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CIRCULATION.

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CONTENTS.

A DOMINION EXPLOSIVES ACT.

The urgent need of stringent Government control of the manufacture of explosives was never more apparent. Although the whole matter has been exhaustively investigated by the Mines Branch of the Department of Mines, Ottawa, and although a bill was drafted more than a year ago, yet no further action has been taken. Dominion and Provincial officials are of one mind as to the pressing necessity of immediately enacting suitable laws, yet, for some inexplicable reason, nothing is being done.

Let us glance for a moment over the fatalities that have occurred within the last 18 months. On April 27th, 1911, in an explosion in the drying house of the Dominion Explosives Company at Sand Point, Ontario, four lives were lost. On September 24th, of the same year, in a packing house of the Canadian Explosives Company, at Beloeil, Quebec, one man was killed and four injured. Three of the injured died a short time after the explosion. Four more lives were lost, on October 19th, in a explosion in the mining house of Curtis & Harvey, Limited, at Rigaud, Quebec. Three men were killed and three injured on December 19th, 1911, in the gelignite mixing house of the Canadian Explosives Company, Limited, near Nanaimo, British Columbia.

This gives the shocking total of 15 lives lost and four men injured in the manufacture of explosives in Canada in 1911, surely too large a toll to be easily explained away.

During the current year a very serious accident occurred at the factory of the Energite Explosives Company at Haileybury, Ontario, which resulted in the death of six persons, and the injury of three.

Thus within 18 months there has been a total loss of life of 21 persons with the serious injury of seven others.

These casualties are directly attributable to lack of proper control of the manufacture of explosives. But the matter does not end here. The same causes that bring about these accidents are responsible for many other fatalities and minor accidents. The users of inferior explosives are in constant danger. While it is impossible to determine and unfair to guess how many mining and railway construction fatalities may be set down to poor explosives, yet no one at all acquainted with Canadian conditions can deny that rigid inspection and adequate legislation would materially reduce the number of accidents.

In addition to recorded accidents in the metalliferous mines of Canada, there are numerous unrecorded casualties in railway construction and other public works. Many of these arise through ignorant handling; but

even these could be minimized if our explosives were all they should be. In other parts of the British Empire where manufacturers are amenable to law and where conditions of manufacture are standardized, accidents in mines from explosions are relatively rare. In Canada the explosives' accidents account often for 50 per cent. of the total mining fatalities. This is certainly not to our credit.

The Dominion Government in 1910 secured the services of Captain Arthur Desborough, H.M. Inspector of Explosives, to make a thorough investigation of the explosives industry throughout Canada. On his exhaustive report was based the bill, referred to above, which was submitted to the House of Commons during the session 1910-11. It has not yet become law. Without question the passage of this bill should be the first duty of the present Government.

THE BELLEVUE EXPLOSION.

Our readers will remember that in a letter published in these columns last February, Mr. Robert Coulthard took exceedingly strong exception to Mr. J. G. S. Hudson's diagnosis of the Bellevue explosion and to certain of his statements of fact.

An article published in "Coal Age," Octoer 5, reprints in part the conclusions of Messrs. John T. Stirling and John Cadman. Microscopic examination of the roof rock from the Bellevue mine showed it to be siliceous with a bituminous cement. It has also been demonstrated that sparks are often generated by falls of rock from the roof. There is little need of pointing out the possibilities of a fall of rock in the presence of an explosive admixture of gas and air. In a general way this confirms Mr. Hudson's report.

THE PORCUPINE STRIKE.

The latest information before going to press concerning the labour troubles in Porcupine is encouraging. The struggle is centering round the Dome and the Hollinger. At both mines large numbers of men are at work. Not once during the strike has the Dome production fallen below 200 tons per day. This will soon be increased. It is expected, also, that the Hollinger output will presently become normal. Several smaller mines such as the McEnaney, Plenaurum, Vipond, and Jupiter are closed completely, and their operators are playing the part of interested spectators. It is patent that the men will not win.

Many newspaper stories about shooting affrays have been circulated. It is most unfortunate that the strikes have given actual cause for these reports. However, in the main, the strike has been conducted in an orderly manner.

For some time to come Porcupine will feel the effect of the present trouble, inasmuch as many of the best miners have left the camp not to return. This and the loss of time and wages is too high a price to pay for an easily avoidable holiday. As a matter of fact, the strike was totally unnecessary. Unquestionably the men, had they calmly discussed matters with the operators, without attempting to quit work, would have put themselves in a very much better light. It seems evident that the miners are under the domination of irresponsible and mischievous demagogues. Not otherwise can we account for their lack of wisdom.

We are convinced that men should be punished for precipitately striking before either formulating or discussing their demands. It is high time our labour legislation were given more positive application. A preventive, not a cure, is needed.

THE HOMESTAKE.

Few more interesting plants exist than that of the famous Homestake mine, a mine that has yielded nearly thirty millions of dollars to its fortunate owners.

An exhaustive description of the milling equipment and practice has just appeared in the latest bulletin of the Institution of Mining and Metallurgy. The paper is far too lengthy to summarize here, but there are a few salient points worthy of special mention.

Thirty years of steady productiveness "with an ore "uniformly of low grade and in a region of high wages "and high freight rates" is surely a proud record. Let us see how it is done.

The Homestake ore contains about $3.50 in gold. 72 per cent. of this gold is recovered as amalgam; 22 per cent. by cyanide; a total of 94 per cent. The crushings amount to 125,000 tons per month from 1,000 stamps. Much surface ore is won cheaply by means of glory holes and is profitably milled when it contains as small a quantity of gold per ton as $1.50. But the general average is as mentioned above.

The administration checks every possible source of waste, knows from hour to hour what is happening at the mine and mill, and carefully tabulates and records every significant item. For instance, the loss of mercury is regularly watched and allocated. It is known just how much is lost, where and how the loss occurs, and what each class of ore requires. In a similarly complee manner the operation of each successive process is exactly controlled and the cost segregated. It is almost impossible for even trifling losses to occur without the knowledge of the management. Stamp-milling costs between 27 and 35 cents per ton of ore, the lower figure being due to the use of electric power. Cyanide treatment costs not more than 21 cents per ton treated. Thus the total mill costs are from 48 to 56 cents per ton. Ore breaking costs about 6 cents per ton of ore. With exceptionally low mining costs it is evident that a handsome profit is made on $3.50 ore.

A few mill details may be mentioned here. The falling weight of each stamp is 900 pounds. The shoes are of special chilled cast iron, the dies of hard cast iron. Nearly all the cast iron parts are made at the company's foundry. The screens are needle-slot, corresponding to from 30- to 35-mesh wire. Inside amalgamation is practised, and there are also outside plates 12 feet long by 4½ feet wide. The mercury is fed hourly

at the rate of 0.13 oz. per ton of ore crushed. No violent methods, such as steaming or scraping with steel, are used on the plates. The amalgam is removed by brushing with small whisks or with stiff straw brooms. Every ten days the weight of amalgam obtained at each mill is reported and verified. Each retort holds 7,000 oz. of amalgam. The retorting is done over pine fires, and always commences at 3 p.m. Early next morning the retorts are opened and the bullion removed. In the four melting furnaces $130,000 in gold can be melted at one time.

EDITORIAL NOTES.

The American Smelting and Refining Company has taken several options in the Sudbury region. The ingestigation of the nickel deposits has been going on for several months under the direction of Mr. Kirby Thomas.

The versatility of the mining engineer was never given better illustration than during the present strike in Porcupine. At least one prominent mine manager took the place of the cook. Another became hoistman. Still another combined the duties of deckhand and machinist. It needs no flight of fancy to imagine what blisters came on unaccustomed hands.

Incorrect newspaper items have done injustice to the persons to whom belongs the credit of successfully developing the Seneca-Superior mine in Cobalt. Briefly, the person who controlled and defined the policy of the syndicate was Mr. W. E. Segsworth, of Toronto. Assisted by Mr. R. H. Lyman, Mr. Segsworth has brought the mine to its present condition.

Many shareholders will welcome the news that the royalties exacted by the Ontario Government from certain Cobalt mines are to be abolished or reduced. The Chambers-Ferland royalty (10 per cent. net) is to be wiped out entirely until such time as the company declares more than 10 per cent. per year dividend. With the Hargraves the same conditions obtain. The 25 per cent. gross royalty now payable by the O'Brien is at present the subject of negotiation.

It seems probable that every country in the world will have adopted a nickel coinage before steps are taken in this direction in Canada, the country that is the chief producer of this metal. The desirability of introducing a nickel currency in Australia, in place of copper, is now being considered, and the press of the Commonwealth is unanimously in favour of the change, while the Prime Minister has also expressed himself as favourable. As we have already suggested, Canada might make amends for dilatoriness by a show of originality in utilizing "Monel" metal, which is an actual product of the country, for coinage purposes.

A proposal to organize an international engineering congress to assemble at San Francisco in 1915 is now under consideration, the intention being to extend invitations to the Canadian Mining Institute, the Mexican Institution of Mining and Metallurgy, the Australian Institute of Mining Engineers, and other mining societies to participate. Presumably it is designed that the congress shall be held in conjunction with the Panama-Pacific Exposition in that year. The selection of date is, however, unfortunate, as it is already arranged that the next meeting of the International Mining Congress shall take place in London in 1915. To this the mining societies of the world are in a sense pledged. It would scarcely seem advisable, therefore, that there should be two international meetings of the same character in the same year. Nor is the present proposal quite fair to the International Mining Congress.

THE RELATION OF TRANSPORTION TO MINING IN COBALT

Written for the Canadian Mining Journal by A. A. Cole.*

Cobalt has always been fortunately situated regarding transportation facilities, owing to the fact that the railway reached the camp before the silver field was opened up; indeed the discovery of this rich mineral district may be traced directly to the railway construction.

The early operators were, therefore, freed from one of the usual sources of worry in the development of a new camp, and after they had mined the ore their chief anxiety was to obtain a market for their product. At first this did not seem a difficult matter, and a quantity of ore was taken for treatment by a New Jersey smelter. The complex nature of the ore at once proved a stumbling block and for months no ore was treated, but finally a method of handling it was worked out, and shipments began. At this time none of the shipments remained in Canada for treatment, but all went to the United States. The rapidly increasing output of the mines and the richness of the ore, naturally attracted attention, and numbers entered this most inter-

*Mining Engineer T. & N. O. Ry.

esting metallurgical field. The result was that a number of Canadian smelters erected plants for the treatment of these ores. For a time the increase in ore production was greater than the increase in smelter capacity, but that time has passed, and the smelters are now looking for ore. At the present time most of the high grade ore is treated by these Canadian smelters, the balance going to the United States and to Europe.

In the early days the mining operator was dependent entirely on marketing his ore to the smelter, and it was simply a question of calculating the freight and smelter charges to find what ores would pay for shipment, and all below that point had to be held for a possible future treatment. The low grade ores were not seriously considered, but as time went on it was realized that these low grade ores were destined to play an important role in the life of Cobalt. As a consequence, mills sprang up rapidly, till now there are seventeen in the camp, and their operation has become a vital part of the industry. Through their operation thousands of tons of ore have become available for shipment, that previously could not be realized upon. During 1911 the low grade ore milled in Cobalt amounted to 382,000 tons, and from present appearances this amount is likely to be materially increased in 1912.

The accompanying schedule shows the freight rates that have been in force for the last two years. On looking over these freight rates, it will be found that, considering the value of the shipments, the rates on high grade ore are very reasonable, but on low grade material the rates are comparatively high, which is a necessary consequence of the long hauls to the smelters.

