, or say 13s. 6d.

Now, the average price for the last twenty years which English coal has realized, including the inflated periods, at the pit's mouth is 6s. 4d.; and leaving out the periods for high prices, 5s. 6d. Welsh coal is carried to the seaboard for 1s. to 1s. 6d., which gives a minimum price f.o.b. of 7s., or only about half what Canadian coal would cost. If, however, we take the London market, which is undoubtedly the only one we could look to in ordinary times, we find that the average price in the Thames for North Country or Midland coal with which we should have to compete is 13s. to 14s., or about the same as it would cost to lay down Canadian coal. We are, therefore, confirmed in our conclusion that whilst it would pay, and pay



handsomely to export Canadian coal to Europe at such times as the present, competition with English coal would be impossible under the ordinary conditions which prevail two-thirds of the time.

There is, however, a market which is open to us, and in which we should have no serious competitor, if we adapted both coal and transportation arrangements to the case. Last year England exported in all 41,180,300 tons of coal; of this Brazil, Uruguay and the Argentine Republic took 2,263,193 tons, and British North America, the United States, British West Indies, Mexico, Central America, Columbia and Venezuela took 248,403 tons, making a total of 2,511,596 tons.

This coal realized an average of $6.00 to $8.00. With proper facilities, Cape Breton coal could have reached any of these points at $2 a ton less, and we still believe that when the requirements of mammoth steel works and gigantic gas combines have been satisfied, this important market will receive attention. The exportation of English coal to South American ports is not increasing, and the connection in this, as in so many other instances, has been retained through the return cargoes. The distance of American coal from the coast will give Canada the advantage, and we have no doubt that in a few years a large slice of this trade will come our way.

In view of the widespread interest in the development of coal resources which now exists, it is interesting to note that in 1898 the British Colonies and Dependencies produced 14,639,102 tons, the chief contributions being:—

New South Wales ....4,600,000 tons.
India ....4,136,813 tons.
Canada ....3,725,685 tons.

According to the latest returns, there are in the United Kingdom no less than 75 collieries using coal cutting machinery. This shows a surprising increase, when the strong opposition of the miners and the conservatism of the owners is borne in mind, and indicates a rapid development towards the adoption of American and Canadian methods.

Whilst on the subject of coal production, it may be interesting to note how greatly the tonnage per man employed varies in different coal producing countries, and also to note the uniform increase per head during the last decade; in every instance except the United Kingdom where there is a decrease from 326 to 291 tons "per capita"; this is undoubtedly due to the slowness with which mine owners in the Old Country have hitherto adopted coal cutting machinery combined with the greater difficulties of production at increasing depths.

TONS PRODUCED PER EMPLOYEE

	1889	1898
United Kingdom	326	291
United States	421	490
Canada	—	398
New South Wales	356	459
Victoria	57	274
New Zealand	342	453

From this table it will be seen that the United States easily leads, but this is not surprising, and after making due allowance for easy access and cheap production in the Southern States, when we bear in mind that nearly ½ of the total production of soft coal was cut by mining machinery instead of by hand. The most productive State in this respect is Illinois which produced last year 23,434,445 tons, of which no less than 6,032,902 tons was cut by machinery, being nearly 30 per cent.

How this affected the production per head may be easily calculated as thirty-seven thousand persons were employed, this gives a yield for the State of 632 per head, and 1370 per machine actually in use, and the extent to which the cost was affected may be gathered from the fact that the average rate paid last year for hand mining was 41 cents, and for machine mining 3¼ cents. This is the key to the whole situation so far as cheap coal in the South is concerned, as this economical method of production enables coal proprietors to sell their product at an average price of 78c. per ton at the mine and yet realize a handsome profit. This also explains why Southern coal is likely to become an important factor in common with British exports.

In a recent issue we referred to the institution of a chair of practical mining in connection with the new University at Birmingham. We now find that this has been decided upon largely in consequence of representations made by Mr. W. A. Kenrick and his confreres who last year visited the principal Universities in Canada and the States for the purpose of getting pointers. North Wales has now resolved to follow suit. Why does not Canada, which has the finest University for the teaching of practical sciences in the world take the lead in this vital matter, and be the first to give the right kind of practical instruction, by means of a professor, who is not merely college trained, but has had experience in conducting the operations of mining?

The suggestion to tax coal exported from Britain has evoked the strongest opposition, especially from the principal coal owners associations. It is claimed that such a policy would seriously hamper trade in ordinary times and cause labor to be idle. Whilst there is no need of such a drastic course with only 6 per cent. of the proved coal resources of the country yet exhausted, clearly the Mother Country is not disposed to help competitors to secure her markets even when these competitors may be her own colonists.

The British Admiralty has issued instructions for a general increase in the stores of coal at all naval bases. This should mean stocking Halifax yards from Nova Scotia and Esquimalt from the Crow's Nest Pass. There is no reason why these coals, which have passed the severest tests, should not displace Welsh steam, which has hitherto been imported for the purpose at double the cost.

For more than a quarter of a century Warrington Smythe's "Coal Mines and Coal Mining" has been the leading work on the subject and has been the recognized text book for all mining students. In revising and extending the 8th edition, Mr. T. Forster Brown has rendered a real service to the industry. No living coal mining engineer is more competent to perform the task and to bring this standard work up to date. Few men have had a wider or a more practical experience, and none have attained a higher or more honorable position in the profession. Whilst on technical points other special treatises may be consulted, Warrington Smyth's colossal work will, thanks to Mr. Brown's wise editing, remain the one authority on the principles of coal mining.

The published accounts of the Lackawanna and Western Co. and of the Delaware and Hudson Co. shew that the profits from anthracite coal is almost entirely in the transportation and distribution, the price on cars at mine leaving practically no margin above cost. Whilst we do not believe in companies working for nothing, it is certain that the policy of our enterprising neighbors to the south is the right one and has done more than could have been effected by any other means to develop local industries. The raw material is produced at the lowest cost by the aid of the greatest possible use of mechanical appliances, and is then sold to the manufacturer at a bare fraction

above cost. In this way coal produced 450 to 500 miles from the coast is carried there by rail and placed f. o. b. for $2 a ton. This leaves 75 cents at the mine for Virginia coal. When it is possible for mine owners to produce, and for railway companies to carry, Canadian coal at those figures, we may look for similar results to these enjoyed by our neighbors in the growth of permanent industries and the peopling of the country.

Whilst prospecting for manganese in the section of country lying to the east of Truro, N.S., some excellent samples of bituminous coal have been found. As this is a carboniferous district, there is nothing against the existence of workable seams. We have seen small specimens of the coal, which closely resembles the Springhill deposits in appearance. The property is in the hands of a Montreal firm and will probably be developed.

There is great activity in the coal trade in the Maritime Provinces. In addition to the very extensive new works of the Dominion Coal Co., coal is now being produced at the Port Hood Mines, and the Newcastle Co. expect to be shipping next month from their Gowrie and Blockhouse mine. We do not attach much importance to the discovery of coal near Antigonish.

Everything points to an output of 2,000,000 tons by the D. C. Co. this year. Montreal claims 850,000 and the Everett Gas Co. 500,000. This is a tonnage which we have always maintained would place the common stock in a healthy position, but there is no reason, in view of the greatly increased possibilities of the market, why it should not be exceeded. The supply of coal is almost inexhaustible, and we hope to see the day when Cape Breton will be inhabited by a thriving and prosperous community with a population of at least 200,000 and an annual output of 10,000,000 tons of coal.

The enterprise of the Dominion Coal Company in Cape Breton is stimulating investors to make a more thorough examination as to the resources of the Island and of the Province of Nova Scotia, and in the near future we are not unlikely to see important developments. The acquisition of the General Mining Association's property by the Nova Scotia Steel Co. is now reported to be an assured fact, the deposit of $100,000 having been paid since our last issue. Messrs. Burchell have bonded their Campbelltown mines together with large areas adjoining to the representative of a New York firm. It is claimed that recent explorations have resulted in identifying their principal seam with the well known Lingan seam, which outcrops at Lingan Head. If this should prove to be correct it will have an important bearing upon the future of these areas.

The announcement made this month by the Dunsmuir people that it is their intention to exclude Mongolian labor from their mine is one of great importance and will no doubt result in the final settlement of a much vexed question. The competition of Mongolian and white labor on the coast has been a fruitful source of agitation and friction for some years past, in response to long continued pressure from the labor market the Government had legislated against the employment of Mongolians; every effort has been made by the employers to retain what was supposed to be a cheap and profitable class of labor without avail. The New Vancouver Coal Company came into line with this legislation some time ago, and now that the large interest of the Dumsmuirs has followed suit we have probably heard the last of this much vexed question. We must confess to surprise at the statement made by Mr. James Dunsmuir that this class of labor has been paid as highly as white labor, especially in face of the continuous complaint from the other side that one of the chief evils attendant upon its employment was the adverse influence it had upon the wages of white men. If, however, they have been receiving as much, it is a greater mystery than ever there should have been any objection to giving them their *conge*.

Last year the United States exported 1,000,000 tons of coal to Mexico, South America, and the West Indies. It cost more to put this f.o.b. than Nova Scotia coal would have cost.

Apropos of the impending introduction of liquid oxygen as an explosive in mines, it is interesting to note that none of the "high" explosives are yielding satisfactory results, and new ones are continually coming to the front. The Secretary of State for Great Britain has just licensed "Pit-ite" and "Stowmarket Gelignite" as permitted explosives, at the same time imposing severe restrictions. There is still room for a high explosive which is really "safe."

The most important recent event, and that which overshadows every other in interest for the mining community, is the terrible catastrophe at Schofield, Utah, by which at least 250 lives were lost. As the facts are well known, we need only refer to the lesson. It is one which will have to be learnt, and, however slowly, it will at last be mastered. We commenced by calling attention to it sixteen years ago, and to-day it will bear repeating. Here we have a mine in which gas had not been found, believed therefore to be free from it, and yet there is an explosion so terrific that one boy is blown 400 feet along the roadway. The mine was "dry and dusty," the explosion may have been caused either by a shot or by firing a little gas, but that the greater explosion and the consequences were entirely due to the dust cannot be doubted. How many of the great explosions of the past have been the result of the same agency will never be known, but we believe that if the significance of this were fully understood the future would know few calamities of this nature. Canadian mines on the whole are not "gaseous," although there are some notable exceptions, and unfortunately both the Atlantic and the Pacific mines have paid dread tribute to the holocaust—but many of our mines are both "dry" and "dusty," especially those in the cretaceous formation of the West, owing to the extreme dryness and friability of the coal. Dust must now be watched as at least as great a danger as gas. Systematic, and we would like to say *automatic*, sprinkling should be resorted to, and no shots should be fired whilst the workmen, or indeed any but the shot firers are in the mine. This would put dust on the same level as gas so far as precautions are concerned.

Rossland in 1899.

By JOHN KIRKUP, Gold Commissioner.*

The most noteworthy features connected with the mining industry of last year are the increased productions over 1898, when the output was 111,282 tons, valued at $2,470,811, the increase in 1899 being 69,018 tons and an increase of $740,589 in value, amounting to 62 and nearly 30 per cent., respectively; the large amount of development work done, especially in the regular producing mines; the varied, extensive and modern character of the machinery employed; the successful flotation of the Centre Star Mining Company, its progress as a producing mine and dividend payer; and the large amount of work outlined for the future.

The amount of ore shipped by the various producers, regular and

*Report Minister of Mines, 1899.

occasional, together with its value, for the year 1899, given in a separate table, the value of the ore for December being estimated, in the absence of complete smelter returns.

The ore shipments from Trail Creek mines for the year ending December 31st, 1899, amounting to 180,300 tons, is made up as follows, odd figures having been dispensed with:—

Le Roi	92,250 tons.
War Eagle	63,250 "
Centre Star	16,700 "
Iron Mask	5,400 "
Evening Star	1,000 "
Monte Christo	400 "
Columbia and Kootenay	110 "
Virginia	100 "
I.X.L.	100 "
Miscellaneous	990 "
Total	180,300 tons.

Statement showing the amount of ore shipped from the various producing mines, regular and occasional, together with the value thereof; also the amount of work done on properties which are not shipping, and the average number of men employed:—

Le Roi Mine: British America Corporation—Mr. Bernard MacDonald, General Manager.

Tons of ore shipped	92,500
Gross value	$1,250,000
Average number of men employed	350

Columbia and Kootenay:

Tons of ore shipped	110
Gross value	$1,600
Development work—driving, 4,300 ft.; sinking, 750 ft.	5,050 ft.
Average number of men employed	40

Nickel Plate:

Development work—driving, 1,930 ft.; sinking, 440 ft.	2,370 ft.
Average number of men employed	25

Great Western:

Development work—driving, 300 ft.; sinking, 200 ft.	500 ft.
Average number of men employed	20

Josie:

Development work—driving, 650 ft.; sinking, 480 ft.	1,130 ft.
Average number of men employed	20

Number One:

Development work—driving, 1,900 ft.; raising and sinking, 430 ft.	2,330 ft.
Average number of men employed	35

Black Eagle:

Development work done, cost	$250

War Eagle:

Tons of ore shipped	63,250
Gross value	$1,138,500
Average number of men employed	250

Centre Star:

Tons of ore shipped	16,700
Gross value	$225,950
Average number of men employed	75

Iron Mask:

Development work done	2,852 ft.
Tons of ore shipped	5,378
Gross value	$70,268.81
Average number of men employed	40

St Elmo:

Development work done	296 ft.
Average number of men employed	8

Gertrude:

Buildings, including plant and machinery, cost	$3,380
Development work, shafting, drifting, &c., 430 ft.	10,564
Prospecting, &c.	190
Total cost	$14,134

Coxey:

Development work, 415 ft.; cost	$7,995
Prospecting, &c.	300
	$8,295

Jumbo:

Tunnelling	500 ft.
Average number of men employed	5

Big Four Group:

Drifting, 32 ft.; cost	$500
Prospecting	200
Total	$700

Iron Colt:

Tunnelling in 1899	30 ft.
Total amount of work to date	1,400 "
Average number of men employed	20

California:

Work resumed Sept. 5th, 1899.	
Drifting	78 ft.
Waggon road built	1,600 ft.
Building improvements, cost	$4,300
Average number of men employed	25

Sunset No. 2:

Shafting	235 ft.
Drifting	1,175 "
Average number of men employed	22

Homestake:

Sinking main Shaft	110 ft.
Drifting	630 "
Cross-cuts	29 "
Average number of men employed	19

Curlew & Parrot:

Shafting	61 ft.

Velvet:

Drifting	564 ft.
Cross-cutting	460 "
Sinking	55 "
Raising	75 "
Average number of men employed	25 "

Portland:

Drifting	250 ft.
Sinking	147 "
Average number of men employed	12 "

Mascot:

Development work done during 1899	2,698 ft.
Average number of men employed	12

Southern Belle:

Development work done during 1899	381 ft.
Average number of men employed	10

Heather Bell:

Tunnel	60 ft.
Average number of men employed	5

White Bear:

Main shaft	368 ft.
Drifting	750 "
Average number of men employed	10

In addition to the foregoing, a large amount of work has been done on small properties in excess of the amount required for the purpose of obtaining the annual certificates of work.

OUTPUT of Trail Creek Mines from 1894 to 1899.

Year.	Tons of Ore.	Ounces, Gold.	Value.	Ounces, Silver.	Value.
1894	1,856	3,723	$59,568	5,357	$3,214 20
1895	19,793	31,497	602,957	46,702	27,021 20
1896	38,075	55,275	1,104,500	89,285	50,830 00
1897	68,804	97,024	1,940,480	110,068	65,821 00
1898	111,282	87,343	1,746,861	170,304	94,539 00
1899	180,300	101,500	1,928,000	272,300	169,000 00
	420,010	376,362	$7,382,361	694,016	$410,425 40

Year.	Copper.	Value.	Total Value.
1894	106,229	$12,738 64	$75,520 64
1895	840,429	72,385 80	702,359 00
1896	1,580,635	79,030 00	1,243,360 00
1897	1,819,586	90,079 00	2,007,280 00
1898	5,232,011	629,411 00	2,470,811 00
1899	7,785,000	1,114,400 00	3,211,400 00
	17,363,890	$1,998,044 44	$9,710,730 64

Dominion Coal Co.

DIRECTOR'S REPORT SHOWS A LARGELY INCREASED TONNAGE IN 1899.

The following report, covering the operations of this company during the year ended 28th February, 1900, was submitted to the shareholders on the 7th instant:—

The sales of the company have increased during the past year to the extent of 400,000 tons. Notwithstanding this gratifying increase in output, the net results were somewhat unfavorably affected by an accident in one of the more important mines which increased the cost of production, and by delaying the steamers, added to the cost of freights.

By reference to the Treasurer's Report it will be seen that your Board has pursued its usual policy of writing off from the current earnings very considerable amounts, which might justly be charged to Capital Account.

Shipments in the coming year will be much larger and at a much higher average price than ever before known in the history of the company. A large increase in the net revenue may therefore be anticipated; and the directors feel that in the near future the company will be able to commence paying regular dividends on the common stock.

The requirements for the year beginning May 1st, 1901, will be not less than 3,000,000 tons, all of which is under contract, or can be sold, at very satisfactory prices. To supply these increased requirements, three new mines are being opened. To pay for these and to provide for the larger working capital made necessary by the increased business, it may be deemed advisable to issue during the year the one million of Preferred Stock held in the treasury for such purposes.

Since the close of the fiscal year, February 28, 1900, $81,500 of the bonds have been retired through the sinking fund, leaving a bonded indebtedness of $2,795,000.

HENRY M. WHITNEY,
President.

REPORT OF THE TREASURER.