Freight Rates on Silver Ores from Cobalt.

From Cobalt to North Bay—	per 100 lbs.
Below $49.00 per ton	10 cents.
Above $49.00 per ton, billed to Canadian points	14 cents.
Above $49.00 per ton, billed to outside points	16 cents.

Silver Ore, Carloads, Minimum 30,000 lbs.

From North Bay to	Rate in cents per 100 lbs. A	B	C	D
Marmora, Ontario	18	20	27	34
Copper Cliff, Ontario	10	12	16	21
Orillia, Ontario	11	13	17	21
Thorold, Ontario	14	16	21	26
Toronto, Ontario	12	14	19	24
*Denver, Colorado, U.S.A.	40	46	54	62½

Application of Rates.

Group A.—Rates apply when valuation is under $50 per net ton.

Group B.—Rates apply when valuation is under $50 and under $100 net ton.

Group C.—Rates apply when valuation is under $100 and under $500 net ton.

Group D.—Rates apply when valuation is under $500 and over per net ton.

When shipments are made to Eastern United States points, a through rate is not quoted, but cars are billed to the frontier, to Buffalo, Black Rock, or Suspension Bridge, N.Y. From there new rates and ratings apply.

Silver Ore, Carloads, Minimum 40,000 lbs.

From North Bay to	Rate in cents per 100 lbs. A	B	C	D
Buffalo, Black Rock, or Suspension Bridge, N.Y., U. S. A.	12½	15	19½	24½

Application of Rates.

Group divisions A, B, C and D apply on same valuation as in previous table.

Silver Ore, Carloads, Minimum 50,000 lbs.

From Buffalo, Black Rock and Suspension Bridge, N.Y., to

	Rates in cents per 100 pounds. A	B	C	D
Bergen Junction, N.Y.	13	16	22	28
Carnegie, Pa.	10	11½	18	25½
Chrome, N.J.	13	16	22	28
Newark, N.J.	13	16	22	28
New York, N.Y.	13	16	22	28
Perth Amboy, N.J.	13	16	22	28

Group A.—Rates apply when valuation is under $100 per net ton.

Group B.—Rates apply when valuation is over $100 and does not exceed $800 per net ton.

Group C.—Rates apply when valuation is over $800 and does not exceed $2,000 per net ton.

Group D.—Rates apply when valuation is above $2,000 per net ton.

The lowest grade of Cobalt silver ore on which any of the smelters will bid must contain 60 ounces per ton, and this also approximately marks the low limit where ore can be shipped and still leave a slight profit above freight and treatment charges. With the introduction of milling nothing assaying that low has been shipped, because by jigging and hand picking, such material could be reduced possibly 50 per cent., yielding a high grade concentrate and leaving a product that could yield a further good profit by milling. This has been illustrated well in the last two years, for while the shipments in 1910 contained two cars of low grade to one high grade, this proportion was reversed in 1911. The decrease of the low grade shipments due to the introduction of milling does not have such a marked effect on the total shipments from the camp as might be expected, for this deficit is made up in part by the mills making the ore available for milling whose values lie below 60 ounces and above 12 ounces.

While it is true, and for the above reasons, that the shipments from Cobalt are on the decline as regards tonnage, the increase in value per ton has been such that the value of the total shipments shows a steady increase. From present indications the value of the total shipments from Cobalt for 1912 will show a material increase over 1911, which was up to that time the banner year.

A later development that is still further reducing the shipments from the district is a process introduced by the Nipissing Mining Company during 1911, for the treatment of high grade ores. This is a combination amalgamation and cyanide treatment, and the resultant product is silver bars 999 thousandths fine. This high grade mill has a daily capacity of five tons, so that the freight shipments will be reduced by this amount as the resultant silver is shipped out by express. A similar mill is now nearing completion for the Buffalo mine, which will mean the further reduction of freight shipments.

*The splitting point for values in the application of rates in the case of Denver is one dollar below that given above, and the minimum carload is 40,000 lbs.

THE FLOTATION PROCESS

As Applied to the Concentration of Copper Ore at the Kyloe Copper Mine, New South Wales

By J. W. Ashcroft.

The Kyloe Mine is situated near the township of Adaminaby, and is 32 miles from Cooma, the nearest railway station.

Geological and Mineralogical Features.—The orebody occurs as a lode in quartz felsite, which, at the lower levels, passes into aplitic granite. In the upper levels of the mine there is an occurrence of slate which also shows on the surface, but is not present in the deeper portions of the mine.

At the time when the present management took charge of the mine, the oxidized ore was practically exhausted. The ore, as now mined, consists of quartz with chalcopyrite and small amounts of bornite and iron pyrites. The composition of a typical sample of clean, rich, hand-picked ore is as follows:

	%
Cu.	21.2
Fe.	24.3
SiO_2.	28.9
S.	25.1
Bi.	trace
Au and Ag	trace
	99.5

In places the orebody is found in the form of small veins in a crushed felspathic filling. A clay seam, or gouge varying from one inch to over a foot wide, occurs in the ore-channel throughout the workings. This clay, and that derived from the kaolinizing of the felspathic portion of the granite filling, was the cause of a good deal of trouble in the flotation treatment. A remedy was subsequently found in the addition of a large proportion of clean quartzose ore.

The Original Process of Treatment.—In the mill, as originally erected, the ore, after hand-sorting at the shaft bins (where waste was eliminated, and some clean copper ore picked out for shipment), was passed through a rock-breaker and broken to 1½ in. gauge and delivered on to a picking-belt, where as much as possible of the clean, rich ore was bagged for shipment.

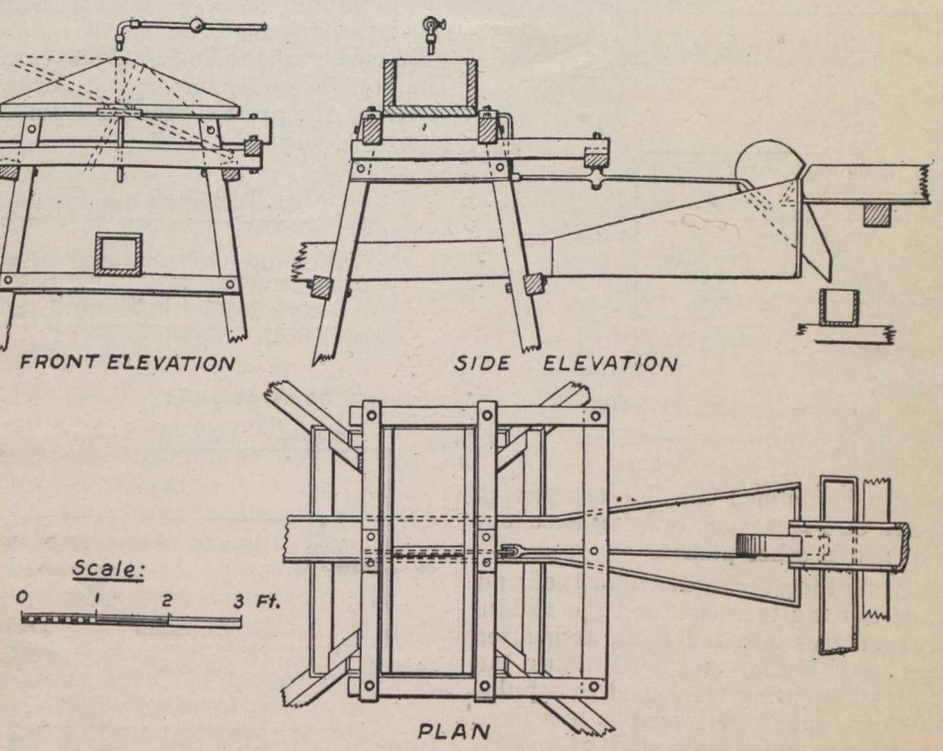


Fig. 1.—Flotation Tailings Sampler

The remainder then passed into the mill ore-bins assaying from 5% to 5½% of copper.

A typical analysis of the average ore treated is as follows:—

	%
Iron.	6.5
Copper.	4.7
Sulphur.	5.2
Lime	3.4
Insoluble	79.4
	99.2

From the mill-bin the ore was fed mechanically into an elevator, which discharged into a shaking screen. From this the oversize was fed, with water, into a set of Cornish rolls, and the undersize went to a May jig.

From the rolls the crushed ore fell into an elevator, and was once again fed into the shaking screen, together with the ore from the bins.

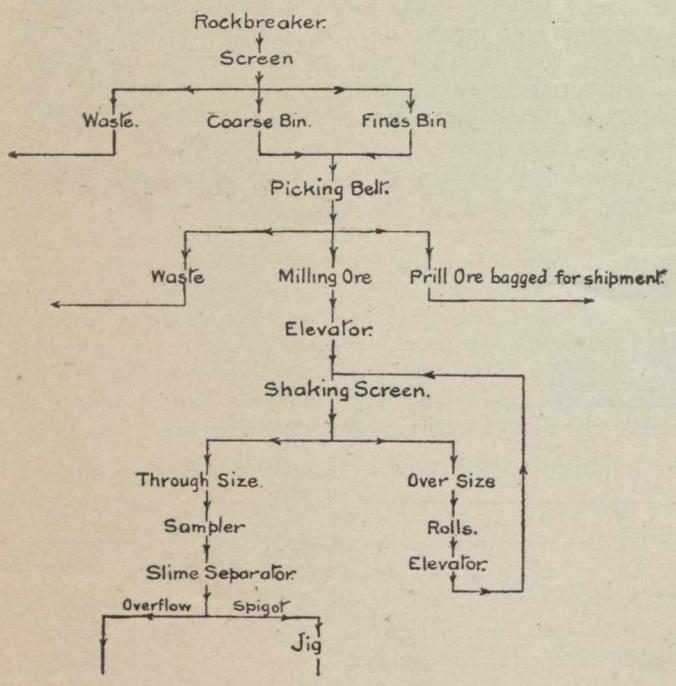
This arrangement is shown in the following flow-sheets, Nos. 1 and 2:—

An automatic sampler was placed in the launder leading to the jig, so that all material passing into the mill for treatment was correctly sampled.

No 1 Flow Sheet

From Rockbreaker to Jig

which is the same for all arrangements of the Mill.



While no originality is claimed for this sampler, a drawing of it is shown on Fig 1, as it is doing excellent work and may be of use in other plants.

The head product from the jig was dried, bagged and sold to a smelter, the tail ran to waste, and the middle products were reground wet in a ball mill, and, after classification, passed over Wilfley and card tables, the overflow from the classifier being thickened in a pulp-thickener, from which the spigot delivered on to a Frue vanner, and the overflow, which consisted of practically clear water, was run to waste.

An abundant supply of good soft water was obtained from the Eucumbene River, 1½ miles away. Subsequent experiments at other mines have shown that the characte rof the water has a noticeable effect on treatment by flotation.

This mill did good work over a period of 18 months, recovering 74% of the copper contained in the mill feed in the form of a concentrate carrying 19% to 20% of copper.

The concentrates were formerly smelted on the ground and the product shipped as a 50% copper matte, but owing to the high cost of firewood and fluxes, and an all-round increase in the rates paid for labour, it became more profitable to sell the concentrates to a smelter.

The cost of transport is extremely high, viz., £2 15s. 0d. per ton of concentrates from mine to the smelting works, and it is, therefore, essential to produce concentrates of as high a grade as possible. By lowering the grade of the concentrates, a higher extraction could have been obtained, but the extra cost of transport, and the lesser price paid by the smelter on the lower grade product, made it more profitable to ship one containing at least 20% of copper.