Net Proceeds from Sales of Coal and Net Income from Steamships, Railroads, Barges, Real Estate, etc		$746,926 97
Less Renewals and Extensions at Mines during year		89,741 96
		$657,185 01
Less Interest on Bonds	$172,575 00	
Dividend on Preferred Stock	160,000 00	
Miscellaneous Interest and Premiums on Bonds retired	48,119 15	380,694 15
Surplus of Net Income		$276,490 86
Less Sinking Fund for 1899		86,351 55
Balance		$190,139 31

Disposed of as follows:

Charged Off:

New Cars and Locomotives	$68,842 22		
Completion of Central Banking Station	12,645 39		
Louisburg Pier	11,260 78		
New Pumping Shaft, Caledonia	7,184 49		
New Steam Shovel	7,100 57		
International Piers Nos. 1 and 2	6,910 14		
New Laboratory	3,039 02		
New Warehouse	2,271 65		
New Coal Cutting Machinery	2,045 00		
New Dwellings	1,994 96		
Miscellaneous New Construction	1,884 60		
		125,178 82	
Balance to General Surplus		64,960 49	
			$190,139 31

Balance February 28, 1900.

ASSETS:

Property Account as follows:			
Amount as per last Report	$20,108,108 39		
Less credits during year	57,391 69		
		20,050,716 70	
Additional Real Estate Purchased		15,195 00	
New Construction as Follows:			
Opening Dominion Mine No. 2	$35,423 89		
" " " " 3	10,710 51		
" " " " 4	16,715 62		
New Low Level Pier at Louisburg	20,560 70		
New Coal Loading Plant, Louisburg	10,900 45		
Railway Extensions	18,628 99		
New Discharging Plant at Montreal	70,001 53		
On Account of New Coal Washing plant	868 60	183,810 29	
			20,249,721 99
Cash in Banks and Offices		171,417 95	
Accounts Receivable		122,668 91	
Balance Due from Agents and Coal on Hand		448,631 12	
New Supplies in Warehouse and Stores		178,282 33	
Accident Suspense		18,574 84	
Interest "		1,552 17	
Steamship Hire Advanced		15,102 35	
Cash in New England Trust Company for Outstanding Coupons		87,690 00	
Cash in New England Trust Company for Sinking Fund		130,835 07	
Cash in American Loan & Trust Co.—Uncalled for Dividends		2,332 00	
			1,177,086 74
Total			$21,426,808 73

LIABILITIES:

Capital Stock, Common	$15,000,000 00		
" " Preferred	2,000,000 00		
First Mortgage Bonds	2,876,500 00		
		19,876,500 00	
Dividend Preferred Stock, Jan. & Feb.	26,666 67		
Unpaid Coupons	87,690 00		
Unpaid Dividends	2,322 00		
Unpaid Royalty	78,682 58		
Accounts Payable	168,407 46		
Bills Payable	752,867 47		
		1,116,646 18	
Balance General Surplus		433,662 55	
Total			$21,426,808 73

General Surplus Account.

Surplus as per last Report	$368,702 06
Surplus from 1899 as per this Report	64,960 49
Total Surplus	$433,662 55

Sinking Fund on April 17, 1900.

$111,800 United States 4s, costing	$124,817 62	
Uninvested Funds	6,032 70	
Cash Deposited April 16th	86,351 55	
		217,201 87
For		
Retirement of $81,500 Bonds	92,201 87	
Balance Reserve Sinking Fund	125,000 00	
		$217,201 87
Balance, Reserve Sinking Fund	$125,000 00	

J. S. McLENNAN,
Boston, June 1st, 1900. *Treasurer.*

MINING IN EASTERN ONTARIO.

By J. WALTER WELLS, Belleville, Ont.

The industry of iron ore mining in Eastern Ontario is making considerable progress owing to the increase in market values of good quality ores, and the fact that the bonus paid by the Ontario Government is based directly upon the utilization of Ontario ores.

The ores now being mined in the district are both hematite and magnetite, the former being worth an average price of $4.50 and the latter $3.50 per ton, delivered at the nearest railway station. All of the known deposits of hematite running sufficiently high in metallic iron are being worked, but there are several deposits of magnetite more or less extensive which contain objectionable quantity of sulphur, although free from other impurities and running high in metallic iron. Most of these deposits are lying untouched, and offer a field for experimental work in magnetic concentration or roasting for the elimination of the sulphides of iron. There are also known deposits more or less extensive of magnetic ores which are at present too far removed from shipping facilities to be commercially valuable.

WORKING MINES ALONG THE CENTRAL ONTARIO RAILWAY.

The following mines are being worked at present along the Central Ontario railway:—

WALLBRIDGE MINE—Hematite of first grade. Located in Madoc township, 2 miles south of Eldorado station, where the ore is taken and freighted to Hamilton Iron and Steel Co., Hamilton, Ont. Owned by Mr. T. C. Wallbridge, and worked under contract by James Gunn; employing 14 to 28 men in all capacities according to season. Shipments are irregular, running as high as 50 tons per day. The mine is an open pit, ore being raised by steam derrick. Sometimes the ore runs almost pure, but often requires cutting out of soft decomposed rock matter.

COE MINE—Hematite of good quality. 300 yards west of C.O.R. track and ¼ mile south of Eldorado station. Owned and worked by A. W. Coe, of Madoc, A. W. Hawley, of Trenton, *et al.* Employing 28 men in all, with James West as foreman. Shipments are said to average 25 tons per day, sent to Hamilton Steel and Iron Co.

DUFFERIN MINE—Magnetite. Located ½ mile south east of Malone station in Marmora Township. Owned and worked by Thomas Barnes, employing about 12 men. Shipments are said to average 13 tons per day, sent to Hamilton Iron and Steel Co.

WELLINGTON MINE—Magnetite, being continuation of the Dufferin mine. Worked by S. Wellington, of Madoc, employing six men. Recently opened up and a small shipment has been made to Hamilton Iron and Steel Co.

SEYMOUR MINE—Magnetite, carrying small quantity of sulphides. Worked irregularly by S. Wellington, of Madoc. A large quantity of ore has been taken out of this mine several years ago and shipped to Pennsylvania furnaces.

ST. CHARLES MINE—Magnetite. Located 1 mile west of McDonald's Siding, C.O.R. Owned and worked by L. Meyer, of Madoc, C. R. Daniells, of Ottawa, *et al.*, employing 30 men. The daily output averages 50 tons per day, shipped to Hamilton smelter.

COE HILL MINE—Magnetite, carrying from 2 to 3 per cent. of sulphur. Located at Coe Hill village, Wollaston Township. Worked under lease by A. J. Longnecker, employing 15 men sorting over the dump, which contains over 30,000 tons of ore. Shipments to Hamilton smelter are small and irregular.

PROSPECTS BEING DEVELOPED—The Jenkins property, west of Coe Hill, being a magnetic ore carrying large quantities of sulphur, is being opened up by L. Meyer, of Madoc, *et al.*—C. H. Farnum, of Detroit, and S. Wellington, of Madoc, own a good surface showing of excellent quality magnetic ore, located near Hermon, Mayo Township, North Hastings, which is being tested by diamond drill. The property is located near the extension of the Central Ontario Railway, and has every prospect of becoming a shipping mine.—Several promising prospects of magnetite are being opened up in the vicinity of Bancroft, in view of the extension of the C.O.R. to Bancroft.

WORKING MINES ALONG THE KINGSTON AND PEMBROKE RAILWAY.

BEDFORD MINE—Magnetite, carrying more or less sulphides. Located 4 miles east of Bedford station. Owned by Kingston & Pembroke Railway and worked irregularly by William Edgar, of Sharbot Lake. Large quantity of ore has been shipped from this and the adjoining property, known as the Janesville mine. Diamond drill at present testing the deposit.

ROBERTSVILLE MINE—Magnetite. Located 2½ miles from Clarendon station, in Ninth Concession of Palmerston Township, Frontenac county. Owned by K. and P. Railway, and worked under contract by Thos. Barnes, of Hamilton, and W. F. Schwendman, of Clarendon, employing 33 men in all. Supplied with steam hoists, drills, pumps, etc. Shipments averaging 30 tons per day or more are made regularly to Hamilton smelter.

CALABOGIE MINES—Magnetite of good quality. Located ¼ mile west of Calabogie Station. Owned by W. C. Caldwell, M.P.P., of Lanark, and worked under contract by C. M. Dolittle, of Hamilton, for the Hamilton Iron and Steel Co. Large quantity of ore has been shipped. Present average shipment is 80 tons per day. Mine is well supplied with steam hoists, drills, etc.

WILBUR MINE—Magnetic. Located near Wilbur, Frontenac county. Owned by W. C. Caldwell, of Lanark, with Samuel Jackson, of Lavant, as foreman, employing 21 men on the average. A large quantity of ore is on the dump and mining progressing steadily, but no shipments have been made.

TITANIFEROUS IRON ORES.

The most important deposits of magnetic ores with regard to extent only are those carrying more or less titanium, which usually run high in metallic iron free from sulphur, but are of no commercial value, as the iron masters in Ontario and the United States steadily refuse to utilize these ores. The objections to titaniferous ores are (1) that they are difficult to fuse or flux down in the furnace, using up considerable fuel; (2) formation of pasty masses at irregular intervals in the burden of the furnace; (3) that complex chemical combinations are formed carrying titanium which attach the lining of the furnace.

Probably the chief objection is the cost of the necessary fuel in fusing the titanates of iron and lime with reduction of iron in the furnace, these compounds although resembling silicates in many particulars being extremely hard to make into a liquid melt with ordinary fluxes.

Mr. A. J. Rossi of New York city, who has been experimenting on the commercial smelting of titaniferous iron ores for several years past, claims to be able to smelt these ores on an economical bases by the proper combination of fluxes.

Mr. F. J. Pope late instructor in chemistry at Kingston School of Mines, spent two years investigating the smelting and concentration of titaniferous ores in the Metallurgical Laboratory of Columbia School of Mines, New York city, using the Wetherill Magnetic Separator, the most successful magnetic concentrator in commercial operation for the concentrating tests.

The results of the experiments showed that increase in per centage of metallic iron also included increase in per centage of titanium with partial elimination of sulphur, phosphorus and silicious matter. This proves conclusively that titanium occurs in chemical combination in iron ores probably as a titanate of iron.

Mr. Pope's experiments show an important fact of interest specially to iron masters that titaniferous ores being leached from gabbro or norite rock masses invariably carry nickel, vanadium, etc., often running high in nickel. In fluxing these ores and reducing to metallic iron all of the nickel goes down in the pig, probably accounting for the fact that pig iron made from titaniferous ores has many properties of nickel steel.

It is not probable that the numerous and large bodies of titaniferous iron ore occurring in Eastern Ontario, will come into commercial use till supplies of cheaper fluxing ores show signs of diminution.

MICA MINING.

There are seven mica mines in the district being worked on an extensive scale at present, the most important being in Loughboro Township, Addington County.

The mica, which may be white, amber or black mica, occurs in six-sided cigar shaped crystals running in size from the almost microscopic crystal to huge masses often six feet long and four feet diameter at the widest portion. The crystals are found in pyroxene rock masses, usually in veins or pockets, more or less extensive, and often running to considerable depths before pinching out. Each pocket or lens is usually followed at greater depths by a similar pocket.

There is found in association with the mica crystals such minerals as apatite, calcite, fluor spar, hornblende, tourmaline, scapolite, quartz, etc. At one mine 42 different minerals were found well-defined and separated out being a splendid field for mineralogists.

METHODS OF MINING MICA.—The mica is usually mined by making open cuts or pits, as often considerable dead work is required on both sides to secure the crystals intact. Dead work is the most expensive item in the mining, as the rock requires only crude culling, simple hoisting and pumping machinery, although steam or air drills are employed to advantage in place of hand drills.

The quality of mica depends on the ease with which it cleaves into uniform plates and its flexibility. It should be without holes, cracks, and containing no traces of magnetic iron ore, which spoils it entirely for electrical purposes. Most of the dealers cater to demands for electrical purposes. The color or transparency is no criterion in electrical uses, as biotite, or black mica, free from iron, answers the same purposes as the white or muscovite variety, both being of same flexibility and free from cracks.

The mica is put on the market as "thumb trimmed," being split in sheets about 1-16 inch thick, and sorted into different sizes or grades

The average prices obtained are:—

1 inch by	3 inch	sells for about	7	cents per pound.		
2 "	3 "	"	18	"		
2 "	4 "	"	32	"		
3 "	5 "	"	75	"		
4 "	6 "	"	$1.15	"		
5 "	8 "	"	1.40	"		
8 "	10 "	"	1.80	"		

The crude mica is dressed in factories near the mines, sorted into different sizes and shipped in barrels, averaging about 400 pounds, to Ottawa, which is the distributing point for Ontario.

The principal dealers being:—

W. H. Sills Mica Co., 398 Wellington Street, Ottawa.
Eugene Munsell & Co., 332 " " "
Webster Mica Co, 274-276 Stewart Street "
T. J. Watters, 49 Metcalfe Street "
Mica Manufacturing Co., 213 Dalhousie St. "

The principal working mines are:—

GOULD LAKE MINES.—Amber mica, located in 9th concession of Loughboro Township, Addington Co., about 5 miles north-west of Sydenham Village. Owned and worked by Webster Mica Co., with J. E. Chown, of Sydenham, as mine manager; employing about 35 men in all. Operations consist of three large pits 180, 140 and 90 feet deep, from which a good grade of mica is being taken out.

The average output from all of the pits is said to be 2½ tons per day.

The rough mica is hauled to Sydenham Village, where the Webster Co. maintain a dressing and sorting factory, employing on the average 25 hands. The sorted mica is shipped in barrels to Ottawa. The Webster Co. also operate several smaller deposits in the neighborhood, and purchase from desultory miners in the district. This company has been working steadily for several years, the manager, Mr. Chown, being probably the most experienced mica miner in Ontario.

FOXTON MINE.—Amber Mica, located in 7th concession of Loughboro Township, 3 miles north of Sydenham Village. Workings consist of two pits, 120 feet and 80 feet deep, in a vein from 6 to 8 feet wide. Supplied with steam hoist, pump, drills, etc., for economical working. Owned and worked by James Foxton of Sydenham, the product being hauled to Foxton factory in Sydenham, where it is dressed, sorted and cut by dies into shapes and sizes required for electrical demands. The product during busy season is said to average one ton per day, and employs about 20 men at the mine and factory.

GRANT MINE.—Amber mica, located near Gould Lake mines, Loughboro Township. Owned and worked by Dr. Grant, of Napanee, and T. McLatchy, of Belleville; employing about 25 men in busy seasons. Workings consist of two open cuts or pits. Product is sold in the open market.

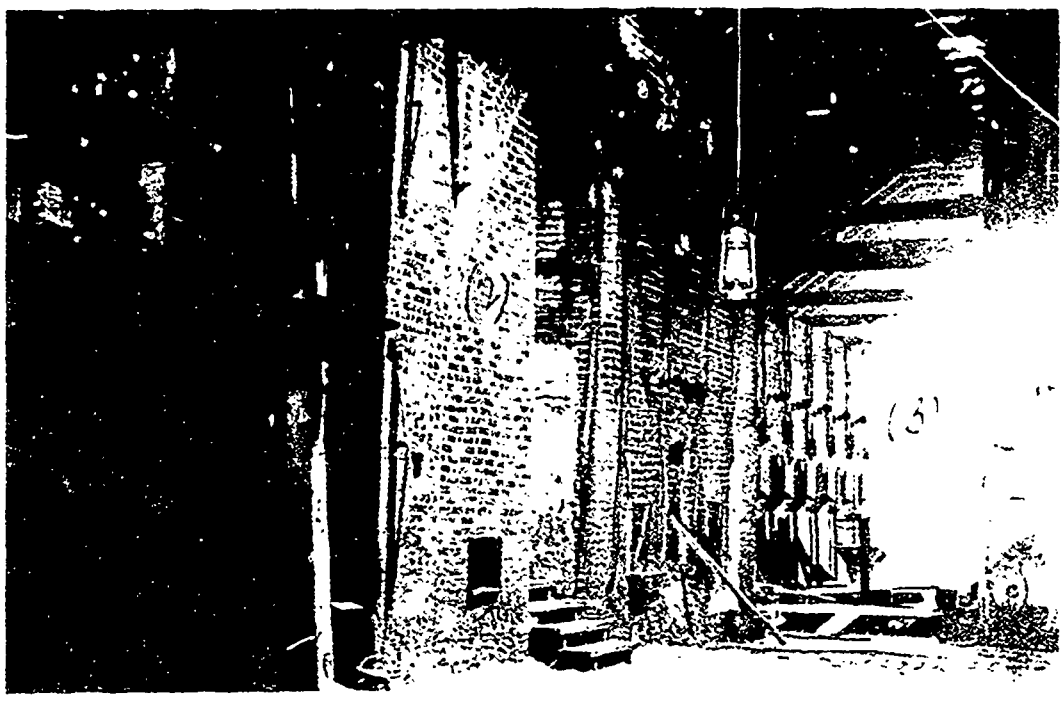
*(*Engineering and Mining Journal, Feb. 10th, 1900.*)

*Paper read at California meeting of A. I. M. E., 1899.

STAFF AT DELORO GOLD MINE.

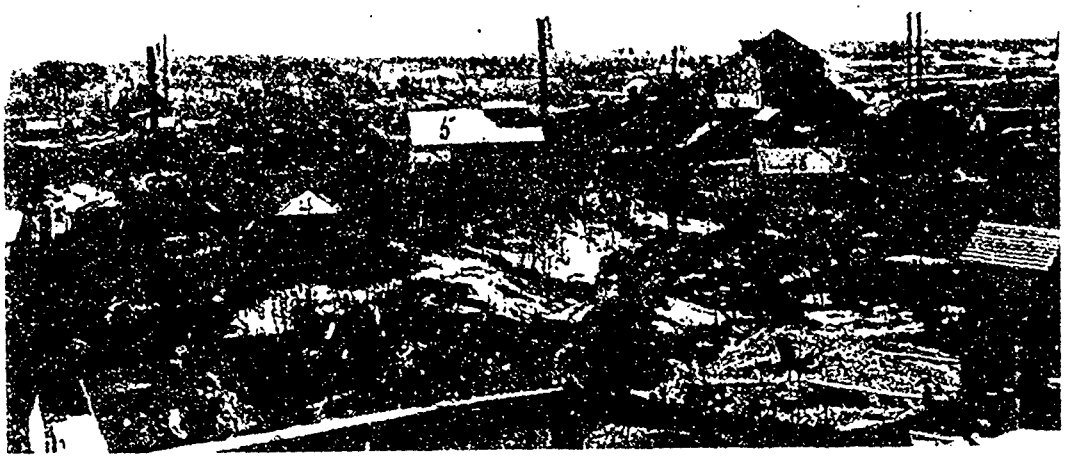
Mr. G. McQueen, *Accountant* Mr. S. B Wright, *Metallurgist.* Mr E. E. Johnsen, *Chem.* Mr. A. H Brown, *Assayer.*

Mr. P. Kirkgaard, *Superintendent.*

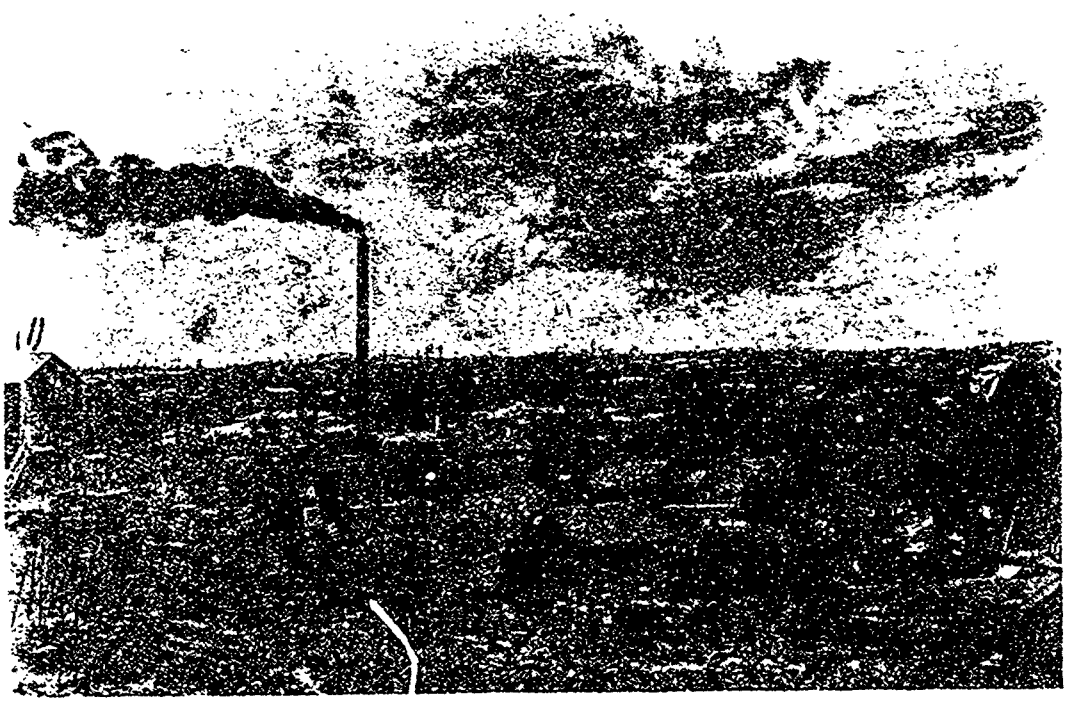


ARSENIC WORKS—DELORO GOLD MINE.

(1) Revolving Roaster (2) Converter. (3) Condensing Chamber. (4) Refining Chambers.

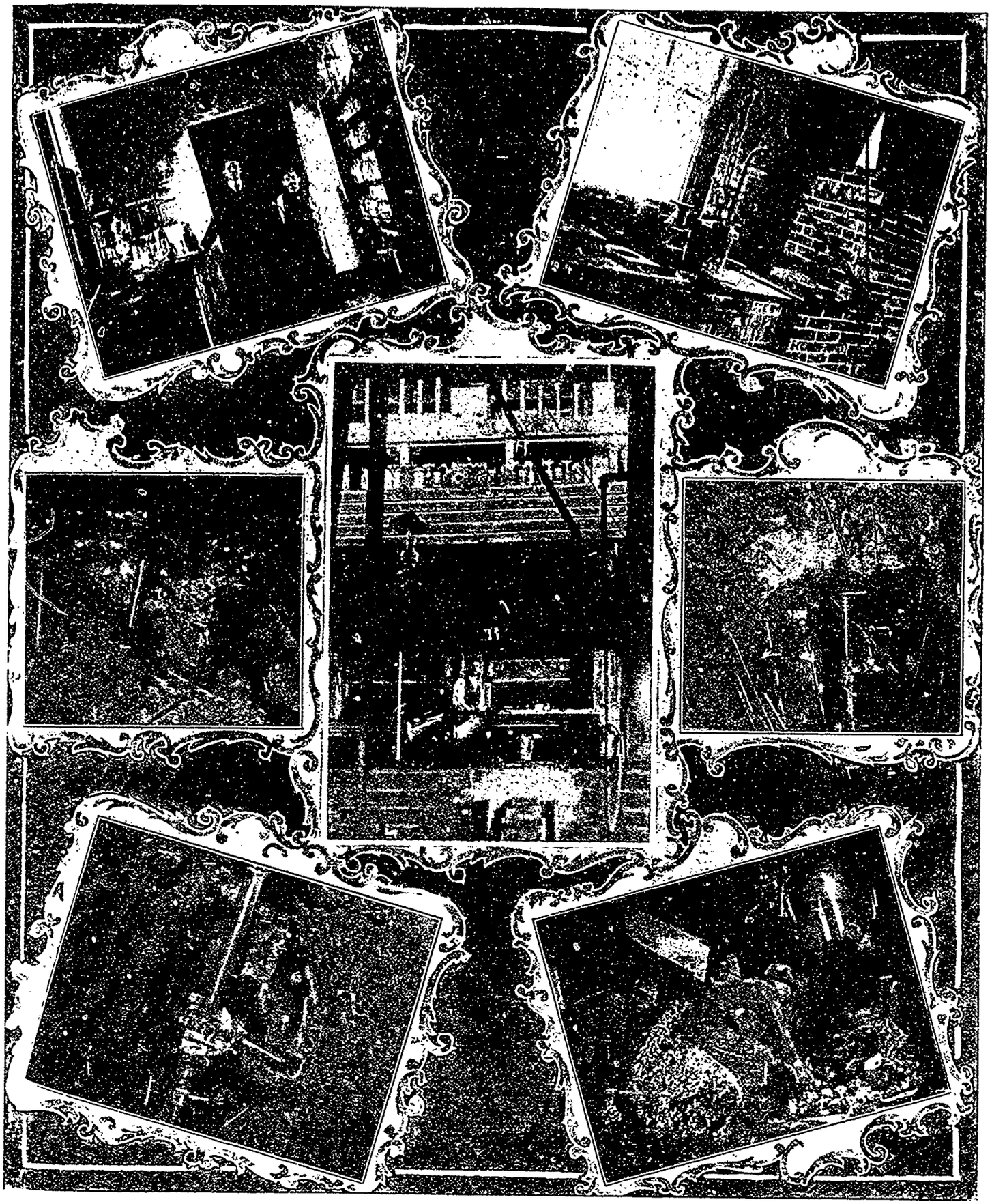


Bird's Eye View of Surface Works—Deloro Gold Mine.



DELORO GOLD MINE.

(1) Gatling Shaft. (2) Hoisting Plant. (3) Tuttle Shaft.



Laboratory.
(S. B. Wright, *Metallurgist.* A. H. Brown, *Assayer.*

200 ft. level (showing Mr. Kirkgaard standing on ledge of ore body. Shows dip and width of vein.

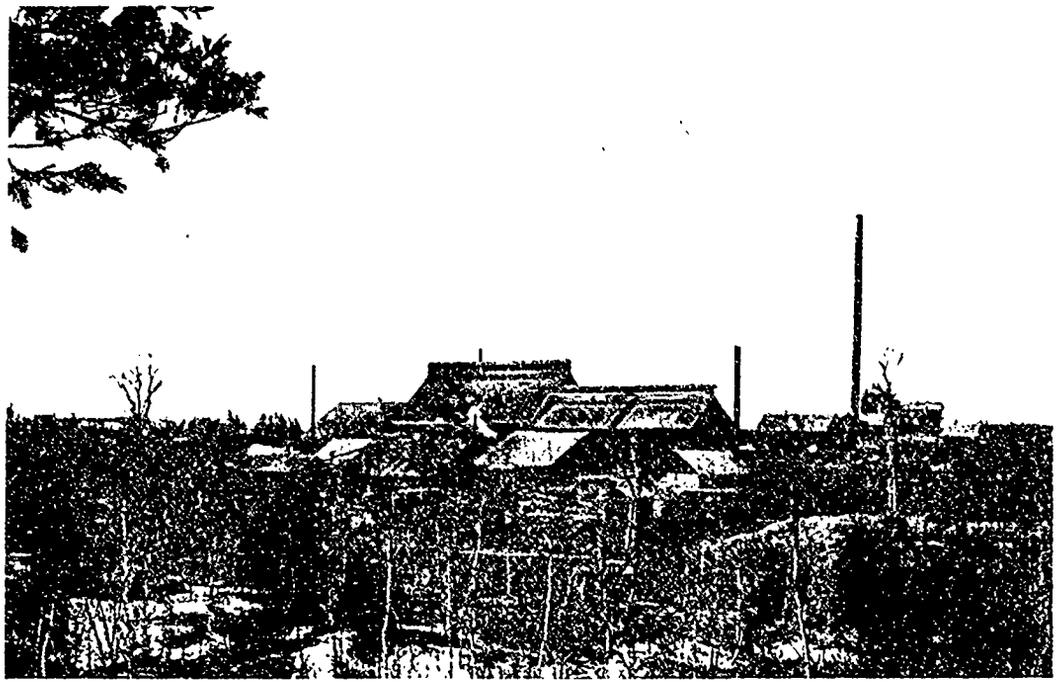
Crosscut on 300 ft. level.

Interior of Battery.

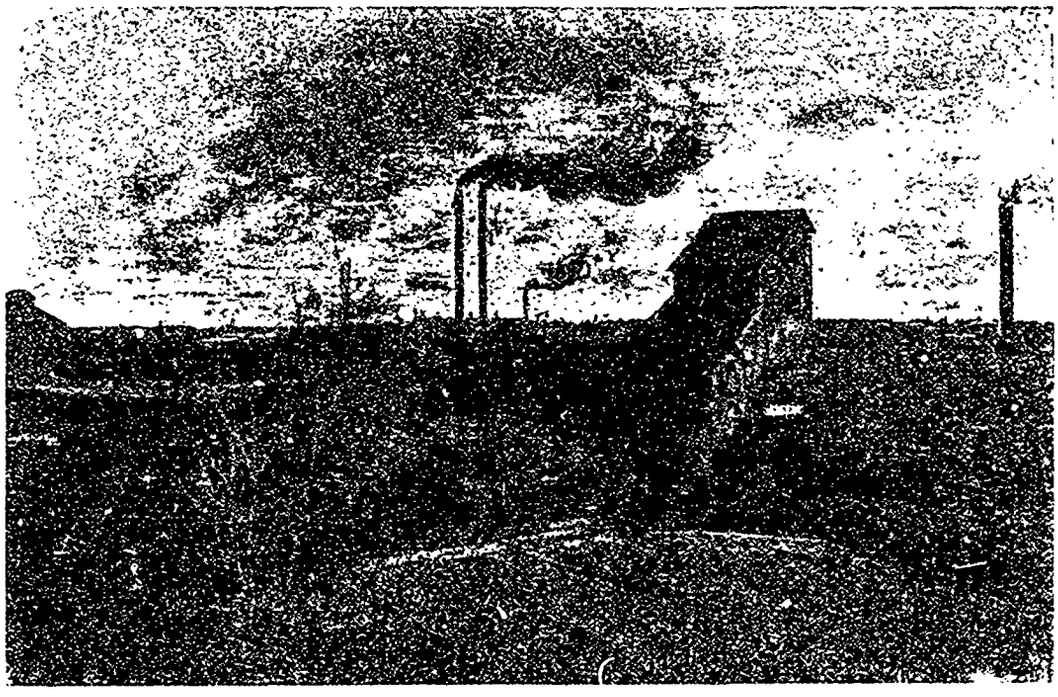
Bullion Room.

Stope, 300 ft. level.

Ore sorting.

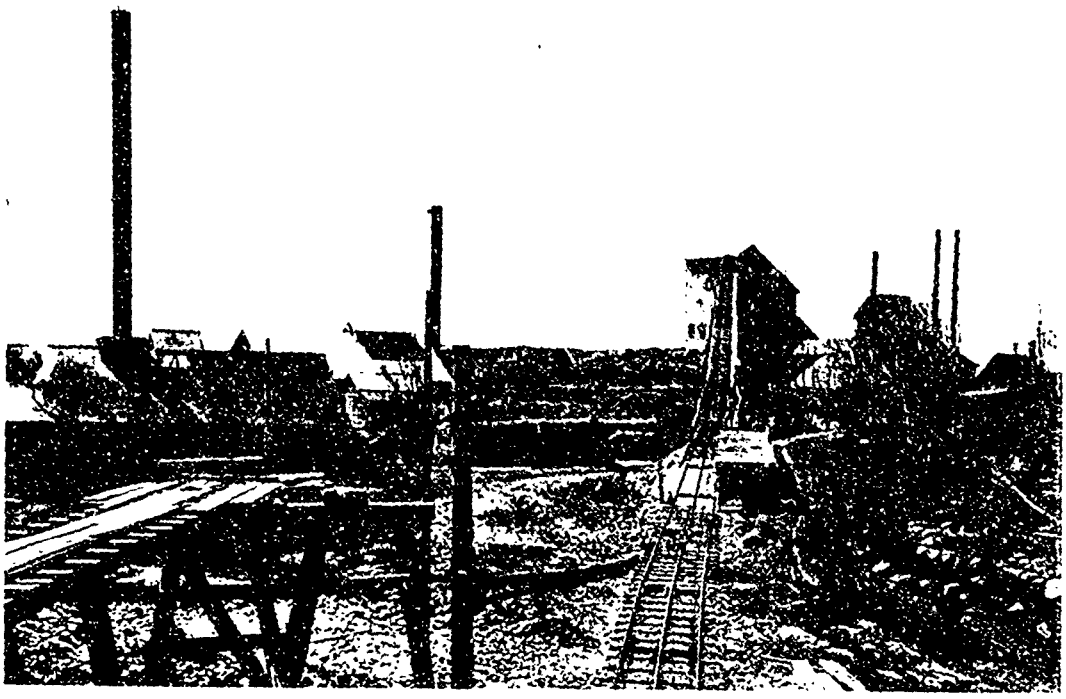


General View of Arsenic Refining Works—Deloro Gold Mine.



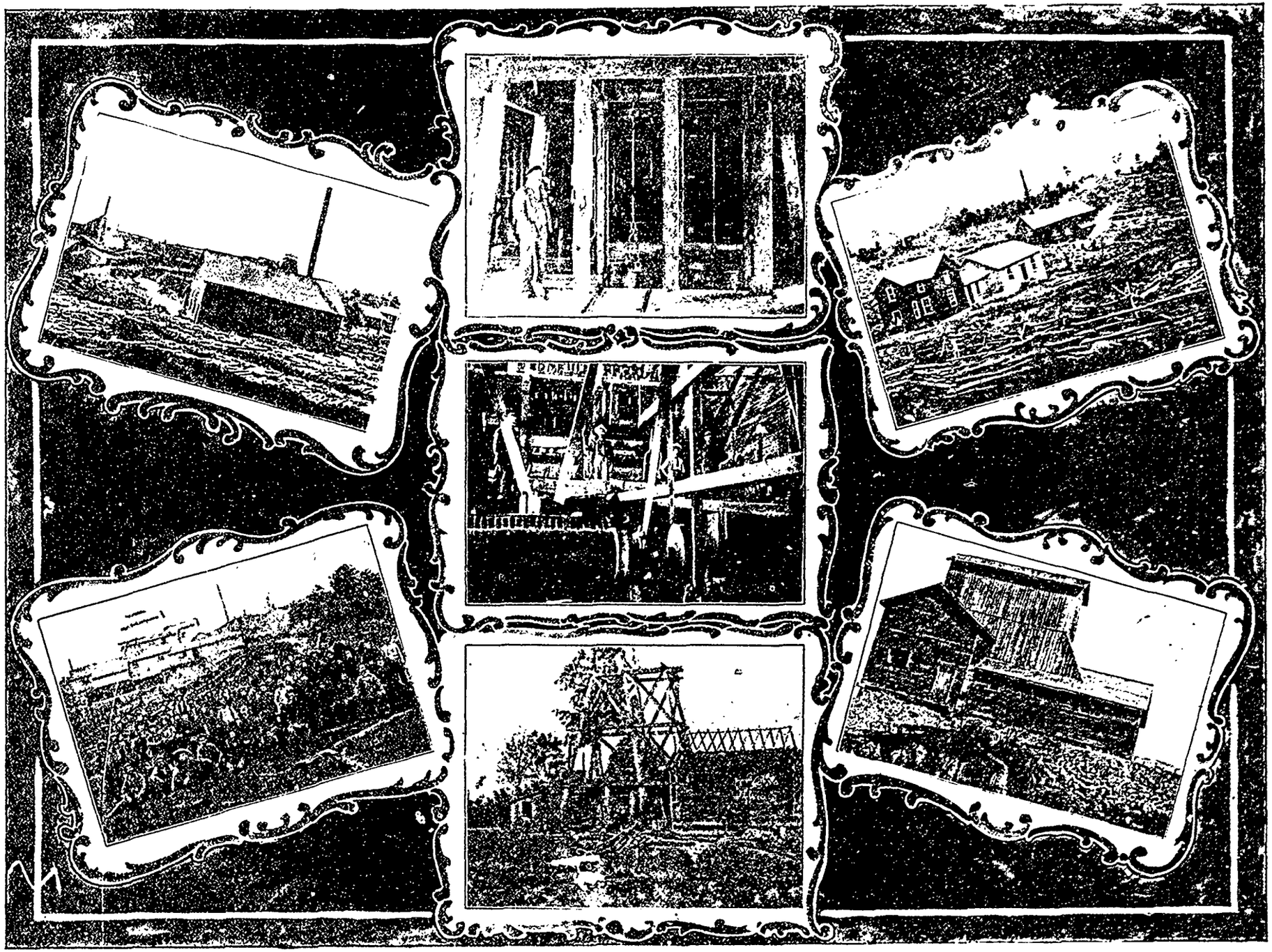
General View of the Milling and Refining Works—Deloro Gold Mine, Ont.