Experimental Flotation Treatment.—With a view of obtaining a better recovery and a higher grade concentrate, experiments were made with the Potter and the Minerals Separation process of flotation, and, the preliminary tests proving satisfactory, it was decided to erect a flotation plant; that of the Minerals Seperation was chosen, as it possessed advantages over the others as far as the treatment of Kyloe ore is concerned, in that it is more simple in operation on this particular ore.

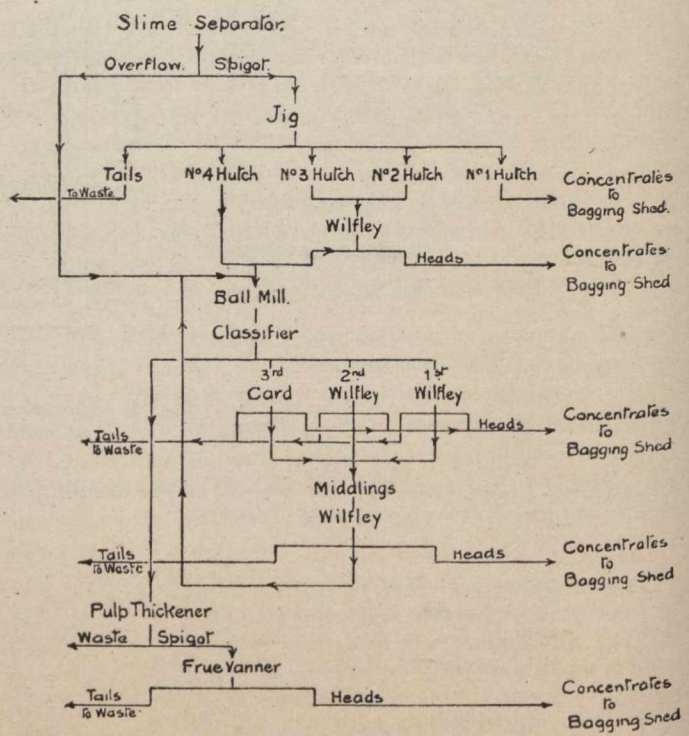
As the process was at that time untried on a working scale for copper ores, the old plant was left intact and a small annex added to the mill building to contain the flotation plant, and the lay-out so arranged that the whole of the work could be turned over alternatively to the original plant at any time; this proved to be a wise precaution, as radical alterations were necessary to the flotation process as first introduced before success was achieved.

Summary of the Different Processes of Treatment.—The flow-sheets accompanying this paper show the evolution of the present method from the original mill as already described.

No 2 Flow Sheet.

Shewing wet concentration lay-out

as adopted in the original Mill.



The flow-sheet, as far as the point of departure in treatment after the jig, has already been given on p. 4, and are common to all. Sheets Nos. 3 and 4 show:—

3. The first lay-out of the flotation plant;

4. The present arrangement of flotation plant as now in successful operation.

The Flotation Process as First Introduced.—This plant is divided into two sections, i.e., a grinding section and a flotation section.

The grinding was effected in two 8-ft. Forwood-Down pans; as originally erected these were made with a classifying discharge and were driven at 30 rev. per min.

The flotation machines is of the latest type used at Broken Hill on the zinc-lead seconds, with six stirring boxes, each 16 in. square, as shown in Fig 2.

The departure from the former method of concentration took place at the jig. The first hutch product was clean concentrate as before, the second and third hutch product was dressed on a No. 5 Wilfley also as before; the tailings from this Wilfley, together with the No. 4 hutch product and the jig tails, were sent to the grinding pans, and the overflow from classifier at the head of jig, together with the overflow from end of jig, passed through a pulp-thickener of the baffle-board type, the spigot from which discharged into the launder running to the flotation machine together with the discharge from the grinding pan. No. 3 flow-sheet on p. 7 shows the first lay-out of the flotation plant.

The pulp-thickener, which is an adaptation of a well-known type, calls for special attention, being of cheap and simple construction, and working admirably. The details of this apparatus are shown on Fig 3.

The flotation machine consists of a series of six square boxes fitted with revolving impellers, and each box connected to an outside chamber in which the separation of the mineral from the gangue takes place. From the bottom of the No. 1 flotation chamber the pulp is drawn by the action of the second impeller into No. 2 stirring box, and from No. 2 flotation chamber to the No. 3 box, and so on; the pulp from which the mineral has been separated being finally discharged from the bottom of the No. 6 flotation chamber.

The flow from the flotation chambers through the diagonal pipes into the stirring boxes is regulated by a valve on the top of each pipe, and the tailings discharged by a similar valve.

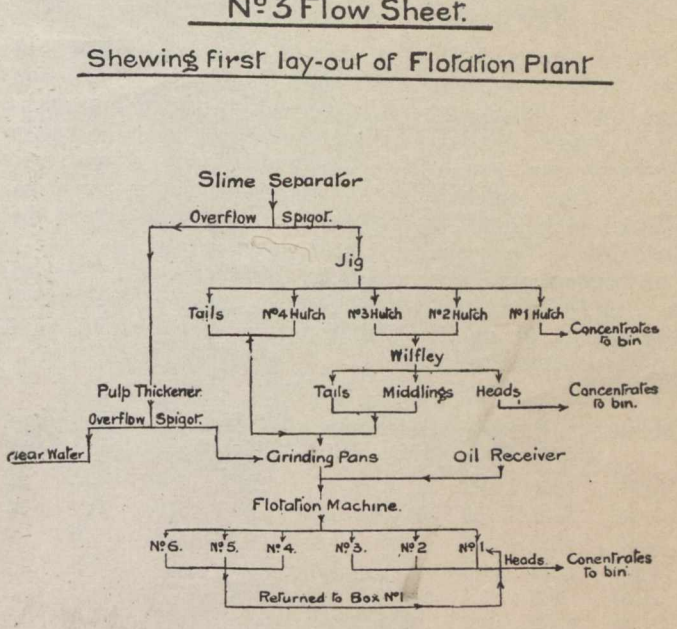
In this flotation process, as used by Kyloe, no acid is required, and the whole operation is conducted at ordinary temperature. The oil used is crude eucalyptus oil containing a large percentage of philandrene. This oil is manufactured in the district, and costs 8.5d. per lb., delivered at the mine. A great deal of information concerning the manufacture and properties of the various eucalyptus oils is found in a publication entitled "Eucalyptus and their Essential Oils," written by Messrs. Baker & Smith, and published by the authority of the State Government of New South Wales.

Defects in the Process as at First Applied.—A number of defects soon revealed themselves in both sections of the plant.

In the flotation machine the original slicing valves used were not sufficiently sensitive to regulate the flow properly, the correct adjustment of which through the different boxes has an important bearing on the successful working of the process, and the sliciny valves were therefore replaced by flap valves, operated by a rod with threaded end and hand wheel, which arrangement proved entirely satisfactory, and permitted very delicate adjustment.

As soon as work was started it was found that owing to the flotation chambers being all of the same width, while the amount of mineral to be floated became less in each one towards the tail end of the machine, the froth became very thin and poor after the first two boxes; to remedy this and give the froth a greater density and thickness, the flotation chambers were contracted on top by means of "crowding boards" which reduced their surface to widths varying from 11½ in. on No. 1 to 4½ in. on No. 5. No. 6 chamber was shortened by putting in a watertight bulkhead in addition to the crowding boards as in the other chambers; this narrowed the surface to 4 in. and shortened the distance through which the poor froth had to travel by one half, and gave less chance for the mineral to drop away from the froth into the tail before it was delivered into the discharge launder.

The machine now appeared to work fairly well, but the following samples, taken from the discharge lip of each of the flotation chambers, showed that the product from Nos. 4, 5 and 6 chambers were not sufficiently rich to be profitably shipped, so the concentrate launder was divided and arranged so that the products from Nos. 1, 2 and 3 chambers went to the concentrates bin, while those from Nos. 4, 5 and 6 were returned to No. 1 box in the machine and re-treated.



The samples referred to were as follows:—

		Copper. %	Silica. %
No. 1	Overflow.	27.2	21.2
" 2	"	24.1	41.5
" 3	"	22.3	59.6
" 4	"	15.6	61.0
" 5	"	14.3	60.7
" 6	"	9.4	68.7

After a short run it was found necessary to insert iron liners in the stirring boxes, as the wooden ones wore away very rapidly.

The opening into the boxes through which the pulp was drawn by the action of the impellers was also modified and made bell-mouthed, which improved the working considerably.

Inspection doors were also provided, so that the wear could be ascertained without dismantling the boxes.

As soon as the machine was again working normally, samples of the feed and tail were taken regularly, and the result of a week's run was as follows:—

	Feed. ½Cu.	Concentrates. %Cu.	Tailings. %Cu.	Recovery. %
1st day.....	5.1	20.1	2.0	67.5
2nd "	4.4	24.2	2.3	52.7
3rd "	4.0	19.1	1.2	73.8
4th "	4.7	19.0	2.2	60.1
5th "	4.0	23.6	1.5	66.7
6th "	4.1	23.5	2.2	49.8

This, although an improvement, was not yet satisfactory, so sizing tests of the various products were made to discover, if possible, in what direction to look for further improvement. The results were as follows:—

Mesh.	Feed.		Concentrates.		Tailings.	
	%Wt.	%Cu.	%Wt.	%Cu.	%Wt.	%Cu.
+20	1.52	2.20	0.18	17.50	1.85	2.0
+40	13.17	1.20	0.30	17.00	17.53	1.2
+60	15.10	0.80	0.31	18.50	20.77	0.7
+80	3.55	1.15	0.52	24.70	6.10	0.6
+100	22.50	1.40	7.42	53.60	21.40	0.6
+130	3.62	3.80	1.55	21.20	4.20	0.5
—130	40.40	5.45	89.60	23.75	28.00	1.2

These figures indicated that the material being fed into the flotation machine was not sufficiently uniform, and that it contained too large a quantity of comparatively coarse particles which could not be held up in the froth, and which in falling would carry down some of the finer particles that would otherwise have remained suspended. Improvement, therefore, lay in the direction of finer grinding and closer sizing.

Attention was now given to the crushing unit, and, as a preliminary, sizing tests were made of the infeed and discharge of the two grinding pans, which gave the following results:—

Mesh.	No. 1 Pan. Feed.		No. 1 Pan. Discharge.		No. 2 Pan. Feed.		No. 2 Pan. Discharge.	
	%Wt.	%Cu.	%Wt.	%Cu.	%Wt.	%Cu.	%Wt.	%Cu.
+16	16.4	2.3	—	—	10.0	1.4	—	—
+20	33.9	1.6	10.0	1.71	9.7	1.0	0.3	—
+40	13.0	1.3	17.1	1.2	10.5	1.2	11.0	1.4
+60	18.3	1.2	31.9	1.4	18.2	1.5	30.9	2.1
+130	6.9	2.1	16.9	3.2	17.0	3.0	23.4	4.1
+130	11.5	3.7	24.1	5.0	24.8	6.7	34.4	6.2

The No. 1 pan was taking the product of Nos. 2 and 3 hutch from the jig after being dressed on a Wilfley table. The discharge was 21 in. above the bottom of the pan.

The No. 2 pan was taking the overflow from the classifier at the head of the jig and a portion of the jig tail, the discharge was 22 in. above the bottom of the pan. The pans as arranged with the classifying feed would not take the whole of the jig tail.

As the foregoing sizing tests showed that an unduly large percentage of material, larger than 40-mesh, was contained in the ground pulp, the discharge of the pans was slightly raised and the product again sized, with the result that while the quantity of slime made was largely increased, the amount of product, larger than 40-mesh, was very little reduced.