CANADIAN GOLD FIELDS, LIMITED, DELORO, ONT.



Another view showing portion of Surface Works—Deloro Gold Mine, Ont.

Atlas Arsenic Company's Batter , Hastings County, Ontario.



Mill, Tramway and Compressor House, No. I Shaft, etc.

Group of Miners on west side Nos. II and III Shafts, Belmont Mine

No. VII Shaft.

Interior of Battery

Pit-head No. 5 Shaft

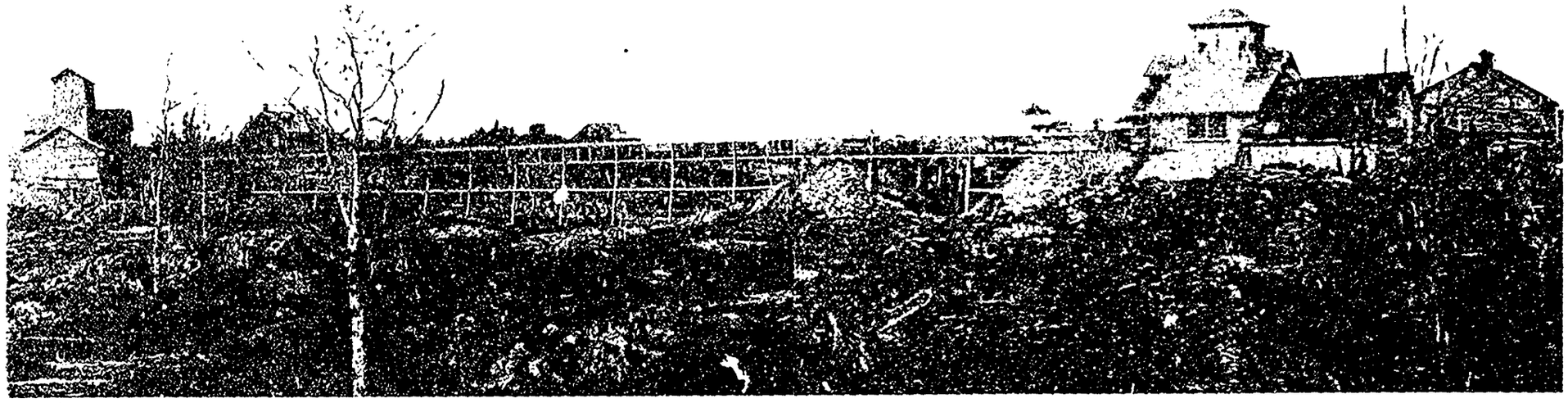
Office, Storehouse, Compressor House and No. 5 Shaft.

No. VII Shaft House

CORDOVA EXPLORATION, LIMITED, BELMONT, ONT.

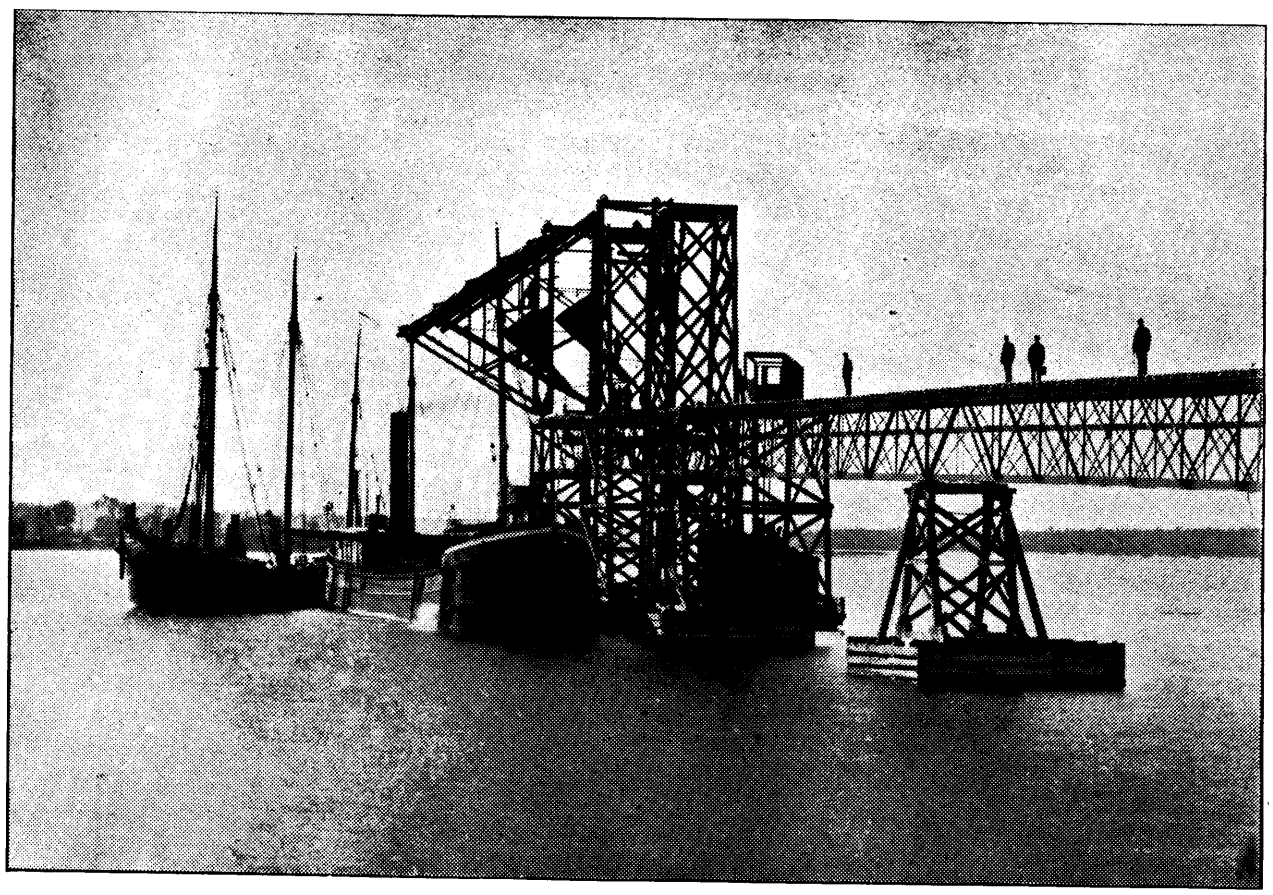
BIRD'S EYE VIEW OF BELMONT GOLD MINE, ONT.
(Taken from the south)

Tank House. Mill. No. 7 Shaft. No. 1. Shaft. Smith Shop. Machine Shop. House. Office and Storehouse. Air Compressor. No. 2 Shaft No Shaft.

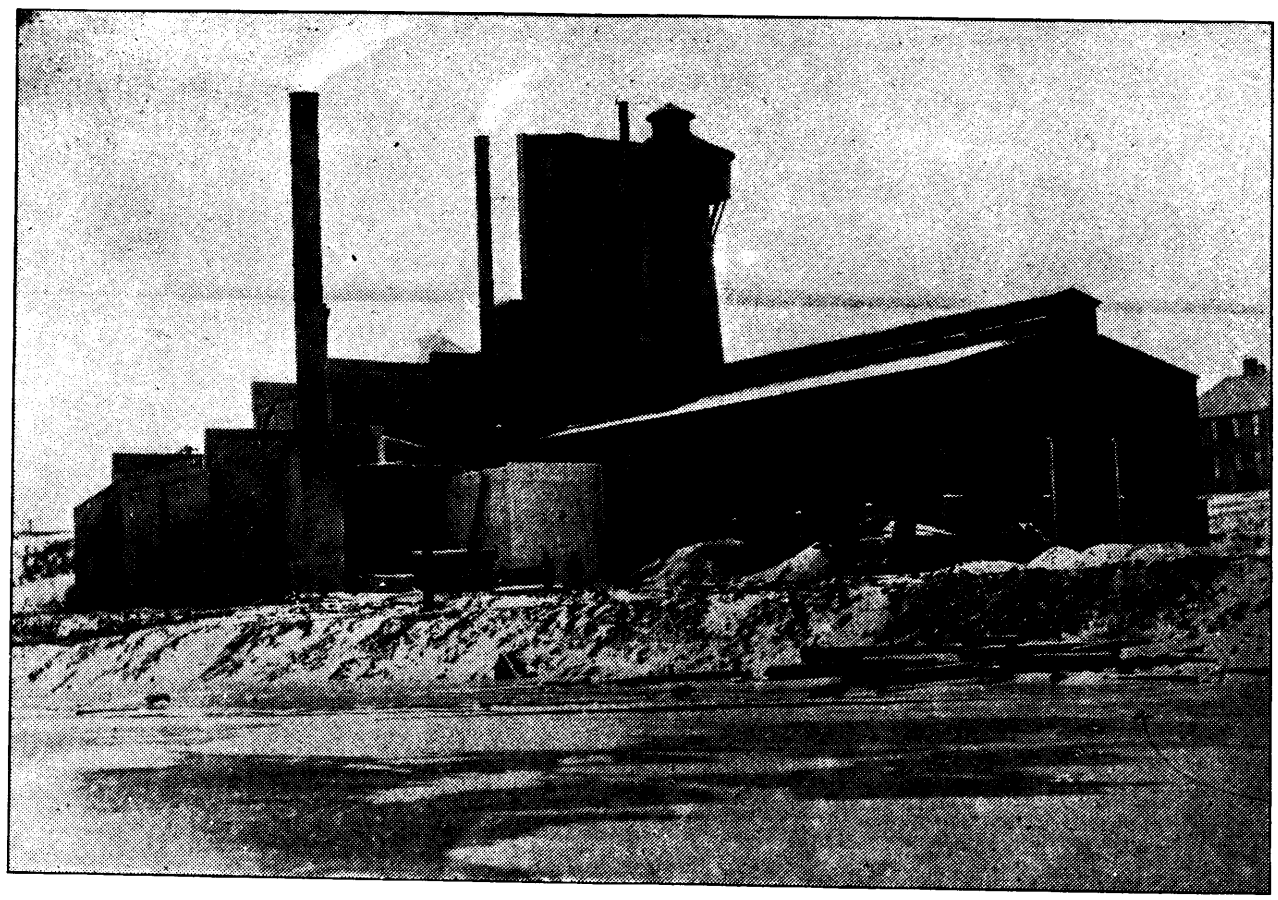


BIRD'S EYE VIEW (looking from the west) BELMONT GOLD MINE.

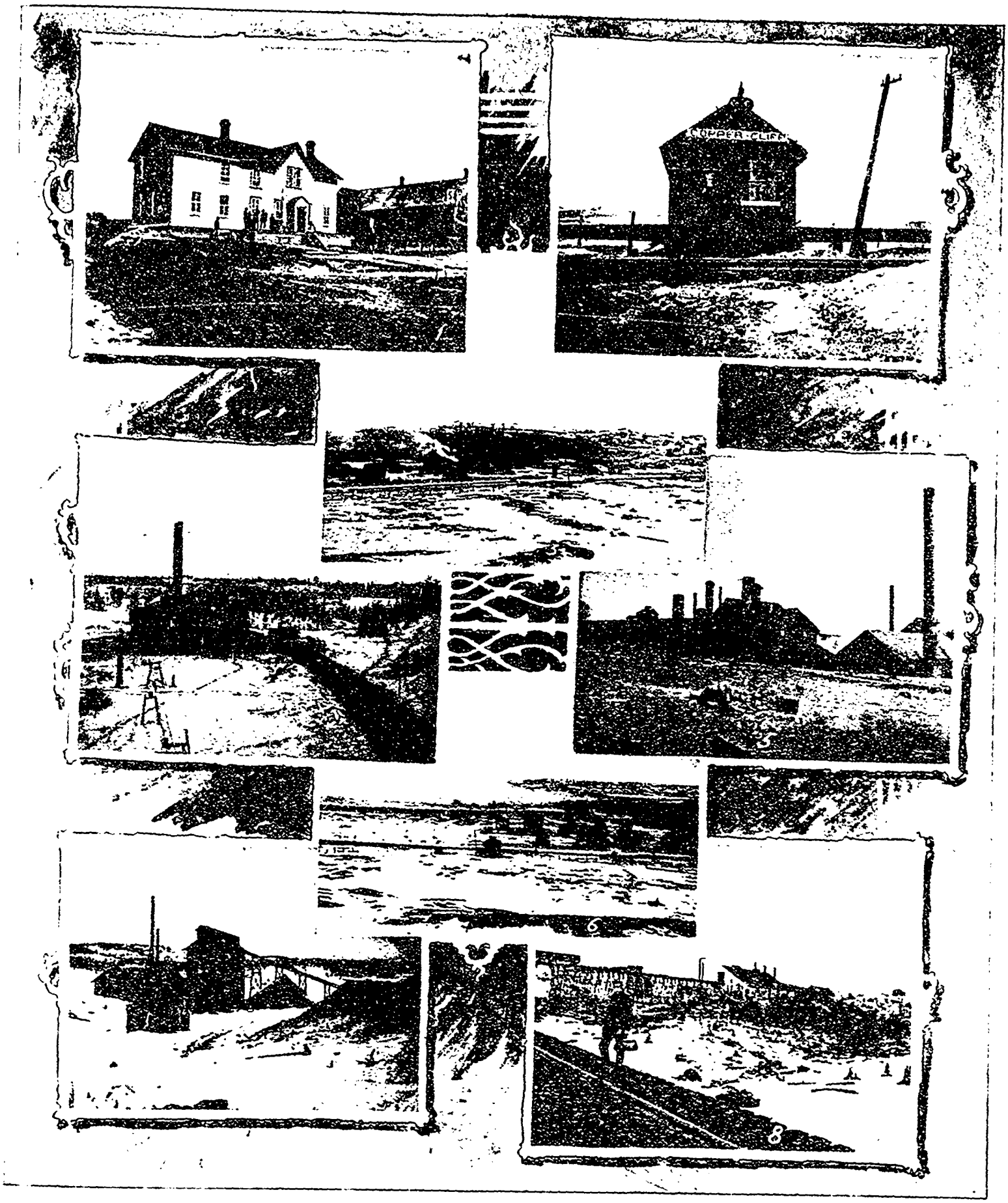
No. 7 Shaft. No. 6 Shaft. No. 3 Shaft. No. 2 Shaft. No. 1 Shaft Blacksmith Shop.



Unloading Pier—Deseronto Iron Co., Deseronto, Ont.



Charcoal Furnace of the Deseronto Iron Co., Deseronto, Ont.



MINES AND WORKS OF THE CANADIAN COPPER CO AT SUDBURY, ONT.

Club House at Copper Cliff.

Compressor No. 6 Mine

No 2 Shaft House.

Cinder Dump at old Smelter.

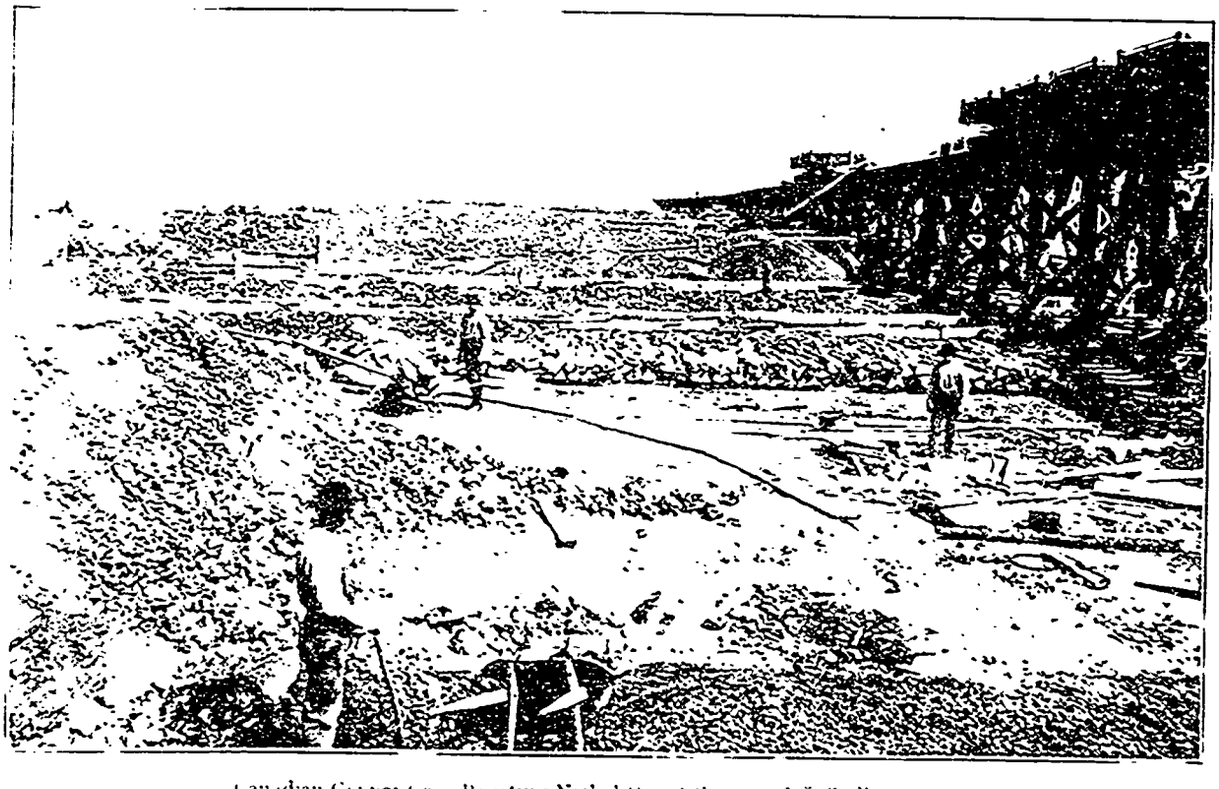
Roast Heaps.

Copper Cliff Siding.

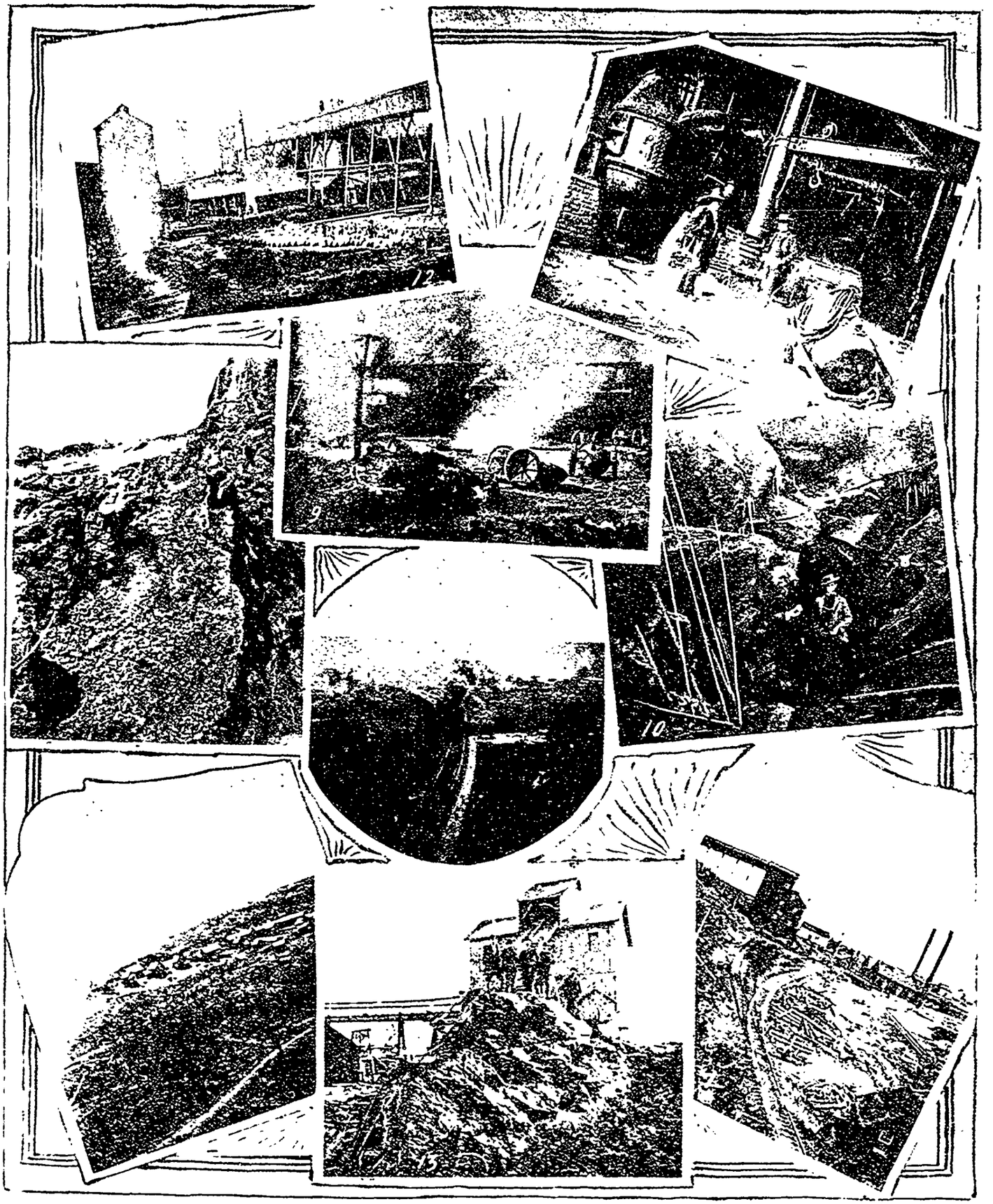
Old Smelting Works.

Trestle New Smelters.

Canadian Copper Co —Pile of Nickel Matte at Copper Cliff, Sudbury, Ont.



Canadian Copper Co —Roasting Nickel Ore at Copper Cliff, Sudbury, Ont



MINES AND WORKS OF THE CANADIAN COPPER CO. AT SUDBURY, ONT.

Matte Dump at Old Smelter.

No. 2 Mine.
Village of Copper Cliff

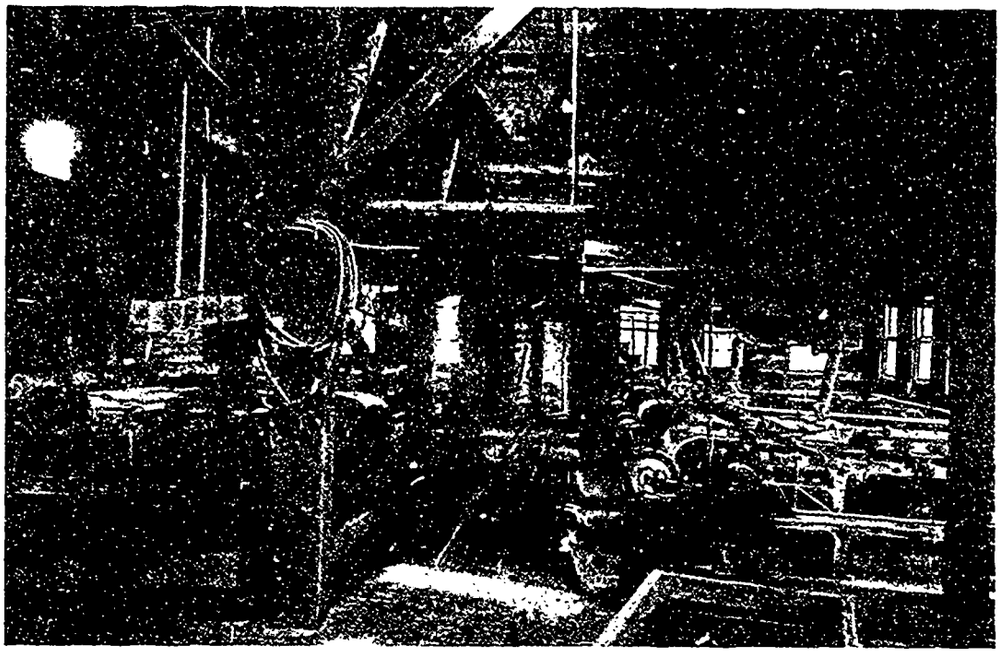
No. 2 Smelter.
Train of Ore Cars running to Smelter.
No. 5 Mine and Rock House.

Interior Bessemer Plant.

No. 6 Mine.
Engine House No. 2 Mine

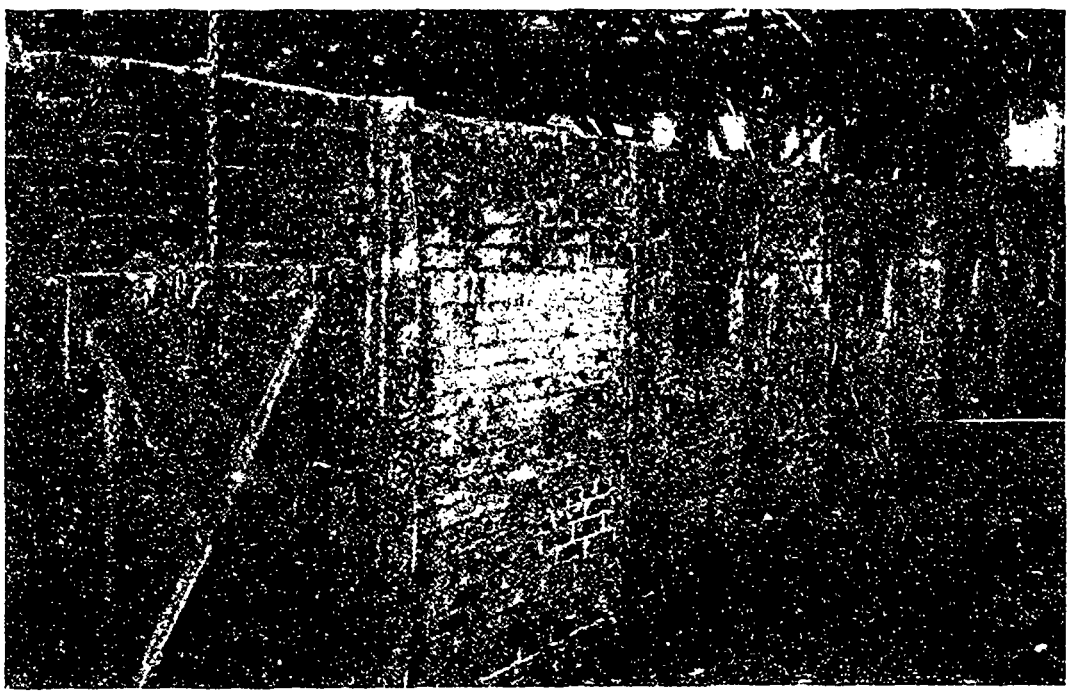
General View of Old Smelting Works—Canadian Copper Co. at Sudbury Ont.

New Smelting Plant at Sudbury—Canadian Copper Co.



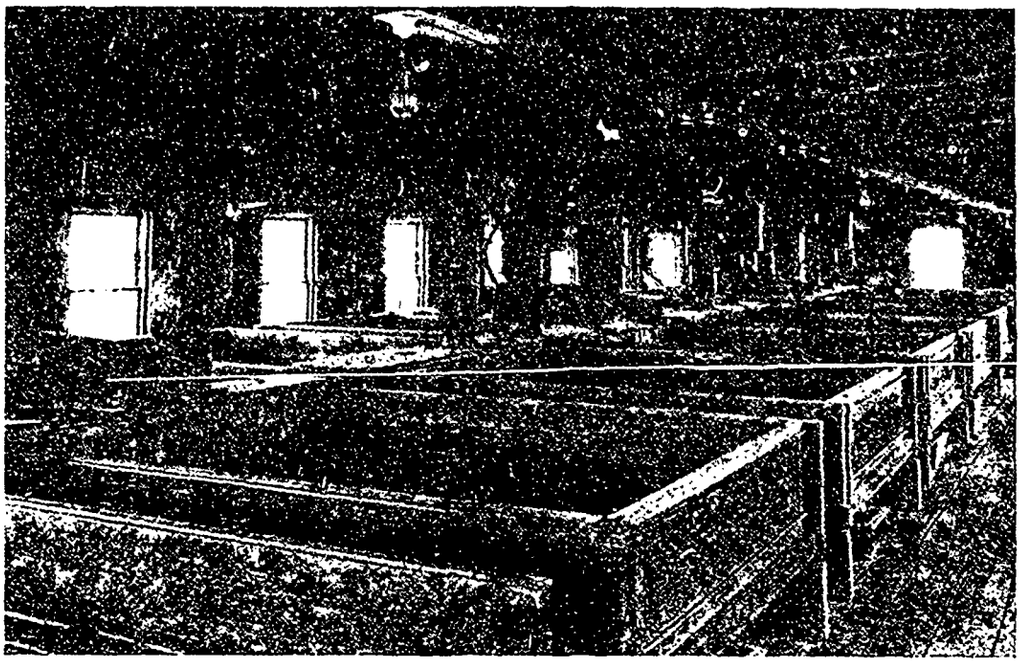
Concentrating Plant of the Brookfield Mining Co., North Brookfield, Nova Scotia

Batteries and 14-foot Plates—Brookfield Mining Co., North Brookfield, Nova Scotia.

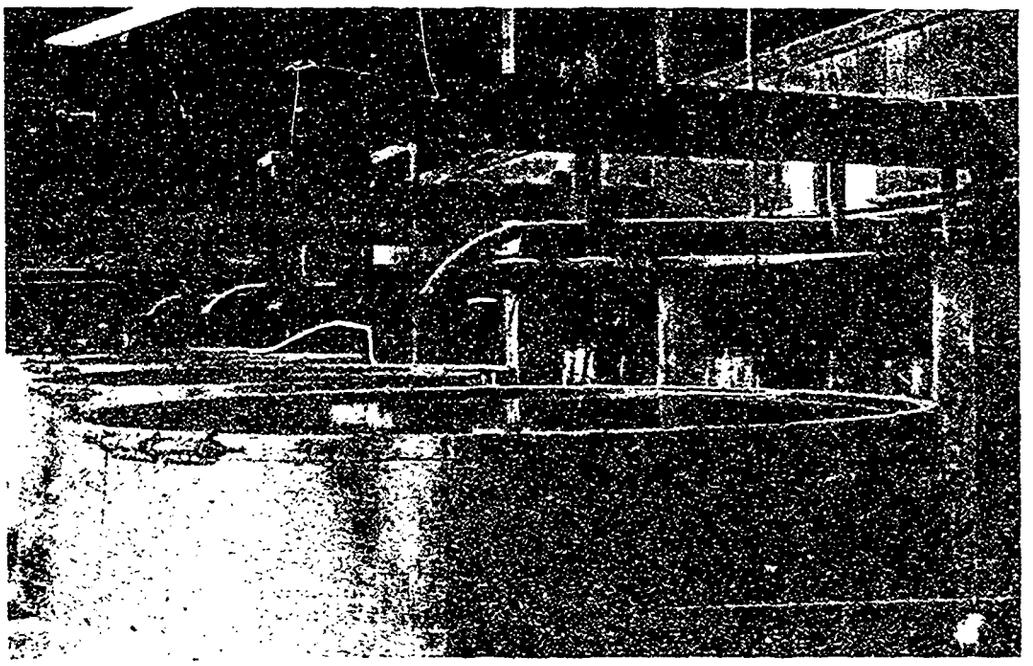


One of the Reverbatory Furnaces at the Brookfield Mine, Nova Scotia.

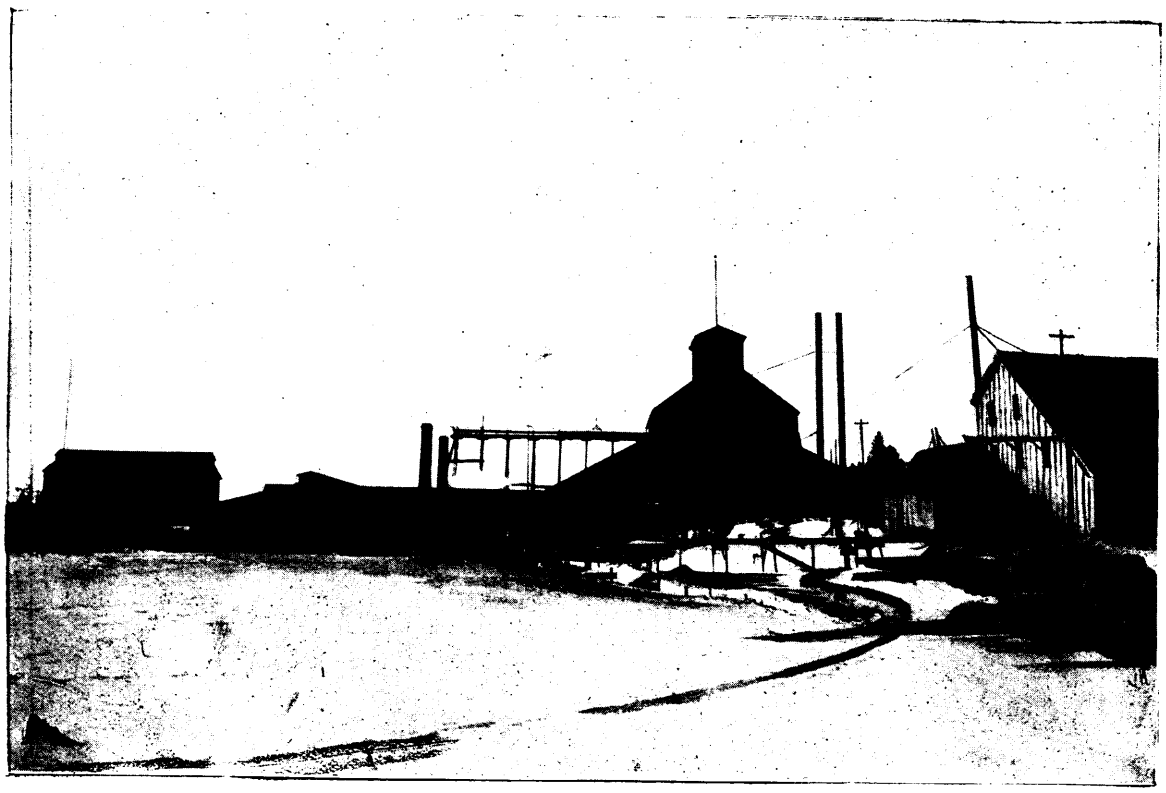
One Ton Chlorination Barrels (Thies' process) at the Brookfield Mine, Nova Scotia.



The Filters—Brookfield Chlorination Works.