The working of the machine was still unsatisfactory, the recoveries in the whole mill being only very little better than with the old system; but as all laboratory tests showed that a much better extraction was possible when the conditions were favourable, and as the trouble appeared to be chiefly mechanical, it was decided to rearrange the whole of the flotation plant so as to remedy the most apparent defects, which were:—

1st. The excessive amount of oversize in the feed to the stirring boxes.

2nd. The excessive dilution of the pulp.

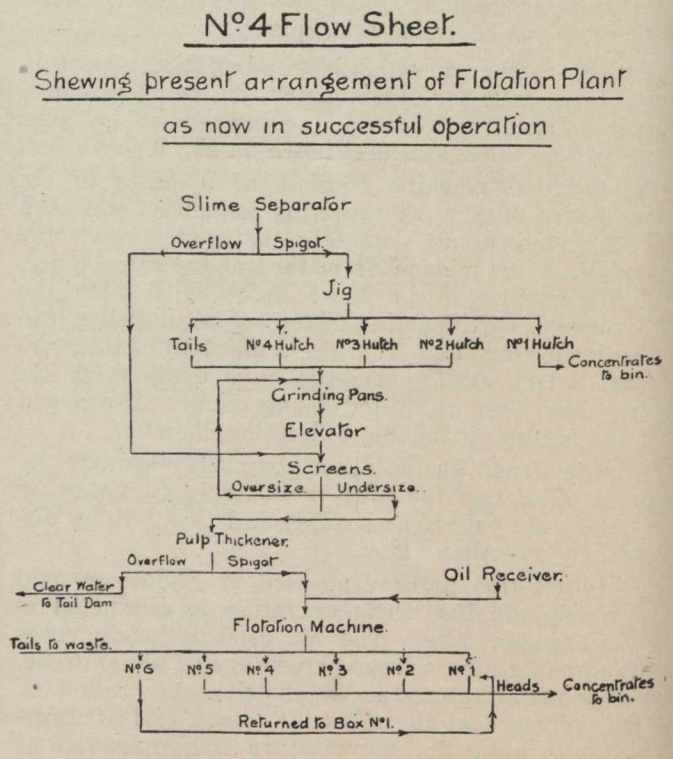
3rd. The irregularity of the overflow from the flotation chambers due to the irregularity of the feed, and of the speed of the impellers.

4th. The want of proper means to control the supply of oil.

Rearrangement of Plant.—In order to remedy the defects mentioned the mill was turned over to the old system while the following alterations were made in the flotation plant, i.e.:—

1st. The grinding pans were altered from the classifying discharge, to the positive feed type, and were arranged to discharge on to revolving screens so as to keep the feed to the flotation machine more even in size.

2nd. The pulp thickener was moved and placed between the screens and the flotation machine so as to keep an even feed to the stirring boxes and to regulate its density.



3rd. The flotation machine was connected to a separate engine with a sensitive governor so as to keep the speed of the stirrers constant.

4th. An apparatus was made for adding the oil to the pulp in such a manner as to ensure an even flow.

The revolving screens are of a type used in Broken Hill and are shown in Fig. 4; they do excellent work and are economical to run.

The screening cloth used is Greening's L.W.C. 600-mesh with aperture 0.0268 in.; size A.K.D. 900-mesh with aperture 0.0217 in. was also used at first, but the L.W.C. was found to last longer and to give equally good results and so was finally adopted. The screens last about ten weeks for each covering.

The method of adding the oil to the pulp, which was finally adopted, consists in placing two drums, one above the other; in working, the top drum is filled with oil from this to the lower one is regulated by a floating ball valve, thus ensuring a constant head in the lower drum. From the lower drum the oil drops at a constant rate into the launder which carries the

pulp from the screens to the flotation machine, at the rate of about one drop per second, amounting to 0.65 lb. of oil per ton of dry ore treated.

In the rearrangement of the plant no concentrating tables were used at all, but the whole of the products from the jig, excepting that from the No. 1 hutch (which was bagged for shipment) were sent direct to the flotation plant in order to give a larger percentage of mineral there, and so form a thicker froth in the flotation chambers.

Flow-sheet No. 4, given on p. 8, shows the rearrangement, and it will be seen from it that the only actual additions to the plant as originally designed are the screens and elevator, but that there is a considerable difference in the general lay out.

Having remedied the defects in the grinding plant the flotation machine began to do much better work, the result of a six days' run being as follows:—

	%Cu.	%Cu.	%Cu.	%
1st day.....	3.9	23.8	1.1	75.2
2nd "	4.0	21.4	0.9	80.4
3rd "	4.7	25.4	1.0	82.0
4th "	4.8	25.8	1.4	74.8
5th "	5.3	26.1	1.4	78.0
6th "	4.1	25.6	1.5	67.3

It was soon found that a certain type of feed gave bad results, i.e., where there was a large percentage of oxidized and kaolinized lode matter, and the high tail values in the last three days' work given above were due to this cause.

On one occasion when there was sufficient of this deleterious material to discolour the pulp to a dirty yellow, practically no flotation took place, the pulp leaving the boxes at approximately the same value as it was fed in. There was no true froth, only large, shiny bubbles, and a little coagulated sulphide which overflowed the flotation chambers; samples taken from each chamber at this time gave the following results:—

Feed	No. 1 Chamber	No. 2 Chamber	No. 3 Chamber	No. 4 Chamber	No. 5 Chamber	No. 7 Chamber	Tails
%Cu.	%Cu.	%Cu.	%Cu.	%Cu.	%Cu.	%Cu.	
3.5	9.3	8.2	6.3	7.3	6.5	8.8	3.0

The film forming these large bubbles was very tenacious, and no improvement took place while the feed was discoloured in this way.

Tests made indicated that the deleterious effect was due to the physical rather than the chemical properties of the material and to the peculiar nature and excessive quantity of the slime produced by it; in order

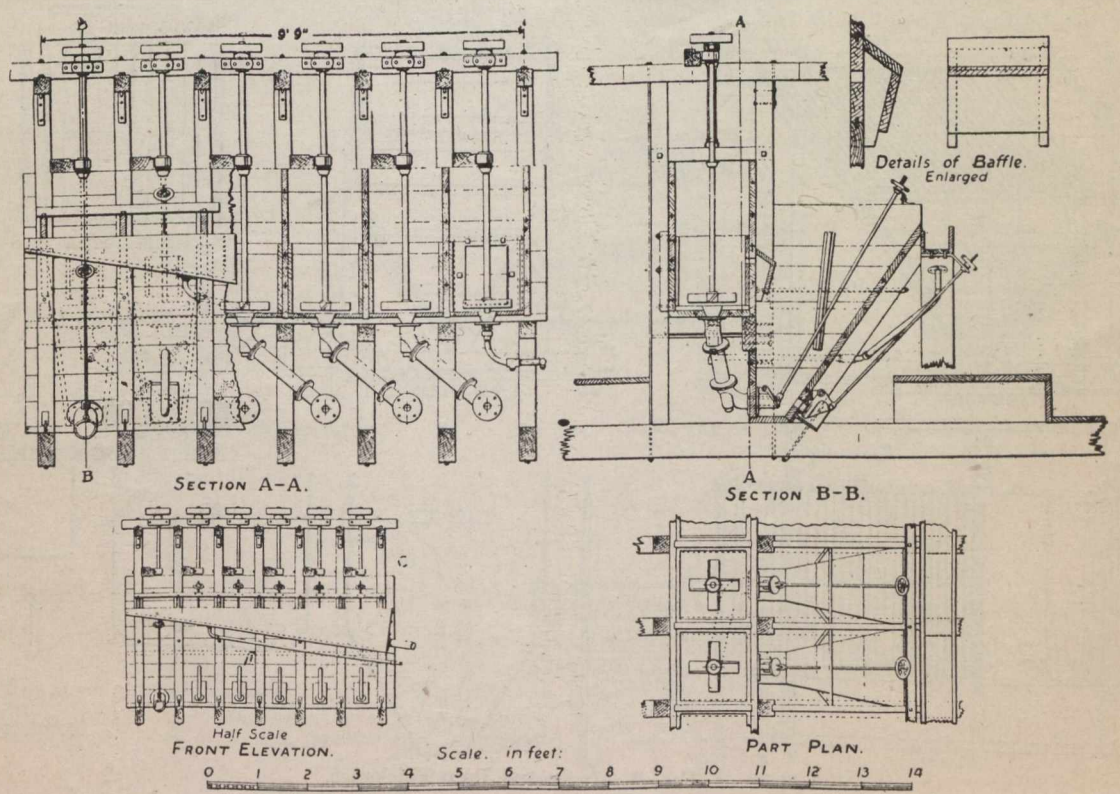


FIG. 2.—General arrangement of Flotation Machine.

The extraction percentage above is worked out on the following formula, viz.:—

$$\frac{\frac{A-B}{C-B} \times 100\ C}{A} = \%\ \text{extraction.}$$

Where A = percentage of value in feed
B = " " " tail
C = " " " concentrate

which is convenient for approximate estimations when it is impracticable to weigh the products.

to determine definitely what effect the large quantity of slime had upon the working of the process, daily sizing tests were made of the infeed to the flotation machine extending over a considerable period, and these showed that when this contained more than 40% which would pass through 130-mesh, the quality of the work began to fall off, while the best results were obtained with from 20% to 30% of this size in the feed.

Since the trouble arising from the "dirty" ore, the mill feed has been regulated so as to contain only a small percentage of this in the total feed, and the result has been uniformly good, only very occasionally the

separation becomes poorer and this can now be very quickly corrected by the man in charge, who can tell by the appearance of the froth; once running in proper order, the machine is easy to regulate, and will sometimes run for 48 hours without being touched, but at others, if the character of the feed changes, it will require frequent adjustment until the feed is again regular in composition.

The results of a week's run of the flotation plant when it was in good working order were as follows:—

	Feed. %Cu.	Concentrates. %Cu.	Tailings. %Cu.	Extract'n. %
1st day....	3.8	25.1	0.95	77.9
2nd "	3.0	23.3	0.85	74.3
3rd "	3.0	24.2	0.65	81.0
4th "	3.15	23.7	0.55	84.5
5th "	4.1	25.6	1.05	77.5
6th "	4.4	24.6	0.90	82.5

These figures show a recovery better than is obtainable by any other known concentrating process on this class of ore, and when it is remembered that, in the case of the Kyloe ore, the mineral contained is nearly pure chalcopyrite, the tailing values are very low.

The plant has now been in successful work for over six months, the mill recoveries from July 29th, 1911, to January 27th, 1912, inclusive, being as follows:

Ore Treated			Concentrates made			
Tons.	Copper Contents Tons	Assay Value	Tons	Copper Contents Tons	Assay Value	Extraction
7855	411.97	5,24%	1562	355.79	22.65%	83.36%

The recoveries are those for the whole of the concentration plant, and are worked out from the weights and values of concentrates made and shipped as against the daily assay of the mill feed. The actual recovery in the flotation plant apart from the jig is approximately 80% on a 3.5% feed and the assay value of the flotation concentrate is over 25% copper. It is as well to state here, that it has been proved by experiment that the extraction could be increased up to 92% or over, by lowering the grade of the concentrates, but, as already explained, owing to the high transport charges, there is more profit in making the higher grade product even though doing so involves making a smaller recovery.