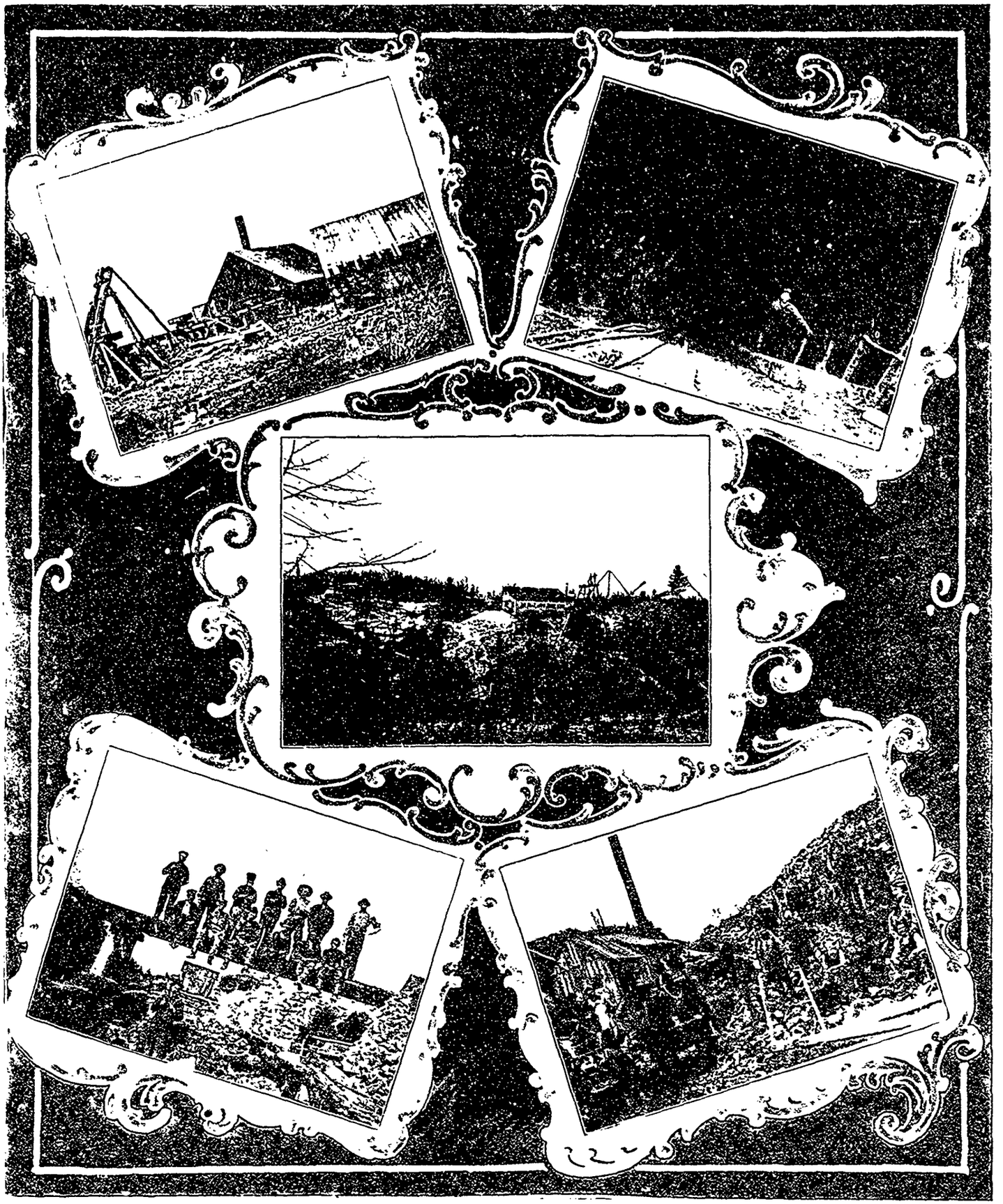
Settling Tanks—Brookfield Chlorination Works



Chlorination House. Furnace. Shed for Chlorination. New 20-Stamp Mill, Old Mill.

Brookfield Mining Co.—Milling and Chlorination Plant at North Brookfield, Queens Co., N.S.

Elevator Floor for Roasted Concentrates—Brookfield Chlorination Works, Nova Scotia.



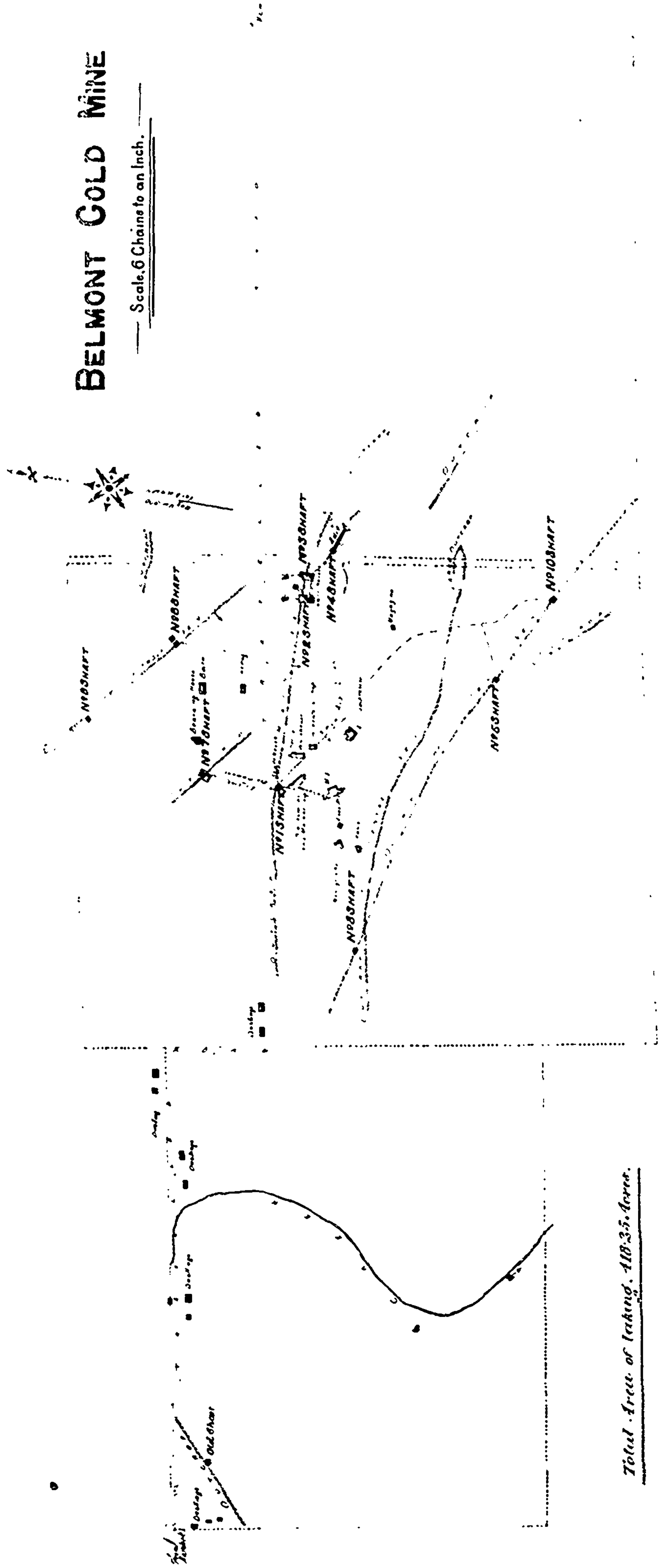
Hoisting plant at Calabogie Iron Mine.

Miners at Wilbur Iron Mine

Workings Stoness Kent Mica Mine.

Mouth of Shaft—Robertsville Iron Mine.

Group of Miners—Robertsville Iron Ore Mine.



MR. D. G. KERR, M. & M.E.,
General Manager, Cordova Exploration, Limited,
Belmont Mine, Ont.

STONESS—KENT MINE.—Amber mica—located in 14th concession of Loughboro township, 14 miles north east of Sydenham village. Owned and worked by J. Stoness, R. E. Kent, of Kingston, *et. al.* employing 18 to 20 men steadily. A shaft is down about 450 feet with considerable drifting, being one of the most extensive deposits yet worked in Canada. The mine is well equipped with machinery for economical working, having steam hoists, pumps, drills, etc., under very energetic management. The product is hauled to Kingston Factory where it is dressed, sorted and sold in the open market. 16 hands are employed steadily in Kingston Factory. According to reports the mine is working on the second pocket now as the first pocket was pinched out by a mass of diorite rock which required removal before the deposit was uncovered.

TEFTS MINE.—Amber mica—located in Bedford township, near Bedford mills. Owned and worked extensively by the Webster Mica Co of Sydenham. Employing 18 men Shaft down 140 feet, discloses a very extensive deposit, which gives promise of being one of the best mica deposits in Canada yet worked. Product hauled to Sydenham Factory.

Besides the regular working mines there are several deposits in the district worked irregularly by owners, the product being sold to dealers. The business is profitable as it requires but little outlay of capital, simple mining machinery, no expense in concentrating except culling and the product finds a ready cash sale.

A novel use of the scrap mica and the low grades is that adopted by the Mica Boiler Covering Co., 9 Jordan street, Toronto, which makes the small scraps into coverings for boilers, steam-pipes, etc., answering all requirements for retaining heat and being very much cheaper than asbestos or mineral wool covering. The scrap is also made use of in lubricants, wall paper manufacture, as a binding material, roofing material, for annealing steel, etc.

GOLD MINING IN EASTERN ONTARIO.

Gold has been known to occur in Eastern Ontario since 1863, when the excitement following the discovery of rich auriferous pockets at Richardson's Hill, lot 18, 4th concession of Madoc township, Hastings county, brought to light several other auriferous veins.

Many desultory attempts have been made to work the auriferous deposits, mostly by men handicapped by lack of necessary capital and experience, with results which could not be otherwise than complete failures.

There are at present four working gold mines in the district, treating ores which have been tried previously by one process and another, and condemned as refractory. A notable fact in this connection is that although the ores are called "refractory" the gold contents are being successfully extracted by modern stamp-amalgamation mills, over 70 per cent of assay values being caught on amalgamation plates, showing that the gold occurs free in the ores as well as chemically or mechanically combined with the sulphides or sulph-arsenides of iron, which are always found in association.

At one mine—the Deloro Gold Mine—the bromo cyanide process (Sulman-Teed patent) is employed to advantage in extracting gold from arsenical pyrites comprising the concentrates saved in milling.

Modern methods of concentrating by the use of improved frue vanners, Willfey tables, etc., are used to save gold values found in pyrites.

The ores of the district may be divided into two classes.—(1) ordinary white quartz carrying free gold, often visible as small nuggets with more or less pyrite, pyrrhotite, or even copper pyrites, also carrying gold values; (2) arsenical ores, consisting of white quartz associated with mispickel or arsenical iron pyrites and often calcite. These carry gold running from $2 to $60 per ton of ore on the average. Very rich specimens carrying native nuggety gold embedded in the crystalline mispickel are sometimes found, proving the occurrence of free gold in the ore and accounting for its free milling qualities. Quartz may be absent, the ore running to almost pure mispickel, often beautifully crystallised as metallic silvery orthorhombic prisms.

With regard to the geological formation of the gold ore deposits it may be said that the auriferous veins occur at or near the contact of igneous rock masses with metamorphic rocks, diorite being invariably found in close association, either as a wall rock or as cross dykes cutting the veins. In all probability the gold has been leached from the diorite rock masses. With regard to the depth of the deposits the deepest shaft at the Deloro mine—460 feet down—discloses a 6-foot vein, and the gold values show no signs of diminishing at that depth At the Belmont mine the deepest shaft, about 148 feet down, shows a well defined ore deposit carrying paying values of gold.

The working gold mines are:—

GATLING MINE—Located on the Gatling Five Acres, said to be the richest portion of the vein upon which the Deloro Gold Mine is working. It is owned and worked by the Atlas Arsenic Co., Ltd., capital being £750.000, the directors A. Coe and C. S. Britton, *et al.*, of Cleveland, Ohio, with W. A. Hungerford, of Belleville, as mine superintendent The ore is quartz, with a large percentage of arsenical pyrites, assay values varying with percentage of mispickel present. The pure mispickel often carry good values, as high as $300 per ton. The mine is in close proximity to the Deloro mines, herein described, both mines working on different parts of the same ore deposit. Two shafts have been sunk on the vein, which runs from 4 to 12 feet in width, and sufficient drifting has been done to block out over 12,000 tons of ore in sight. The mine is well equipped with steam hoist, pumps, air compressor for drills, etc A tramway carries the ore from mouth of the shaft to the top of the mill, where it is passed on by gravitation to crushers and stamps.

The milling plant consists of a ten stamp battery, Blake crusher, large amalgamating plates, run by a 60 h.p. engine.

Two Frue vanners and one Willfey table are used to save the concentrates, which carry high values The mill and machinery were supplied by the Hamilton Manufacturing Co., of Peterboro.

According to authentic reports values in gold averaging $8 per ton of ore are caught in the plates, while the remaining values in concentrates averaging $6 per ton of ore are being saved in the concentrates for further treatment. The directors are apparently satisfied with the amount of ore in sight, and acting on the recommendation of the superintendent arrangements are being made to put in a cyanide leaching plant as well as an arsenic refining plant, in order to secure the full values of gold and arsenic contained in the ore.

The mine employs 54 hands, and ore has been milled for the past five months. The amalgamation and concentrating tables are in charge of H. W. Spottiswoode, of Kingston School of Mines.

This mine bids fair to become a rival of its neighbour, the Deloro Mine, both in extent of workings and value of gold recovered. Thirty tons of ore are being daily treated, with a probability of an early increase in the milling capacity.

CRESCENT MINE.—Located on lots 16 and 17, in 11th Concession of Marmora Township, Hastings Co., near the village of Malone. It is owned and worked by the Sovereign Gold Mining and Development Co. of Ontario, Limited, with O. R. Sprague of Toronto, as general manager, and Geo Wilson of Malone, as superintendent. The ore is quartz carrying considerable iron pyrites and shows of free nuggety gold are often found. Assays on the ore being raised made at the Government laboratory at Belleville, show high values on samples carrying considerable pyrites, but probably assay values of the whole deposit will not average more than $10.00 per ton of ore.

The deposit occurs in irregular pockets more or less extensive at the contact of red granite with dark dioritic rock masses, the latter being overlaid by limestones of later formation. Considerable development has been done. The deepest shaft being 140 feet down, with drifting to block out milling ore. The ore is essentially free milling, the concentrates also carrying good values Several years ago the deposit was worked for three years steadily by John McFee of Belleville, under lease from the owners.

The present company took over the property about two years ago, and although finding difficulty to raise adequate funds by the sale of the company's stocks, the mill is now in fairly good working shape.

The 10-stamp amalgamation-mill made by Fraser & Chalmers of Chicago, was overhauled and now treats the ore with C. Ullyot of Syracuse, N.Y., as amalgamator and H. F. Huffman, student at Kingston School of Mines, as assayer.

The concentrating plant consists of three different sizes of frue vanners.

Hand drilling is used, several Nova Scotia drillers being employed. At the drilling contest held in Marmora on May 24th, a team consisting of T. Ganley and E. Croft made the remarkable record of drilling a ¾-inch hole in solid country rock (Trenton limestone) 28¼ inches in depth, during the short interval allowed of 12½ minutes.

The ore is raised by a steam hoist and transferred to the mill by gravity. This mine employs 36 men in all. Its future success no doubt depends on the continuance of the deposit, as the mill seems to be in the hands of practical men, and according to reports the full assay values of gold are being saved. The management is seriously handicapped by lack of capital.

BOERTH MINE.—Located in Clarendon township, Addington county, 1½ miles west of Ardock village. It is owned and worked by the Boerth Gold Mining Company of Ontario, Ltd., the directors of the company being—J. Boerth, restaurateur; W. J. Marygont, brewer; A. L. Groesbech, solicitor; W. W. Glass, broker, of Detroit, Mich.; J. W. Cook of Marmora, the original owner of the property.

The ore is quartz, more or less interspersed with dioritic rock matter separated out from one of the walls and contains a small quantity of iron pyrites, calcite, hornblende, tourmaline, and pyrrhotite.

Assay values on samples selected by Mr. Arch. Blue, Director of Ontario Bureau of Mines, and assayed at the Government assay laboratory at Belleville, ran from $4 00 to $85 00 per ton of ore in gold. The surface ore was in places very rich, but the average values in gold of the whole deposit do not run over $8.00 per ton of ore.

The ore is free-milling, and should be worked at a small profit by a 20-stamp mill as water is abundant, and fuel and labor are cheap in the district.

The company was seriously crippled at the outset by investing $20.000 or more in a plant built to extract the gold by the Eames process, which was claimed to extract more than the assay values of gold from the ore.

The "process" consisted in roasting, or rather trying to roast, ore (crushed to the size of a walnut) (carrying not more than four per cent concentrates), in a series of ten upright cast iron cylinders.

The "roasted" ore, which was supposed to be dead sweet after passing through this process, was then transferred to pulverizers and amalgamators to extract the gold freed from combination in the ore by roasting.

Expensive brick condensing chambers were erected in connection with the roasting cylinders to catch the arsenical fumes (white arsenic, As_2O_3) to be obtained from the ore which carries only traces of arsenical pyrites.

The cylinders, which cannot be called furnaces, refused to entirely desulphurize the ore, and after a few trials the iron casing was found to be honey-combed with holes as might be expected.

The pulverizers were torn to pieces on the first trial at crushing the "roasted" ore, which was supposed to be partially disintegrated by heating.

This plant is now dismantled, and the inventor, "Professor" Eames, is in parts unknown.

The ore was found to be free-milling, and the owners, not dismayed by the failure of the Eames process, erected the present plant, which consists of a 10 stamp amalgamation mill put up by Jenckes Machine Co. of Sherbrooke, Quebec, with two Willfey concentrating tables.

According to recent reports the mill, under supervision of G. H. Patterson, mining engineer, and G. W. Yorke, amalgamator, is giving fair results, but the ore at the lowest levels—148 feet—is low grade, requiring more milling capacity and cheaper methods of winning ore in order to be worked at a profit.

The mine is at present fairly well equipped with steam hoists, pumps, drills, etc., and employs 25 men.

A more recent report states that the mill is temporarily shut down till compressor plant is installed and stamping capacity increased.