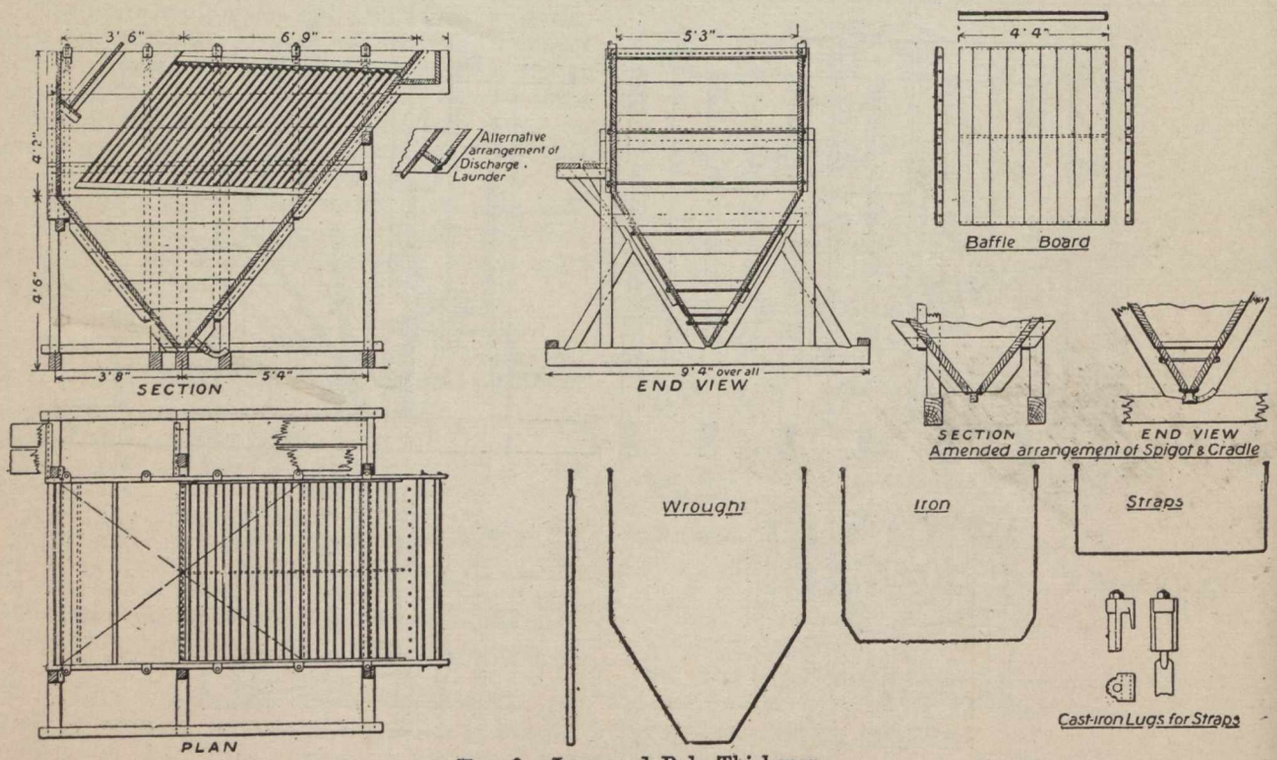


Fig. 3.—Improved Pulp Thickener.

Drying the Concentrates.—The concentrates made are in a very fine state of sub-division and very frothy; filtration was tried as a means of getting rid of the water, but proved a failure without the aid of presses or vacuum plant. It was found, however, that by running the material into a tank and spraying the surface, the froth was broken up; the introduction of a baffle board at the overflow end of the tank caused the mineral to settle and allowed an overflow of clear water. There are two of these tanks in use, and the concentrates are settled in each one alternately, the water is run off as closely as possible, and the wet concentrates then shovelled out on to a drying floor, heated from underneath, and from there, when sufficiently dry, into bins ready for bagging.

In order to demonstrate this clearly, the following figures are given for 100 tons of ore:

The costs of transport are as follows, i.e.:

Cartage to railway station	£1	12	6	per ton.
Trainage to smelting works	0	13	10	"
Agency and sundry charges	0	1	6	"
Bags and bagging concentrates	0	7	2	"
Total per ton of concentrate	£2	15	0	"

The feed in both cases is taken at 5.24% copper.

1st case—

Making an 86% recovery with a 22.6% concentrate as at present

86% of 5.24=4.5064 tons copper,

and 4.5064 tons copper=19.94 tons of 22.6% concentrates.

Copper is taken at £60 per ton.

Returning charge on 22.6% material is 2s. 7d. per unit, with 1.3% deducted from assay value.

Then 22.6—1.3=21.3×19.94=423.33 units copper.

423.33×(12s.—2s. 7d.)=9s. 5d.....£199 6 4

Deduct—

19.94 +3% moisture=20.54 at £2 15s.. 56 9 8

Nett return £142 16 8

2nd case—

Making a 92% recovery with a 19% copper concentrate:

92% of 5.24=4.8208 tons copper,

and 4.8208 tons copper=25.37 tons of 19% concentrates.

Returning charge for this grade is 2s. 9d. per unit.

Then

19—1.3=17.7×25.37=449.05 units copper,

and 449.05× (12s.—2s. 9d.=9s. 3d.)= £207 13 8

Deduct—

25.37+3% moisture=26.13 tons at £2 15s 71 17 2

£135 16 6

Ore miller, 8556 tons. Residues treated, 5732 tons.

Costs.	Per ton of Ore Milled. s.	d.	Per ton of Residues Treated. s.	d.
Re-grinding, screen and flotation.	1	3.6	1	11.2
Power	0	2.3	0	3.4
Drying and handling concentrates	0	3.8	0	5.7
Maintenance and renewals	0	6.6	0	9.8
Assaying, lighting, etc.	0	2.3	0	3.4
Water supply	0	3.4	0	5.1
Superintendence and proportion of management and office expenses	0	2.1	0	3.3
	3	0.1	4	5.9
Royalty	0	6	0	9
Total cost	3	6.1	5	2.9

The royalty paid is saved by the Kyloe Company in the lesser returning charge from the smelters due to the higher grade of concentrate made.

During the first three months of this period a portion of the jib residues were run to waste, as owing to the want of power the pans could not take the whole of them; this has since been remedied and the cost per ton

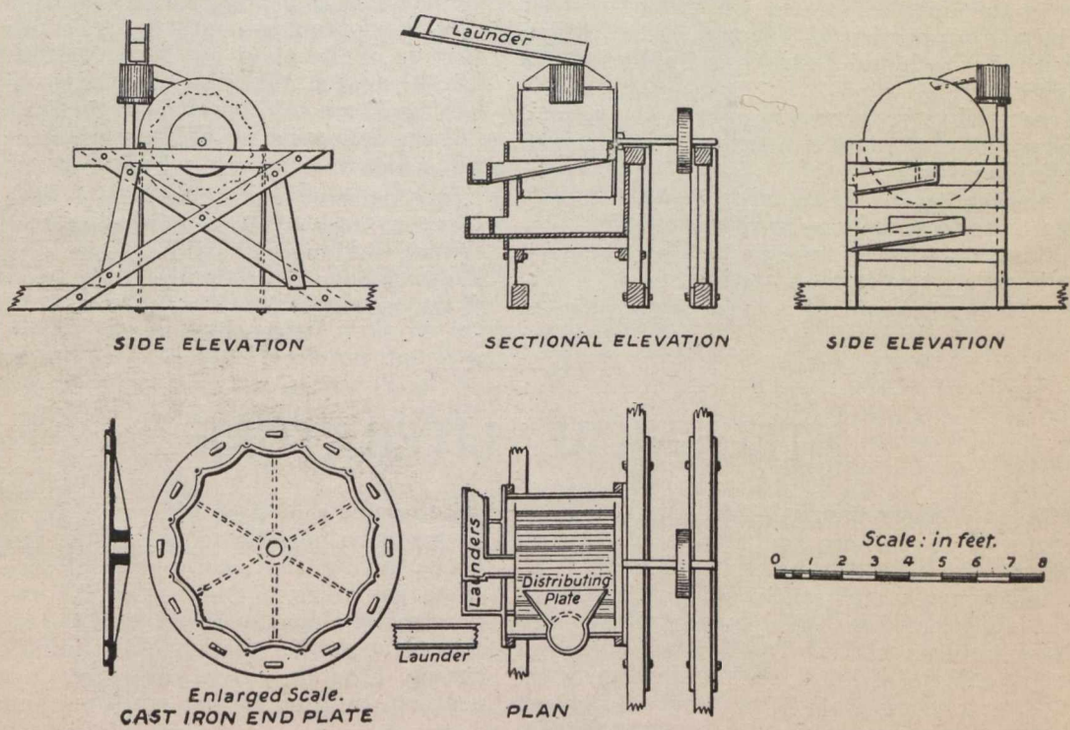


FIG. 4.—Revolving Screens.

or a difference in favour of the lower recovery and higher grade concentrate of £7 0s. 2d., equal to 1s 5d. per ton of crude ore of 5.24% original value in copper.

It is thus clear that under the conditions existing at Kyloe it is essential to keep the concentrates to as high a grade as possible, even at the cost of sacrifice in the recoveries.

Cost of Running Flotation Section.—The actual cost for the 24 weeks from July 3rd to December 16th, 1911, were as follows:

of residues treated is now only about 10% over the cost per ton of total ore milled.

These costs include the re-lining of the stirring boxes with iron liners in place of the wooden ones originally put in, and also some alterations to the pans, which makes the item "Maintenance and renewals" appear high.

The cost of oil, which is included under (1) is 5.2d. per ton of residues treated, or 3.5d. per ton of ore milled.

The total cost of milling for the period, including crushing, belt picking, fine crushing, jigging, re-grinding tails and flotation, together with all maintenance costs and proportion of management and office was 7s. 8.7d. per ton, and the cost of delivering the ore from the mine to the mill bins was 3.3d. per ton.

The mine being a small one, the tonnage available for treatment is also small, i.e., 60 tons per day, and costs are therefore higher than they would be on a large tonnage, but owing to there being no acid required, no heating of solutions, and to the more favourable conditions existing at Kyloe, the flotation costs are considerably lower than they are at Broken Hill, where the process is worked on the zinc-lead tailings.

Cost of Plant.—This will necessarily vary with local conditions, but owing to the very small space occupied and the simplicity of the apparatus employed, it will probably cost 25% less to instal than a corresponding wet dressing mill with tables, slime plant, etc.

Conditions for Successful Working.—So far, present experience indicates that any clean sulphide of the metals can be treated if the physical conditions are right; these are:

(1) That the particles must be clean and free from oxidation.

(2) That the gangue must not be of so clayey a nature as to form a fine slime which coats the surface of the sulphide particles and prevents their attaching themselves to the bubbles formed, or which in itself forms too large a proportion of "gangue slime" which comes up with the froth and destroys its holding power for the sulphide.

(3) The material to be treated requires to be ground as evenly as possible; the best size has to be determined on each individual ore.

(4) The feed and speed of the stirrers must be correctly proportioned and kept as even as possible.

(5) The thickness of pulp fed into the machine must be regulated and kept as even as possible.

(6) The minimum amount of mineral required to be present in the ore has not yet been determined; at Kyloe it amounts to approximately 10% of the weight of the ore, and this gives excellent results. Experiments are now being made to determine if possible the minimum amount allowable; any excess can, of course, generally be removed by jigging or some other form of concentration before flotation.

In some cases the addition of clean pyrites may be beneficial, but as the successful float depends largely upon the total quantity of minerals, rather than the percentage in the ore, it is in many cases possible, by keeping it back in the flotation chambers, to treat successfully very low-grade material. This must, however, be tested on each ore separately.

(7) The water used has a marked effect on the process, and necessitates modification according to its hardness and chemical constituents, but a bad water is not necessarily detrimental to the working of the process.