BELMONT GOLD MINE.—Owned and operated by the Cordova Exploration Company of Newcastle-on-Tyne, England. The property comprises 125 acres in the west ½ lot 20, 1st con. of Marmora, Hastings County; 300 acres, lots 20 and 21, 1st con of Belmont Township, County of Peterborough; 160 acres, west half lots 24 and 25, 2nd con. Belmont Township, with water power on Deer River at the outlet of Deer Lake, where it is intended to install in the near future a 700 h.p. air compressing plant, to deliver compressed air to the mine, a distance of 2¾ miles, south east of power station. The mine location is 10 miles N.W. of the village of Marmora, and 12 miles N.E. of the village of Havelock. There are 10 veins on this property. The north vein is near the north boundary of the property and running parallel with main vein. Main vein runs nearly east and west with a dip to the south of about 80 degrees. The centre vein is south of the main vein and almost parallel to it.

South vein strikes diagonally across the S. W. portion of property, with a N.W. and S. E. strike, and a dip to S.W.

DEVELOPMENT WORKS—

No. 1 Shaft—Has a depth of 300 feet and is being sunk to a greater depth. This shaft is equipped with a 30 h.p. hoist, 2 pumps, one with a capacity of 250 gallons per minute, and one with a capacity of 100 gallons per minute; two 3½ rock drills, self-dumping skip of 17 cubic feet with rail track to the bottom, and head gear on the mouth of shaft 25 feet high to sheave pulley.

No. 2 Shaft.—Depth 95 feet, and there is at present a raise coming from a lower level of No. 3 Shaft to cut the bottom of this shaft ; to operate the drifts of this shaft there is one 20 h.p. hoist, one pump, capacity 100 gallons per minute ; two 3 in. rock drills, with head gear and cars and tracks in the drifts. From this shaft there has been about 10,000 tons of ore stoped out.

No. 3 Shaft.—Depth 185 feet, with levels at the 90 ft. and the 185 ft. ; 850 ft. of drifting. This is a three compartment shaft, two self-dumping skips, tracks and ladder way, on a dip of 80 degrees. There are at work on this shaft, five 3 in. rock drills, one pump, 100 gallons capacity, one large double drum hoist, pithead frame 32 ft. to sheave pulley, with a 30 ton ore bin beneath floor.

No. 4 Shaft.—Depth 35 ft. ; this is a prospecting shaft on a spur of the main vein.

No. 5 Shaft.—Depth 103 ft., equipped with 15 h.p., hoist, pump, 50 gallons capacity, and rock drill.

No. 6 Shaft.—Depth 85 ft., equipped with small hoist, and pump, and rock drill.

No. 7 Shaft.—Depth 75 ft., with level at this depth. This is a three compartment shaft sunk vertically on the vein ; at present this shaft is being completed with a 35 ft. pithead frame house, and large double drum house.

No. 8 Shaft.—Located and sunk a few feet.

No. 9 Shaft.—Located and sunk a few feet.

No. 10 Shaft.—Depth 40 ft., is being equipped with a 15 h.p. hoist, pump, and rock drill, to start sinking operations when ever the weather conditions will permit.

Plant and Buildings.—One 40 x 60 ft. frame building, containing a cross compound air compressor with inter-cooler, after-cooler and condenser, 185 h.p. with air receivers and air line from air receiver to the various shafts.

High pressure steam cylinder,			125	lbs.
Low	"	"	25	"
High	" air	"	85	"
Low	"	"	20	"

Two return tubular boilers in separate room, with electric damper regulators, and large water tank of 7,000 gallons capacity for coolers.

One ten stamp mill with ball pulverizer for re-grinding the tails then repassing over copper plates.

Explosive magazine, 10 x 12 ft., sealed inside and banked with sand.

Machine shop, 45 x 45 ft., frame building, with 5 h.p. engine, lathe, drilling machine, emery wheels, etc.

Blacksmiths' shops, one at No. 1 Shaft, and one between No. 2 and 3 Shaft houses, one at No. 10 Shaft.

Carpenters' shop, 2 storey frame building, 24 x 40 ft. No power as yet.

Office.—Two storey office, of 6 apartments connected by phone with Marmora, with brick material storehouse behind it, 24 x 40 ft., with basement floor for oils, etc.

Assay Office, 20 x 20 ft., two apartments, built of brick, with basement.

Residence for staff, one large 12 roomed house, 600 ft. north of office.

Manager's residence, south-west from mill, with stables behind it.

Mechanics' house, north east of offices, with barn behind it.

Workmen's houses in construction towards the west of property.

CANADIAN GOLD FIELDS, LIMITED.—The largest gold mining enterprise in Hastings county, is undoubtedly, that of the Canadian Gold Fields, Limited, an English syndicate formed in 1898, with a capital of £150,000. It controls about 2,500 acres in the township of Marmora, but the principal works are at the well known Deloro mine, four miles east of the town of Marmora. Here it is operating under the able administration of Mr. T. P. Kirkgaard, an extensive plant, mining mispickel ores and extracting gold and arsenic, also buying mispickel ores from outsiders. The process employed is crushing by gravity stamps, amalgamation, concentration, and leaching by bromo-cyanide ; the concentrates after leaching are treated for arsenic. Many diffieulties have been encountered in former years, and a vast amount of money has been expended in vain attempts to treat these ores. The mine is now being worked very successfully.

DIAMOND MINE.—Located in Elziver township, Hastings county, near the village of Queensboro. It is owned and worked by a company consisting of L. Meyer, M.E., and D. E. K. Stewart, Barrister, of Madoc ; Hon. A. G. Blair, and C. L. Magee, of Ottawa, *et al.*

The ore is a quartz with a large quantity of iron pyrites and mispickel.

The development, so far, discloses an eight foot vein running nearly two miles in length, and is the largest body of auriferous vein quartz in the district. A dyke of diorite crosses the vein and at the contact is found mispickel which carries $120.00 per ton of ore as gold values, according to assays made at the Government assay office in Belleville.

Where the mispickel runs out the ore is lower grade. Free gold is found both in the quartz and the pure mispickel showing the ore is free-milling.

Over 1,500 tons of milling ore is now on the dump.

The company is erecting a 10-stamp amalgamation mill made by the Wm. Hamilton Co. of Peterboro, with latest improved machinery for concentration. The mill will probably be working within one month's time.

CRAIG MINE.—Located in Tudor township, North Hastings. It is owned by S. Maitland of Bannockburn, *et al.*

A vein of quartz averaging 5 feet in width has been stripped for 400 yards, and a shaft is down 60 feet.

The property is under option to the Warren Exploration Co. of Warren, Pa. Assay values are said to run from $4.00 to $7.00 on average samples.

LANDENBERGER MINE—Located in Grunsthorpe Township, North Hastings. Owned and worked by F. Landenberger, of Belleville, *et al.* A vein of white quartz, averaging 5 feet in width, has been stripped for 200 yards, and a shaft put down 45 feet. Samples selected by the owner gave values in gold from $2 to $300 per ton of ore at the Government Assay Office, Belleville.

COOK MINE—Located in Marmon Township, being a continuation of the Deloro and Gatling mines on the same vein. The property is owned and being developed by Cook Bros., Lambermen, Toronto. A shaft has been put down 65 feet some years ago, and is now being deepened. The ore is a quartz, with mispickel, and is said to carry paying values of gold.

TALC—Silicate of magnesia. A deposit one and a half miles south-east of Madoc village. Is being worked by A. A. Robins, of New York City, who purchased recently from J. B. Harrison, of Actinolite. The deposit is 18 ft. wide, of first grade, and continues at depth of 60 feet. Shipments are being made via Belleville to Governeur, N. Y., the centre of the talc industry in the United States. The pulverised talc finds a ready market, being used in the manufacture of paper, crayons, cosmetics, etc. Other deposits in Madoc county are being prospected.

HELENA MINE—Located in Barry Township, Addington Co., near Clogue. It is owned and developed by W. W. Chisholm, R. Kreussler, *et al*, of New York City. The ore is a quartz mixed with chlorite and calcite, and heavily impregnated by copper pyrites, tetrahedrite (fahl ore), pyrite, etc., in spots. The portions of ore carrying fahl ores are rich in gold, silver, copper. The whole ore dump is probably low grade. Some shipments of sorted ore have been sent to Eastern smelters. The mine is supplied with steam hoists, pumps, drills, etc., and employs about 23 men. Work has been in progress for nearly two years.

RICHARDSON HILL—This old working, at Eldorado, Madoc Township, Hastings Co., is being pumped out by S. P. Barnum, *et a.*, of Madoc, who intend to prospect for another auriferous pocket, such as have been found. The hill is a mass of quartz stringers carrying more or less gold values, but the richest parts are at the contact with a dyke of diorite which crosses the hill.

O'HARA PROPERTY.—Located near Malone, Marmora Township, Hastings Co. Several prospect workings have shown a large quartz vein heavily charged with iron pyrites and mispickel and carrying more or less paying values of gold.

At present under option to Glass and Groesbeck, mining brokers, Majestic Building, Detroit, who propose to develop further.

CORUNDUM—Deposits of this important mineral are found scattered over the counties of Peterboro', North Hastings, South Renfrew, North Frontenac, being found in a matrix of pegmatite, free from quartz and in nepheline syenite.

The corundiferous areas have been explored and mapped out during the last two years by Professor W. G. Muller, of Kingston School of Mines, under commission from the Ontario Government. (See Bureau of Mines Report, 1898.)

It has been satisfactorily proved by practical mill tests that the corundum can be successfully concentrated from the matrix of felspar, mica, magnetite, a product analyzing 99.60 Al_2O_3 being attained. The concentrated product has been made into wheels at several emery wheel manufactories and pronounced satisfactory as to abrasive quality. (See Bureau of Mines Report, 1899.)

The Canada Corundum Co. of Toronto (John Shenstone, B. A. C. Craig, *et al*) has purchased several deposits from private owners and obtained concessions from the Ontario Government.

They are now erecting a concentrating plant at James' Mill, York branch of Madawaska River, near Cumbermere P.O., to be run by water power adjacent.

GRAPHITE.—This important lubricating mineral is known to exist in many places in Eastern Ontario. Only one deposit in Brougham Township, Lanark Co., is being worked, the product shipped after being subjected to a washing process *via* Calabogie.

This offers inducements for investors, as concentrating machinery for treating low grade graphite is now on the market.

ONTARIO GOVERNMENT ASSAY OFFICE.—This office, located in Belleville, was started July, 1898, as an experiment on the part of the Bureau of Mines to aid prospectors by giving an opportunity to secure reliable returns on samples for assay at a nominal fee.

The office has a well equipped assay and analytical laboratory, which has met with some success, since during the last year 1680 determinations were made, each being in duplicate, and 370 samples for qualitative examination or identification were reported on.

The office is also prepared to give reliable information regarding developments in Eastern Ontario.

Eastern Ontario is a producer of gold, arsenic, mica, graphite, iron ore.

The district still offers inducements to capital combined with technical skill and experience, although most of the deposits known to be valuable are held in fee simple by interested parties for speculative purposes.

The North Star Mining Company.

INTERIM DIVIDEND OF 3 PER CENT.

Your directors beg to submit a statement of the company's business from the date of incorporation to the close of the financial year, the 31st May, 1900, being a period of eleven (11) months.

The development of the company's property has proceeded with most satisfactory results during the above mentioned period, establishing that on the 1st of April, 1900, there were blocked out and ready for shipment, ore to the value of $1,923,390.00. The value of these ore bodies has been ascertained by elaborate system of development, enabling careful and exact surveys to be made and values obtaided by many hundreds of assays.

The total values mentioned above does not include several other ore bodies known to exist ; for the reason that the contents not yet having been determined, your directors consider it advisable not to estimate them among the ascertained ore reserves.

Shipments of ore commenced on the completion of the branch line of railway, and the aerial tramway on 18th February, 1900 ; and to date 4,562 tons have been shipped, yielding a sum of $184,132.92.

The Canadian Pacific Railway has built a branch of their track from Cranbrooke to Kimberly. Towards the expense of this work your company has deposited the sum of $50,000.00, which is being repaid your company by rebate of thirty per cent. on freight, in and out, from the mine.

Your company has also constructed from the mine to the track of the C. P. Ry., an aerial tramway of a capacity of 100 tons per day ; and it is now in satisfactory operation. There are adequate ore bins at both ends.

Your directors, having declared and paid an interim dividend for the quarter ending 31st of May, at the rate of three per cent. quarterly, respectfully request your confirmation of the same.

Successful Gold Mining in Nova Scotia.

BROOKFIELD MINING COMPANY.

Among our illustrations this month we reproduce some recent photographs of the chlorination and other plant installed and in successful operation at the property of the Brookfield Mining Company at North Brookfield, Queen's County, Nova Scotia. Since this property was acquired by the present owners (a period of little over five years) there has been extracted about 45,500 tons, which has yielded, up to 15th May, 1900, about $381,000. The returns officially reported are as follows :—

1895....	2,975	ozs.	11	dwt.	15	grs.	from 4,242	tons rock milled.
1896....	4,667	"	10	"	15	"	" 5,351	" "
1897....	3,906	"	18	"	00	"	" 9,712	" "
1898....	2,659	"	00	"	00	"	" 8,020	" "
1899....	3,125	"	06	"	00	"	" 9,568	" "

Generally the method of treating the ore is by stamping the ore wet, passing the pulp over electro silver plated copper plates and then saving the sulphurets by means of the Improved Triumph Concentrators. The resulting concentrates are roasted in single hearth reverbatory furnaces, and then subjected to barrel chlorination by the Thies process—a process without patents, which is used with many adaptations by a large number of successful mines in the mining regions of the United States and other parts of the world.

The mill, with power and capacity for 40 stamps, at present fitted with 20, is placed directly over the working shaft. The shaft is perpendicular for 100 feet and then dips south to the depth of 400 feet at an angle of 23 , cutting the pay chute on the fissure vein which has given to Brookfield its yield of gold. The shaft also dips north, cutting a large main lead at about the same angle, thus enabling the products of both leads to be hoisted to one deck on the top of the mill. The ore is hoisted to the iron-clad deck by a double cylinder steam hoisting engine placed on the ground floor of the mill, the whole arrangement being such that the engine-man hoists and dumps the self-acting skip of one ton capacity without assistance from the deck-man. The ore is shovelled from the deck into a 10 x 15 Dodge rock breaker placed below the level of the deck, whence it is fed through chutes into any desired ore bin. A waste rock car runs beneath the deck to take waste over a tramway elevated 50 feet high. In fact, although this mill is in a low swampy place the most ample elevation has been given, by means of a massive stone foundation, for the concentrators below the stamps and for the deposit for years of both waste rock and tailings. On the lower floor are two sixty-horse power boilers, the main engine, the hoisting engine, 5 drill air compressor, 20 stamps with 14 foot silver plates and a large amalgamating room fitted up with hot and cold water, panning tubs, iron sheathed table to handle amalgam set retort, smelting furnace, and clean-up barrel.

The whole building, including the large concentrator room, is heated with the exhaust steam and is lighted by two 15 K.W. dynamos, whicl likewise transmit power for the chlorination and furnaces houses. The stamps are 900 pounds stamps run on a 5 to 6 inch drop, 92 to the minute ; 30 mesh wire screen is used. The mortars are narrow, single discharge, the latter being about 8 inches. The concentration is done on eight Improved Triumph Concentrators 4 x 12 feet with smooth rubber belts. (This machine was patented by Mr. W. A. Sanders, late manager of the Equitable Mining Co., at Caribou Gold Mines, Nova Scotia, and by him sold to the Joshua Hendy Machine Co. of San Francisco.) They are set at an inclination of 2½ inches in 12 feet and receive 230 shakes per minute. The load is distributed over the endless rubber belt which travels about four feet per minute, at a depth of about 5-16 of an inch and of about the consistency of paint. Great care is necessary to keep even speed and not to allow pulp to become too thick or too thin. These two points, added to the absolute necessity for cleanliness, are the three most important points in running the machines, and, it may be added, most difficult to obtain. From the concentrating room the sulphurets are hauled on the tramways by electric power to the furnace house. Here there are three single hearth reverberatory furnaces each 8 x 70 feet, with a capacity of two tons each per twenty-four hours. Each furnace is worked by two men to a shift of twelve hours. These concentrates contain about 28 per cent. of sulphur and 16 per cent. of arsenic, practically all of which is eliminated in roasting. The ore, when cooked, is run on to a brick cooling floor, whence, when cooled, it is elevated by chain bucket elevator to the top of a 5 storey frame building containing four chlorination barrels, 16 filtering tanks, four storage tanks, 16 precipitating tanks, two settling tanks, two acid tanks and one tank in which to make ferrous sulphate. The ore is discharged from the elevators into cars containing one ton each, wheeled along over the desired barrel and dumped through a hopper into the steel barrel 60 inches long, 42 inches in diameter and lined with lead 12 pounds to the square foot. The entire charge consists of 125 gallons water, 15 lbs. chlorine of lime, then the ore, and last 30 lbs. of sulphuric acid 66° Beaume. The barrel is at once hermetically closed and revolved at twenty revolutions per minute for five hours. The barrel is then discharged through a lead-lined half-circle in the floor to a filter tank on the floor below. There are four of these lead-lined filter tanks to each barrel, each being 6 x 8 feet by 18 inches deep in front and 17 inches back. The bottoms are covered by specially made mineral tiles 8 x 12 inches, perforated, and having 1½ inch gutters underneath. On top of these is a rack 1¼ inch slats 4 inches high and 6 inches apart. Three sizes of quartz, from ½ inch to ordinary gravel, are placed in the rack for the filter. Before emptying the barrel, sufficient clean water is let into the filter to cover the gravel. This acts as a cushion to receive the pulp. Then the barrel is dumped, the contents striking on a wooden float to prevent disarranging the filter bed The pulp is then washed three times with clear water, tests being made with ferrous sulphate to determine when the chloride of gold is all out of the pulp. The resulting solution is conveyed through lead pipes to the stock tanks on the floor below, and there retained until it is desired to precipitate the gold. It may be here remarked that all the tanks in this building are lead-lined, except the 16 precipitating tanks, which are made of Florida cypress and coated several times with an acid-proof paint. When it is desired to precipitate, the solution is drawn down to the tanks, which are eight feet in diameter and three feet high. Each tank is provided with three outlets, one 18 inches from the bottom, and another 1 inch, and the third in the bottom. About eight or ten buckets of the ferrous sulphate is a lded to each tank of liquor and thoroughly stirred, then the whole is allowed to settle for three or four days, the gold being precipitated in the form of a brown powder on the bottom of the tank. The solution is drawn off through the two upper outlets, opening one after the other to prevent stirring up.