The machines as now used are a great improvement on the old type of pointed boxes, and will no doubt be further improved upon as experience suggests modifications.

The grinding of the ore to prepare it for flotation may be done in nearly any form of machine, provided that it does not make to much slime, although the process can work successfully with a considerable quantity. The best type of machine is one which screens off the material as soon as it is crushed and returns the oversize back again. The ideal to be aimed at is to keep the particles as nearly of a size as is practicable.

In the foregoing pages the poor success at the first starting of the plant has been dealt with rather fully, for the reason that the experience gained therefrom may be of use to others when starting on a new plant, and the following up of the various causes of trouble may assist in locating weaknesses in other installations.

In conclusion, the writer would state that the Kyloe Company are very largely indebted to Messrs. Faul and Lavers, the engineer and chemist respectively of the Minerals Separation Company, for the ultimate success of their plant.

TECHNICAL LITERATURE

Natural Gas in Western Canada.—Mr. Aubrey Fullerton contributes to the Mining and Engineering World an interesting account of the natural gas belt of Alberta, extending north and south, in the neighbourhood of the 112th meridian. The latest strike in this field was made in June last, at Tofield, gas being here encountered at a depth of 1,054 feet. The quality of the gas is said to be excellent for both heating and lighting purposes. At other towns in the surrounding district arrangements are being made for boring. Gas from the Bow Island wells has been piped a distance of 180 miles to Calgary, where it is sold at rates varying from 15 cents per thousand for power, to 35 cents for domestic uses. In the northern section of the belt, at Pelican rapids, a point on the Athabasca river, 200 miles north of Edmonton, is a gas well that has been burning for 14 years, and the flow shows no indication of lessening. This well was sunk by the Geological Survey in 1898. Gas was struck at a depth of 820 feet, and the flow was so great that it drove back the drill, and the noise of the escaping gas could be heard at a distance of two or three miles. The Survey recommended that a new bore at the depth of 820 feet, where the gas was first encountered, "should be at least 10 in. in diameter; then it would be possible to reduce the casing four or five times, giving that many lines of pipe in getting by these gas veins." Meanwhile the search for oil was necessarily abandoned, and until the railway render the region accessible there is little likelihood of further search. The big gas jet is still blazing wastefully, and a great coal area further north is also on fire.

The Gold Placers of Woodchopper Creek, Alaska.—The United States Geological Survey has recently issued a bulletin, in which these deposits are described. Auriferous gravels are distributed over a considerable area along Woodchopper creek, on the Upper Yukon; but no rich or extensive deposits have been found. The relative accessibility of the placers to the Yukon is favourable to cheap mining, but only a small volume of water is available for sluicing. Operations to the present have been of a primitive description, with one exception.

Copper as an Alloy of Steel.—In a letter to the Mining and Scientific Press, Mr. Kirby Thomas, in discussing the effect of copper on steel, quotes from a report

on the subject made by Mr. C. F. Burgess, who in collaboration with Mr. James Ashton, conducted a series of experiments in the use of copper as an alloy of iron, under the auspices of the Carnegie Institute of Washington. This report stated: "Our results and comparisons would indicate that the copper-iron alloys are also worthy of consideration and might be comparable to the nickel steels in use, even if the strength should not reach such high values as those of the nickel. A 1½ per cent. copper alloy is of promise, since the smaller percentage required and the lessened cost per pound of copper as compared with nickel would result in a lessened cost of construction, even if there is some increase in tonnage required because of the slightly decreased strength per equal weight." Other investigators, Mr. Thomas remarks, have made interesting tests of alloys of copper and steel. Notably Pierre Breuil, who in 1907 endeavoured to ascertain if beneficial results would follow the addition of copper to steel, as suggested by the favourable influence of copper on steels for railway axles, which was noted as being the case on some of the French railways. Breuil mentions that a 4 per cent. copper alloy with mild steel as being worthy of further study, and generally confirms the claim that certain copper-steel alloys are of commercial advantage. It is meanwhile reported that the New York, New Haven & Hartford Railway has found that Scotch rails, containing 1½ per cent. copper are in point of durability greatly superior to ordinary steel rails. If this becomes universally recognized, it will undoubtedly have an important bearing on the copper industry.

The Effect of Alumina in Blast-Furnace Slags.—We referred in a recent issue to some statements made by Mr. Bellinger in the course of his presidential address to the Australasian Institute of Mining Engineers, bearing on this subject. It is again discussed in a paper contributed by Mr. J. E. Johnson to the Cleveland meeting of the American Institute of Mining Engineers. Mr. Johnson, after stating that in the discussion on the effect of alumina, some have regarded it as an acid, others as a base, while a few have declared that it can be made to act as a base or acid almost at will, gives as his own view that under such circumstances it is probable that its action was neither acid nor basic, but perfectly neutral, being simply a dilluent affecting the viscosity of the slag to some extent, but, with a given ratio of lime to silica, not affecting its chemical nature at all. He advances much data in support of this contention.

Milling Practice on the Rand.—In the discussion following the presentation of a paper by Mr. P. Nissen and read before the Chemical, Metallurgical and Mining Society of South Africa, on the subject of the high duty gravity stamp mill, the prediction was made that in the near future nearly all ½-inch product on the Rand will be sent direct to the tube mills, without even passing through the crushers. Already at one mine ¼-inch material is being pumped direct to the tube mills.

Gob Fires and Their Prevention.—In an address before the Manchester Geological and Mining Society, Dr. John Harger, in dealing with the subject of gob fires, classified them under three heads, namely. (1) Those which occur in unworked coal; (2) those which originate in the coal and shale left in the goaf—left there because it is dangerous to the man to take it out or because for some reason it does not pay to take it out; (3) those which originate on a fault side where some coal is often left, and where the coal is often found in fine condition, caused by the grind to which it has been subjected. The second class of heating is generally supposed to be due to a short circuiting of air through such waste from the intake to the return road. The fires of this class all have one feature in common. Thus the roof has been held up and so has not crushed the waste close enough to prevent the short circuiting. In many cases it has been observed that the first signs of a bog fire are not noticed in the return, but in the intake side of the waste. In these cases the first signs, smell or smoke, are observed after a big decrease in atmospheric pressure. Such places may be likened to a bottle having only one opening for the air. In most gob fires of any size belonging to class 2 and 3 some props are found to have been left in. Timber thus left will certainly tend to hold up an open space for some time, and if the coal heats the timber, no doubt it will ignite before the coal; but in all probability such timber is not the primary cause of heating. It does, however, have the effect of hastening heating, and renders moreover the treatment of such heatings more difficult by reason of the pungent fumes given off, and it is more likely to blaze when exposed to the air than is coal at the same temperature. It is, therefore, of great importance in a mine subject to gob fires that no timber should be left in the waste. With regard to the prevention of gob-fires, the reversal of the air current from time to time was recommended as a simple means of removing the danger of dust explosions. It was further advised that a constant supply of inert gas be conveyed into the suspected wastes, where heatings were most likely to occur, and so prevent them forming. The quantity of such gas required was comparatively small—just sufficient to counteract the changes in the atmospheric pressure, all openings being stopped so far as possible, would undoubtedly arrest heating. The inert gas is readily obtainable by the combustion of suitable fuel, but care must be taken that it contain no carbon monoxide. The exhaust gas from an ordinary gas engine, with its exhaust apparatus suitably modified, would give excellent results if the air supply was controlled and complete combustion attained by passing the hot gases over a catalytic material. One way of treating gob fires with absolute safety is to at once reduce the oxygen ventilation in the district in which a fire is discovered. With 17 per cent. oxygen no fire can make much headway.

Persistence of Ore in Depth.—In a recent issue of the Mining and Scientific Press, Mr.. Malcolm MacLaren criticizes some generalizations on this subject that he attributes to Mr. T. A. Rickard, who, he states, concludes that after the oxidized zone and the zone of secondary sulphide enrichment are passed, ore deposits must be expected to become leaner with increasing depth. This he considers to be pernicious doctrine if universally applied; "the more so, in that for most ore bodies it contains a kernel of truth. Thus it is entirely true when its application is limited to a certain group of ore-bodies, namely to those formed near the existing surface, including not only deposits formed in recent geological times, but also some of Paleozoic and pre-Cambrian age. In the latter cases subsidence and burial beneath later deposits have protected the upper portions of these ore channels against the effect of erosion; and the auriferous conglomerate of the Witwatersrand is quoted as an example. Mr. MacLaren remarks that all deposits of this group originated from the cooling of rising solutions on approach to the

earth's surface; but, he states, many deposits, occurring chiefly in Archean and Paleozoic rocks, and occasionally in Mesozoic strata, cannot be ascribed to simple cooling. Lode fissures in these rocks are normally very steep, while the strata are usually much disturbed. It is a fundamental axiom that in these older deposits the nature of the lode-wall exercises a vital influence on the richness and sometimes on the mineral character of the orebody. Hence it rarely happens that a great depth is reached before the lode, worked from the outcrop downward, has passed out of the favorable rock. "Herein lies the kernel of truth in Mr. Rickard's generalization, but surely the fact should be stated in terms of geologic structure and not of depth." Future industry, Mr. Maclaren considers, must more and more concern itself with concealed orebodies, and it is here that a universal acceptance of Mr. Rickard's proposition would prove harmful both to the engineering profession and to mining capital.

Gasoline Locomotives for Mines.—Gasoline locomotives for mine haulage have already been introduced in Canada, and two or three are now in use in the Frank district. A description of one of the latest types is known as the "Otto," is given in Mining Engineering. The locomotive consists essentially of the underframe, the engine, and the driving gear. The underframe resting directly upon springs carries both the engine and the driving gear. The engine, of the horizontal type, works on the four-stroke cycle. A mixture of air and oil in an atomized state is sucked into the cylinder by the first forward piston stroke, which is compressed by the return stroke, at the termination of which the ignition occurs. The actual work done is accomplished by the combustible gases during the second forward stroke of the piston, the so-called "power stroke," after which the exhaust gases are driven off the cylinder by the second return stroke of the piston. The cylinder itself is made of specially hard cast iron and is so fixed into the water jackets that it is free to expand and contract by the uneven heat, and can be readily removed for renewal. The valves are mechanically actuated by the cams, rollers and levers from the cam shaft, the latter running at half the speed of the crank shaft and driven in the usual manner by means of worm gearing. The speed of the engine is regulated by admitting a larger or smaller explosive mixture into the cylinder to suit the varying loads upon the engine. The quantity of fuel and air admitted is controlled by the governor, which continually adjusts the length and duration of the stroke of the admission valve by shifting the position of a tapered cam sleeve. By this method of governing, the explosive mixture, proportioned to ensure uninterrupted firing and favourable to an economical operation, always remains in the same proportion for all loads. The air inlet is designed with a view to make back firing of any flame impossible. The exhaust gases are cooled and cleaned, being made to pass a condenser provided with baffle plates, and thence, accompanied by a stream of water, into the silencer, where a gravel filter and several inserted wire-gauze strainers complete the purification. The exhaust gases are thus discharged in a cooled state and practically free of smell. The ignition of the charge takes place inside the cylinder by suddenly breaking the electric current. The locomotives are mainly designed for one speed only, namely from 4 to 4½ miles an hour. The fuel consumption per h.p. per hour is stated to be 0.66 lbs. of gasoline. At Frank, the working costs per ton per mile are estimated at from 2 to 2½ cents.