The remainder is swept out through the bottom hole and placed in a small settling tank 2 x 2 x 4 feet and allowed to stand 24 hours. The supernatant liquor is then carefully syphoned off and the precipitate filtered on paper, dried, mixed with one half its weight of bicarbonate of soda and glass borax and then smelted ; the resulting buck averaging .980 fine. The solution drawn from the precipitating tanks in every case is run through a sawdust filter, which every few months is subjected to chlorination to get any gold that may be in it.

So far as the Brookfield ores go chlorination is a success, and there is every reason to believe that many, if not most, Nova Scotia ores could be more profitably worked if concentrators were introduced with subsequent chlorination in view. After the character of an ore is definitely determined, and the amount of chemicals necessary to use per ton of ore is settled, the process is a very simple one, which is a special advantage to a country like Nova Scotia, where there are no men in the line of chlorination who combine theory and practice.

Another successful company operating on a comparatively small scale is the Blue Nose Gold Mining Company at Sherbrooke. The returns from this Company's mill last year as officially reported to the Mines Department were :—

Month.	Quartz Crushed. Tons. Cwts.	Yield of Gold. Ozs. Dwts. Grs.
January	1200 . .	472 12 . . .
February	No clear-up.	
March	1101 . .	425 . . . . .
April	1250 . . .	440 . . . . .
May	1173 . . .	418 5 . .
June	1050 .	336 . . . .
July	1003 . . .	330 8 . . .
August	1080 . . .	331 . . . . .
September	1100 . . .	327 6 . .
October	1200 . . .	360 . . . . .
November	1275 . .	407 10 .
December	1156 . . .	368 . . . . .
Total	12,588	4,218 1 . .

Returns from Other Mines.

(*Incomplete.*)

Production for Quarter ended March 31, 1900.

Name of Company or Operator.	District.	Tons crushed.	Yield of Gold. Ozs.	Dwts.	Grs.	Average per ton. Ozs.	Dwts.	Grs.
Tributers	Oldham	189	203	15	.	1	1	13
Blue Nose Gold Mining Co.	Sherbrooke	3618	1192	11	. .	. .	6	13
Crow's Nest Gold Mining Co.	Ditto	360	22	. .	. .	. .	1	5
Guffy-Jennings Gold Mining Co.	Caribou	1138	260	13	. .	. .	4	15
Andrew McGregor	Caribou, Moose River	557	57	5	. .	. .	1	21
Touquoy Gold Mining Co.	Di to ditto	388	81	3	22	.	4	4
Modstock Mining Co.	Stormont	550	212	. .	.	. .	7	17
Hurricane Pt. Gold Mining Co.	Ditto	644	374	5	. .	.	11	15
Richardson Gold Mining Co.	Ditto	4486	903	. .	.	. .	4	2
South Mining Co.	Ditto	300	126	.	. .	. .	8	9
Peter Cameron and Co.	Ditto	23	20	10	10	. .	17	19
Imperial Gold Mining Co.	Kemptville	30	11	10	.	.	7	16
J. B. Neily	North Brookfield	35	14	14	. .	.	8	9
J. W. Lowe	Wine Harbour	690	428	8	. .	. .	12	10
Guysborough Gold Mining Co.	Ditto ditto	70	63	. .	.	. .	18	. .
M. L. Pratt	Ditto ditto	148	24	17	.	. .	3	9
J. H. Townsend	Laurencetown	9	9	18	. .	1	2	0
Tributers	Montagu	78	56	8	. .	.	14	10
F. W. Hanwright	Lake Catcha	127	92	. .	. .	. .	14	11
E. H. Oland	Harrigan Cove	40	18	1	2	.	9	.
Total		13,480	4169	17	10	. .	. .	.

Mica Mining in Quebec.

By Mr. J. Obalski, Inspector of Mines.

In 1899 the amber mica industry was very flourishing, owing chiefly to the steady demand and the good price paid for small mica of 1 by 3, which enabled small operators to work without loss and to realize without delay upon their outputs. The work done by the larger companies has been rather less than usual ; but the great number of small workings has largely made up the difference, and the production this year has been above that of last year. As usual, I visited the region in detail, but I shall only mention the new points or those presenting some new feature of special interest.

There were 35 companies or private individuals producing this year, besides some 20 others prospecting without producing. During the year, 13 mining licenses and 124 prospecting licenses were granted for mica alone.

According to the reports received from the companies, the output of amber mica during the year was as follows, and an equal quantity was shipped to the United States or used in Canada. This industry gave employment to 500 hands, including those engaged in sorting and transportation, for periods of from 3 to 10 months, without taking into account many small prospects lasting for a few days :

1 in. x 3 in.	284,036 pounds,	worth	$18,926
2 in. x 3 in.	136,054 "		19,146
2 in. x 4 in.	179,113 "		32,721
3 in. x 5 in.	37,284 "		16,720
4 in. x 6 in.	17,937 "		10,908
5 in. x 8 in. and over	7,767 "		9,642
Total { In lbs.	662,211		$108,063
Total { In tons	311		
Mica not prepared	240 tons,	worth	28,800
General total	571 "		$136,863

These figures seem to me to well represent the production and also the shipments.

According to the Ottawa trade and navigation returns, the export of mica for the twelve months ending on the 30th June, 1899, amounted to 1,186,185 lbs., worth $148,239, as compared with 501,335 lbs., worth $69,572 for the same period of 1898. According to the official reports, the United States in 1898 produced a total of 120 520 lbs. of mica in sheets, worth $103,534, and imported thereof to the value of $150,082.

Mining in Kingston District.

Mica mining is pursued with considerable activity in the Townships of Loughborough, Bedford, Hinchinbrooke and Storrington. It is stated confidently that much thieving goes on without any effort to detect it on the part of buyers who consider it none of their business. The sufferers are unable to protect themselves without police aid. No representation appears to have been made to the Government by the sufferers, therefore, it is unlikely the Government will take the initiative. Thus will grow up a formidable amount of crime while mica mining is profitable. Many of the pits are in remote nooks and glens little known to any but the culprits.

Iron mining is going on actively at the Robertsville Mine under F. W. Schwendi-

man. The Diamond Boring Drill of the Buffalo and Niagara Investment Company is in operation on lot 3, 3rd con. of Bedford.

The Graphite Mine of Messrs. Brophy and others, is shipping about three carloads a week from Calabogie Station, Kingston and Pembroke Railway.

The Hamilton Iron and Steel Company commenced operations at three points along the line of the K. and P. Railway, but have quit work. Their leases are taken up by Thomas Barnes at Robertsville, and will be taken up by other parties at Calabogie and in Bedford Township.

A promising discovery of iron ore has been made on the Mississippi River in Palmerston Township, on lots Nos. 7 and 8, 4th concession, also on lot No. 18 in the 14th concession, Portland Township.

Corundum mining in Campbell's Mine in Hinchinbrooke Township has engaged the attention of a party from Scranton, Penna. The ore is said to be of considerable value. The work so far does not amount to much.

J. B.

Lake of the Woods.

THE WENDIGO.

215 tons of the ore has just been milled at the Rat Portage Reduction Works. The yield in freemilling gold was six dollars per ton, and the concentrates were estimated to contain $7.25 per ton of ore. The values in the tailings have not been reported, any further than that they contained a considerable amount of sulphides. The ore has about 1.60 per cent. of copper. About 40 per cent. of the ore is sulphides, chiefly iron and copper pyrites. Development work is being pushed.

TRIGGS.

Over 300 feet of development work has been done already, and it is being increased at the rate of about four feet a day in shafts and drifts. The second shaft will soon break through into the first level beneath, thus affording a considerable amount of ventilation.

SULTANA.

A rich vein about five feet in width and carrying much galena has been cut in the second level; it assays high in gold.

There is prospecting and surveying of locations going on all the time, and quite recently a rich find was reported from Sturgeon Lake country.

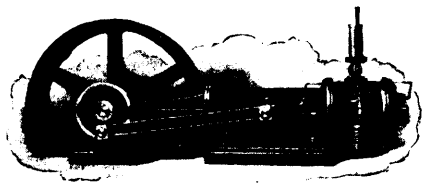
The season is unprecedentedly dry, and the water is scarce in the bush.

J. M.

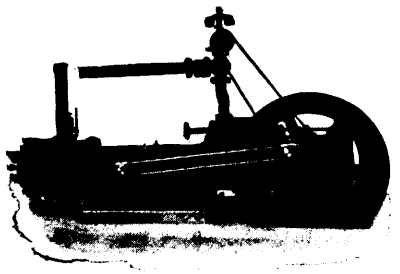
Rat Portage, June 18th, 1900.

..AIR COMPRESSORS..

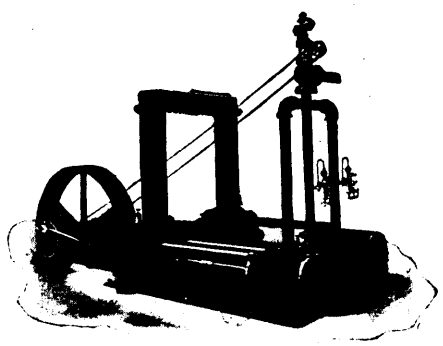
Cross-Compound Corliss Compressor.



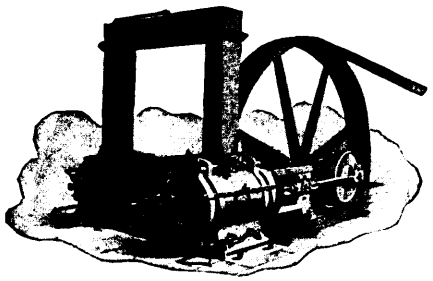
Straight-Line Belt-Driven Compressor.



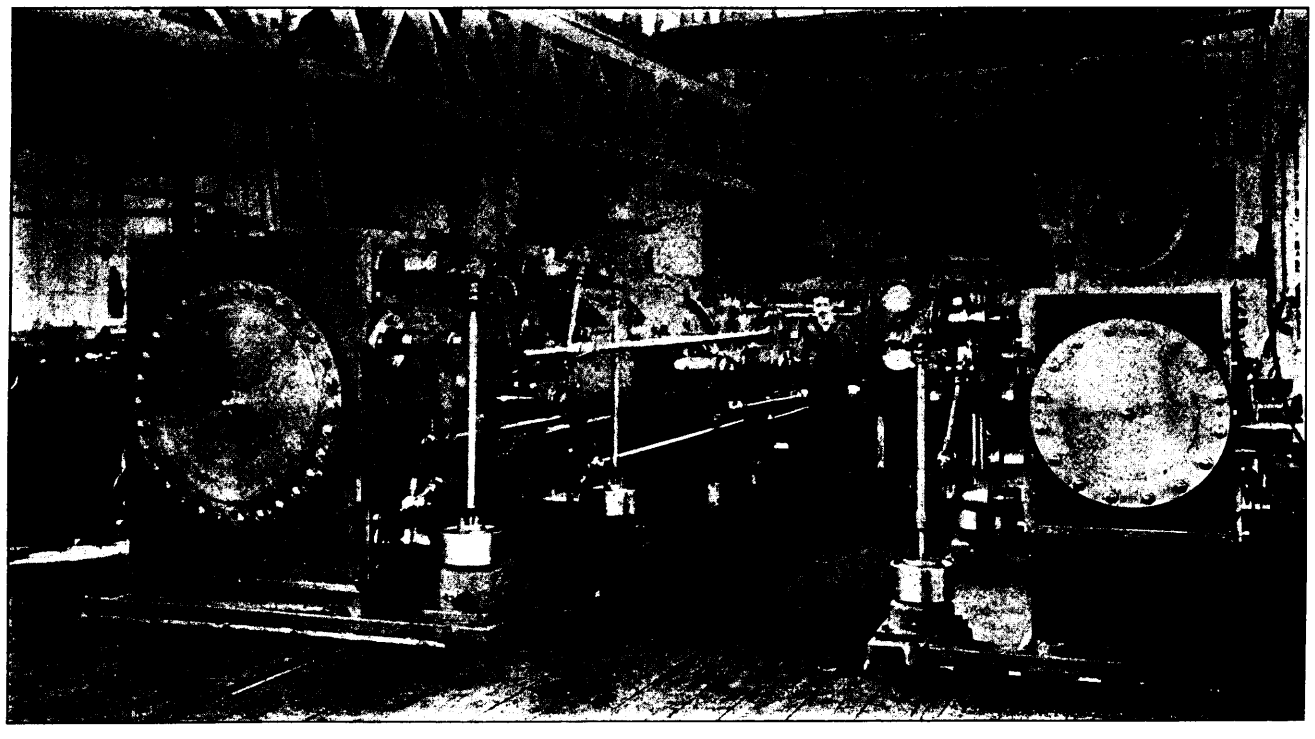
Straight-Line Steam-Driven Compressor.



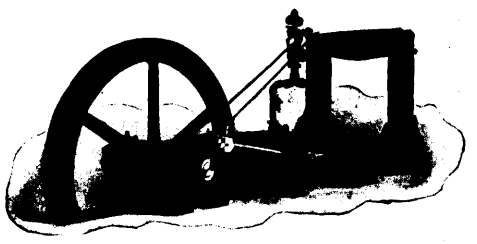
Class B D Compressor
(Air Cylinder next to Frame)



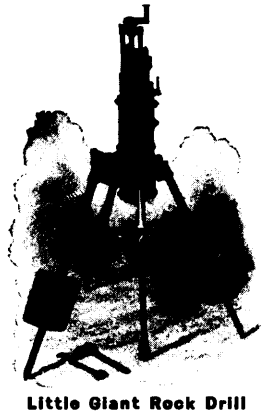
Compound Belt-Driven Compressor.



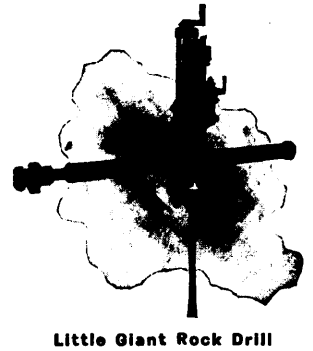
CROSS-COMPOUND CORLISS COMPRESSOR.—Two machines now being installed, one at Centre Star Mine, the other at Le Roi Mine, Rossland.



Duplex (Meyer-Valve) Compressor.



Little Giant Rock Drill
with Tripod.



Little Giant Rock Drill
with Stoping Bar

CANADIAN RAND DRILL CO. Montreal. Sherbrooke.

SCHOOL OF MINING,

KINGSTON, ONTARIO.

AFFILIATED TO QUEEN'S UNIVERSITY.

The Following Courses are offered

1—Three Years' Course for a Diploma in

(A) Mining Engineering.
(B) Analytical Chemistry and Assaying.

2—Four Years' Course for a Degree B.Sc. in

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Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

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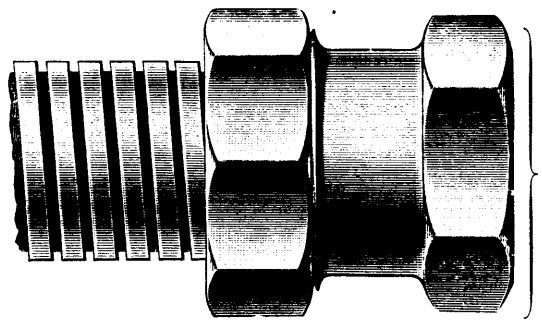

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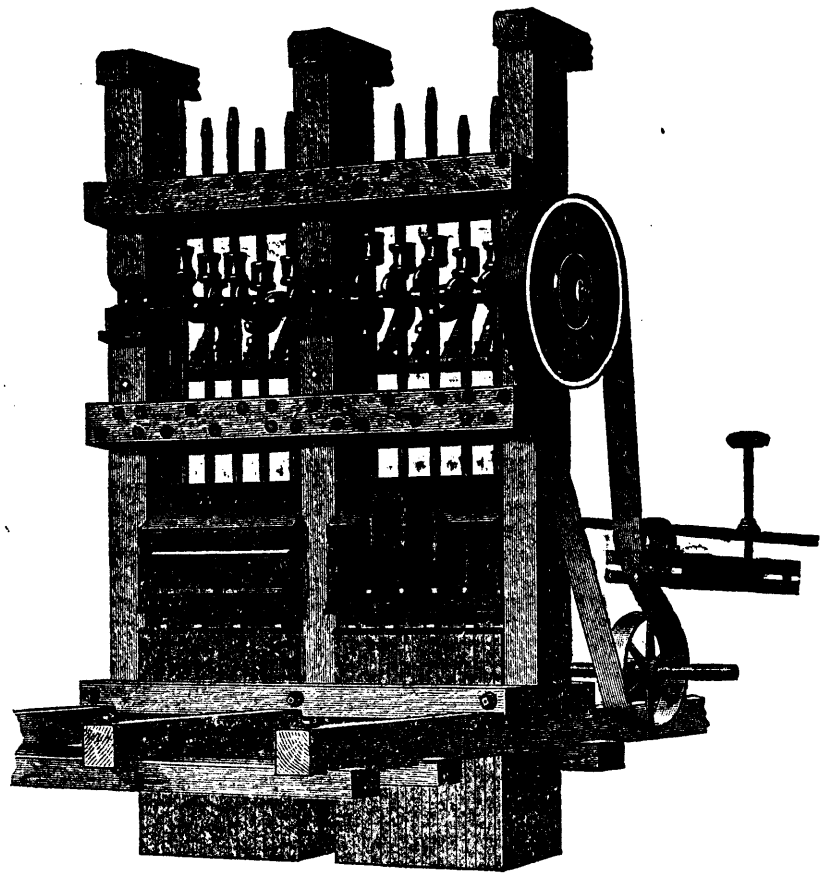

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