The Russian Platinum Deposits.—Writing in the Mining Journal (London), on the platinum occurrences of the Urals, Mr. E. de Hautpick points out that recent geological investigations have confirmed the fact that the platinum in the placers is derived from olivine rocks, the outcrops of which conform—for example in the Urals—to the known narrow zone where the deep-seated rock was exposed. Thus, the only hope of new discoveries of the mineral is in the districts of the Northern Urals, where there are considerable exposures of olivine. The present known richer placers are, meanwhile, being exhausted rapidly, but the high prices now obtaining have stimulated the exploration of poorer territory.

Graphite Mining in Ceylon.—In the course of an article contributed to the last issue of "Economic Geology," descriptive of the graphite deposits of Ceylon, the author, Mr. Edson S. Bastin, gives an interesting account of the mining and dressing methods in vogue in that country. The graphite is mined either from open pits or through vertical shafts connecting with underground workings; but the majority of the mines are not deeper than 100 feet. In a few of the mines steam pumps and hoists are employed, although as a rule the mining methods are still very crude, "the acme of mechanical ingenuity being reached in a windlass operated by five or six men for hoisting the graphite in a sort of tub." The mineral as it comes from the pits may contain as much as 50 per cent. of impurities, mostly in the form of quartz and wall rock. It is conveyed in bags to a dressing shed where it is picked over and the impurities reduced to 5 or 10 per cent. It is then packed in barrels for transportation to Colombo or Galle. Here it is submitted to further treatment known as "curing." The graphite merchants have fenced yards in which graphite is finally prepared for the market. In the methods of "curing" there is some diversity, but the first is usually to set aside the large lumps and to pass the remainder through stationary screens of different size mesh. The large lumps and screened ore are then broken by women, who remove the coarser impurities, and they are then rubbed and polished. The poorer material is usually beaten to a powder with wooden mauls or clubs, and then sorted into different grades. In some establishments the more impure grades are washed in a tub or pit. In this process the mineral is placed in saucer-like baskets and by a circular "panning" motion, while immersed in the water, the graphite particles are thrown off into the pit, while the heavier impurities remain. To separate the very fine material the powdered graphite is placed in a basket, the contents being thrown into the air. The heavier particles thus fall back into the basket, while the finer material is blown forward and settles on the floor.

Coal Dust and Explosions.—The second report, just made public, of the Home Office Committee on Explosions in Mines, states that when considering the relative degrees of inflammabiliy of coal dust it can be accepted as an axiom that the finer the dust from any particular coal the greater its inflammability. The true chemical nature of coal is not yet properly understood. Some insight, however, has been acquired into the general character of the compounds that form the "coal substance," and a relationship has been traced between the proportions in which these different compounds exist in any particular sample of coal and the inflammability of its dust. The methods that have been applied as a general rule to elucidate the question

of the chemical composition of coal have been either (1) to treat the coal with different solvents or agents in the hope of being able to extract some simple substance therefrom, or to form some definite chemical combination therewith, or (2) to distil the coal destructively, and to examine the products of decomposition. The first-named method has shown that certain resinous bodies, soluble in such liquids as chloroform and benzine, are contained in certain coals in small quantities, but their identity has no been definitely established, and they do not form an important part of the coal substance. A discovery by Bedson hat pyridine dissolves a considerable proportion of many bituminous coals promises, however, to yield more valuable results. A method is described by which the relative inflammability of different dusts can be ascertained by measuring the temperature of a platinum coil, which just ignites a uniform cloud of dust and air projected across the coil fixed in a glass tube. It is shown that the relative inflammability does not depend upon the "total volatile matter," but on the relative ease with which inflammable gases are evolved. The order of inflammability so obtained corresponds in a remarkable degree with the percentage of inflammable matter extracted from the same coals by pyridine. The committee are of the opinion that these two methods form a valuable means of discriminating between different coals in regard to the sensitiveness of their dusts to ignition. It must, however, be borne in mind that these tests have been made with dusts artificially ground and sieved to an equal degree of fineness, and, since coals differ considerably in their power of resistance to pulverization, the friability of the coal must be taken into account. No doubt, also, the porosity of a coal and the shape of its dust particles may affect its inflammability.

MOOSE MOUNTAIN IRON MINE

By F. A. Jordon, Selwood, Ont.

The Moose Mountain Iron Range has been traced by prospectors in a northwesterly direction, from the northwest shore of Lake Wahnapitae, in the district of Nipissing, to Lake Onaping, in the district of Algoma, a distance of approximately 35 miles.

A description of the property of Moose Mountain, Limited, will in a general way describe the ores and deposits of the range. The property is located in Hutton township, in the district of Nipissing, and its development has caused the building up of the town Selwood, which is its centre and its post office, and which was named after Captain Joseph Sellwood, whose name is prominently identified with the development of the Lake Superior iron region, and who is the real father of the Moose Mountain range, being one of the owners of Moose Mountain, Limited. Sellwood is located on the C.N.O. Ry. 289 miles north of Toronto. Sudbury is its nearest important centre, which is 35 miles to the south. Relative to the Range, Sellwood is at about its centre, and here the range limits the finding of all the deposits in a width of northeast to southwest of about four miles.

Iron ore had been known to exist in Hutton township for many years. During the gold excitement of the early nineties, prospectors travelling the west branch of the Vermilion river, in search of the precious metal, portaged across a ridge, at a point known as Iron Dam, and what is now called a part of No. 2 deposit.

The wearing away of the moss had exposed the ore in several places, but at this point the ore is low in iron, probably not over 30 per cent., and this is quite likely the reason that it attracted only passing notice. It was not until 1901 that some prospectors, who in a couple of years previous had done some exploratory work in a radious of two miles around Iron Dam, interested the Moose Mountain, Limited, to undertake the development and mining of iron ore on the range. At this time, there was no railroad into the district, but Mackenzie, Mann & Co. were then contemplating their Toronto to Port Arthur line, and, after some negotiations, arrangements were completed with them to give the range transportation facilities. This took some time, and it was not until the spring of 1906 that any work was done towards developing the mine. In this year the work consisted in test pitting, trenching, cross-cutting in rock and magnetic reconnaissance. The deposits which had been outlined in 1902 by Mr. Kenneth Leith with the compass, were test pitted, trenched and further extended by magnetic reconnaissance, and one not previously known was found, making in all, eleven deposits, numbered for convenience from 1 to 11 inclusive. At that time data were collected of the different deposits, which, with the diamond drill done in the following year, makes it appear that the tonnages are as follows:

	Tons.
Deposit No. 1	2,000,000
2	60,000,000
3	3,000,000
4	2,000,000
5	2,000,000
6	.....
7.	1,000,000
8	.....
9	.....
10	.....
11	40,000,000
	110,000,000

No estimate has been made of deposits 6, 8, 9 and 10 since very little work has been done on them and their exposures are small. In September, of this year, 1906, work was commenced on a crushing plant at No. 1 deposit. This deposit rises as a hill, from a depression through which the railroad reaches it, to a height of 140 feet. At a point 65 feet about the track, a rock cut was driven to the ore and below this was chosen as the location for the crushing plant which will be described later. It is well here to describe the ore of this and other deposits on the property, and to classify them into two groups, purely from the operating standpoint. It will still remain for the geologists to classify their different geological relations.

All of the deposits are inclosed on all sides, by rocks of the Keewatin series, collectively as greenstones, except isolated and small intrusions of Laurentian gran-

ites. There has been very little disintegration of these enclosing rocks, and the iron ore deposits do not stand out as mountains of iron, as might be popularly supposed, from the name Moose Mountain, given by the early prospectors to the No. 1 deposit. The ore is exposed, because of erosion on top of the deposits, and the glaciated surface, covered in most cases by glacial drift, shows in a marked way the action of the glaciers, which at one time covered the country. No. 1 deposit may then be described as a greenstone hill, with a core of iron ore, and this will answer for all the deposits, except that the erosion may have reduced the hill to a plain in some cases. The drilling of 17 holes on the property shows that the walls of the deposits are practically vertical. The present knowledge oftheir depth is not very certain. The drilling that has been done has been across the deposits, in order to prove their width, and, incidentally, their depth. This drilling shows that the ore bodies are at least 400 feet deep, this being the deepest vertically that any drilling has been done. It also shows, that at depth, the ore is similar at any point, to that vertically above it on the surface, and that a sample taken on the surface in the same vertical plain as the drill hole, will be very closely similar in its physical and chemical makeup to the core from the hole. No vertical hole has been drilled in the ore body to the granites below. A vertical transverse section of No. 1 deposit where the width is, say 75 feet, would be about as follows:

	Feet.
Lean Magnetite, with bands of greenstone	15
Possibly a residual mass of greenstone	5
Magnetite, lean, grading up to very rich	25
Epidote	10
Magnetite, very rich, grading down to a fairly rich	20

It is quite characteristic of this deposit ore that the banding is with greenstone, and that practically no quartz is present; that the greenstone and epidote masses are found irregularly within the deposit, and that the ore next to the epidote mass is very rich, some of it being 70 per cent. metallic iron. There must have been some important relation, chemically in the enrichment of the ore, between the ore and the epidote. The presence of the greenstone displays no such effect. It is characteristic of all the deposits that they are lean on one side and grade to richer ore on the other. It is a difficult proposition to answer the question as to what the average metallic content of this ore would be. The ore is a hard magnetite of very great crushing strength, in other words, tough. It is made up of very fine microscopic crystals, so small, that crushing to 100 mesh does not entirely free one from another. There is no parting plane between the magnetite and the greenstone or epidote. The ore does not break free from the gangue, but it does break free from the walls of greenstone leaving a perfect contact wall, both foot and hanging. The ore when weathered is grey, darkgreen and black in appearance, and glaciated surfaces have the lustre of metallic iron. When broken, the ores have a steel grey appearance. The residual greenstone (and here it is assumed that the ore either replaced or entangled the greenstone), and the epidote are comparatively small masses, and have to be mined with the ore. A tram car of ore might be made up of some lean ore with greenstone banding, some very rich ore, some pieces of green stone and epidote, and every car would, because of different elements of which the ore body is made up from, differ much from each other. It is, therefore, not strange, that the attempt made to mine this ore and sort it by hand, was not a complete success. However, that was the plan, and in September of this first year, 1906, the erection of a crushing plant was commenced. The crushing plant, as has been before stated, was located on the slope of the hill known as No. 1 deposit. A chute down the side of the hill with a capacity of 20 tons or thereabouts fed the ore into a No. 6 Austin gyratory crusher. It passed from this into a revolving screen with 2½-inch perforations, the undersize being elevated to a shipping bin, and the over size through a No. 5 gyratory crusher, and thence to the elevator and shipping bin, mixing with the undersize from the screen. From the shipping bin it was spouted into cars on the track alongside of the bin. This mill was completed during 1907. During this year and the next, the operations were not carried on very intensively, since the railroad was not completed, but development work up to the fall of 1908 had accumulated a stock pile of about 15,000 tons. This stock pile had been sorted by hand. The lrst ore was shipped in the fall of this year, 1908. It was prepared by again re-sorting the stock pile and crushing in the mill just described.

Some slabs resulted, since the product from the No. 5 crusher was not screened, and thus there were some pieces larger than the undersize from the screen, but they were few and no piece was larger than could be passed by hand through a 4-inch ring. Altogether, there was prepared of this, 3,568 tons.

This ore did not meet a favorable reception at the hand of the purchaser, for when it arrived and was unloaded at the Lake Erie dock, the purchaser inspected it and refused to take it. The great objection to the ore was, that it was too coarse, poor, physically. This ore was finally disposed of, and the analysis was as follows:

	%
Iron (dried at 212)	53.80
Silica	14.27
Moisture	24
Iron in natural condition	53.67

This ore was selected from the very richest portion of No. 1 deposit. It was sorted and re-sorted, and at considerable expense, and it was certainly disheartening to find, that it was only with a prohibitive cost that the ore could be brought up to merchantable grade, and that it had to be crushed yet finer.

It was reported in the mining centres at this time that the Moose Mountain venture was a failure, and it would have been had not the company at this time adopted magnetic separation. The concaves in the No. 5 gyratory was packed out by filling with iron back of them, to crush much finer. A twin revolving screen with 1-inch perforations was installed to screen the product from the 2½-inch perforated screens and from the altered No. per cent. crusher. The oversize from this screen was returned to the No. 5, and the undersize was passed over a single drum magnetic cobber. A small generator and engine was put in to furnish direct current at 110 volts for the cobber. These alterations were made in the winter and spring of 1909. There was shipped of this magnetic cobbed ore in this year nine cargoes of the following average assay:

	212 F.	Natural.
Iron	55.77	55.34
Phosporous	1.07	1.06
Silica	12.78	12.68
Manganese	.09	.09
Alumina	1.58	1.57
Lime	3.77	3.74
Magnesia	3.52	3.49
Sulphur	.074	.073
Loss by ignition	none	none
Moisture	....	.77

A sieve test of this ore showed the following:

	%
On 8-ft. mesh sieve	79.53
On 20-inch mesh sieve	7.53
On 40-inch mesh sieve	2.64
On 60-inch mesh sieve	2.00
On 80-inch mesh sieve	.53
On 100-inch mesh sieve	.70
Three 100-inch mesh sieves	7.07

The ore is shipped from the mine to Key Harbour, on the Georgian Bay over the Canadian Northern Railway, a distance of 82 miles.

The ore being very dry and having considerable of it as fine as through 100 mesh sieve, presented difficulties at the unloading ports. The plaint of the first few boats was that they had difficulty in keeping a crew to unload. Finally one crew quit and after that the cargoes were wetted down before unloading. The ore as naturally prepared, has not to exceed 0.4 per cent. moisture, but the wetting down increases it to ¾ of 1 per cent. and 1 per cent. This remodelled plant was not of sufficient capacity, and was, in fact, a make-shift, but it enabled the company to try out the magnetic concentration, so that at the end of 1909, there was started the building of a much larger plant which was completed and put in operation in August, 1910.

This plant, which we now call No. 1 plant, made use of the No. 8 gyratory crusher of the old plant, and added along side of it, a 24-inch by 36-inch jaw crusher. The ore is conveyed from these crushers to a storage bin of 800 tons, which is then fed to No. 4 gyratory crushers. The product from these crushers passes through a 1¼-inch revolving perforated screen, the oversize being returned to the crushers and the undersize to storage bins by belt conveyers. The undersize is then fed from the storage bins to single drum cobbers the tails and concentrates being conveyed to shipping bins. The tails are taken by the railroad and used for ballast. In the old mill, there were only the two products from the magnetic cobber, concentrates and heads.

It was thought that even, were there not a cleavage plane between ore and gangue, it might prove advisable to take three products from the cobbers, concentrates, middles and tails, and re-crush the middles and treat them over belt separators. In the new No. 1 mill this plan was put into practice, but results did not warrant it, and it was discontinued. This mill was operated from August, in 1910, to May 31st, 1911, when it was shut down on account of the unsatisfactory ore market then prevailing, and at this time is still quiet. A stock pile of some 40,000 tons is now at the mine, and the dock has 13,000 tons stored there.

The total shipments from the mine, exclusive of that now in stock pile and dock has been 107,042 gross tons. The average metallic iron in the ore in the natural condition shipped in 1910 was 54.75 per cent., and the smaller tonnage in 1911 was 54.36 per cent. This ore was sold to nine different customers, and the following is the metallic iron per cent. in the natural condition, on which settlement was made, in each case, respectively, 54.17, 54.18, 54.18, 54.19, 54.20, 53.88, 54.58, 54.57, 55.53. The above shows with what great uniformity this ore can be prepared for market by the aid of the magnetic separators. One would be more than surprised to know that this was done without a chemist at the mine. It would be quite possible to sell ore on a guarantee that one cargo should not differ from another to exceed 2/10th of 1 per cent.

The ore met with general favour from the furnace men, but with the poor market conditions which came in 1910, objection was raised to the fine dust in the ore. At that time the company was planning putting in a plant after the Grondal process, and it was then determined, and has since been carried into effect, to screen all the dust out of the No. 1 ore and sending it to the Grondal plant, thus not electing any loss by reason of screening. The following is a sieve test of the present product:

	%
Held on 8-inch mesh	97.75
Held on 20-inch mesh	1.16
Held on 40-inch mesh	.11
Held on 60-inch mesh	.06
Held on 80-inch mesh	.02
Held on 100-inch mesh	.03
Passing 100-inch mesh	.87

That passing 100-inch mesh is probably due to dust adhering to the large pieces.

No. 1 deposit produces by magentic separation, a non-bessemer ore, ore averaging in the natural condition:

	%
Iron	54.35
Phosphorous	.090
Silica	13.94
Manganese	.06
Alumina	1.90
Lime	3.79
Magnesia	3.61
Sulphur	.029
Loss by ignition	.62
Moisture	87

all of which is crushed to maximum size of one inch and practically all of which can be held on an 8-inch mesh sieve, there being no dust.

In the separation with the cobbers, the phosphorous content is not affected, but the sulphur content is reduced to one-half of that in the crude ore. A determination of the tails resulted as follows:

	%
Iron	11.00
Phosphorous	.074
Silica	40.60
Manganese	.18
Lime	15.10
Magnesia	6.98
Sulphur	.027

Three-quarters of the total iron in the tails is magnetite. It requires the mining of about 1.35 tons of crude ore to produce one tone of the shipping or concentrated ore, and here is the only possible answer as to what is the average value of the deposit.

Earlier in this paper, reference was made of classifying the ores into two groups. No. 1 deposit, which has thus far been described is one type, and similar to it are deposits Nos. 4 and 5. These deposits run in a

northeast to southwest direction, and please note that they are at right angles to the other deposits of the other group which run in a northwest to southwest direction. These three deposits are adapted to the process just described, but you will observe that the tonnage in these deposits is small and that the great tonnage of ore on the property is in the other group of deposits. Typical and probably the largest of the other group of deposits is the one known as No. 2. The depth of this deposit is known to be at least 400 feet. It is of the banded variety of magnetite, the bands being of quartz, and while it grades from lean ore on one side of the deposit to richer on the other, it is not in such a pronounced way as in the other type. There is neither epidote nor greenstone included in these ores, as in the other group, but there is considerable quartz, which is entirely lacking in the other. Following is the analysis of a sample taken on the surface directly over the line of No. 4 diamond drill hole on this deposit:

	%
Iron	36.70
Phosphorous	.057
Silica	45.20
Manganese	.04
Alumina	.25
Lime	1.06
Magnesia	1.59
Sulphur	.024
Loss on ignition	.15

It is quite noticeable that the silica has increased from 14 per cent. in the other group of deposits to 45 per cent., and that all the other elements have decreased. During the past two years the company has been devoting considerable study and expense, in an experimental way looking towards the utilization of this very large tonnage in this group of deposits and is now in the process of building a plant, adapting the Grondal process. It would require a rather lengthy paper to give in detail the work done in this connection, but the test on the largest scale was carried out at Sheridan, Pa., the crude ore being very nearly of the same values of the analysis above. A thirty-ton sample was put through the grinding and separating machines and the result was:

	%
Iron	65.58
Phosphorous	.019
Silica	8.69
Manganese	.04
Alumina	.20
Lime	.46
Magnesia	.41
Sulphur	.029

This new plant, known as No. 2, is being built entirely of steel and concrete, and the expectation is that it will be ready for operation some time in May of this year. The capacity of the plant will be 800 tons per 24 hours of crude ore, and its output will be about 400 tons of briquettes. These briquettes will measure 2½ x 3 x 6 inches and are of a very porous but sufficiently hard nature. The briquetting changes the magnetite, such that 90 per cent. of the briquette is in the form of hematite. The power throughout both of the plants is electricity, obtained from the Wahnapitae Power Co. over a transmission line 35 miles and at thirty-three thousand volts.

This year the company will produce the non-bessemer ore from No. 1 plant, and the briquetted bessemer low silica ore from No. 2 plant.

AN ELECTRICALLY DRIVEN PERCUSSION DRILL.

By Frank C. Perkins.

A novel German mining electrically driven percussion drill has been devised as noted in the accompanying photograph. It is held that this is the simplest percussion drill in the world and that the consumption of power is only 1½ horse power at the same time it is equally suitable for all kinds of current.

It is further claimed that the performance is equal to that of the best drills driven with compressed air, as holes of 30 millimeters diameter are drilled in the hardest granite at the rate of 6 oms per minute. There is said to have been developed an absolutely reliable reversing device for the drill and independent of the percussion mechanism with very simple protection of

the reversing device when the drill jams. The weight of the complete drill is 18 kilograms, and with this apparatus 1,000 blows of the percussion drill obtained per minute.

There is provided a flexible shaft 3 meters long with strong protective tube the electric motor for direct or rotary current, for all admissable voltages being mounted in a portable box and a cable terminal box is being utilized for the current distribution.

This electric drill operated by only one man made a hole in half an hour, whereas it is claimed two men would have required a week to do the work by hand.

It is maintained that the introduction of the percussion drill into the building industry in Germany has excited general interest, and, without doubt, the machine will be largely used in the building trades throughout the world just as it is already used in mines and quarries and has proved satisfactory in every way and economical in operation.

Mr. W. E. Finch, of Spokane, Washington, with associates, is developing, under option of purchase, the Idaho-Alamo group of silver-lead mines, in Slocan district, British Columbia.

QUARTZ MINING IN THE KLONDYKE DISTRICT

(Abstract of Report by D. D. Cairnes, in Summary Report of Geological Survey for 1911.)

Quartz veins are plentiful in the schistose rocks of the Klondike District, and although the greater number of these deposits are small and non-persistent, still the aggregate amount of quartz is very great. Occasional very encouraging assays have been obtained, but with rare exceptions it is not even approximately known what average amounts of gold the deposits in the different localities contain. The quartz is practically all free-milling and is but slightly mineralized, the only metallic constituents apparent being pyrite, and rarely magnetite, chalcopyrite, galena and native gold.

The Quartz Deposits.

A great amount of quartz occurs in the old schistose rocks that are so extensively developed in the Klondike district, and in some localities it is in sufficient quantity to even constitute a considerable portion of the whole rock mass. The quartz occurs prevailingly in veins which exhibit considerable variety of form, and are as a rule small and non-persistent, but range in size from mere threads to masses several hundred feet in length, but in most places less than ten feet in thickness; one vein, however, on Yukon River, below the mouth of Caribou Creek, exceeds 30 feet in thickness.

The most common type of vein is lenticular in form, the individual lenticles measuring but a few inches in thickness and less than 50 feet in length; in places, however, individuals as much as ten feet in thickness occur, but even these are rarely traceable for any considerable distances. The lenses in most places follow, in a general way at least, the strike of the schistosity of the containing rocks, but along their dips they frequently cut the wall rocks at various angles.

Typical bedded or sheeted veins are also characteristic of some localities; in this type of deposit the quartz occurs interleaved with the folia of the schists, the individual quartz bands being generally but a few inches in thickness; in places such deposits occur in zones up to ten feet or more in width that consist entirely of alternate quartz and schist lamellae exhibiting a wide range of relative proportions.

Typical fissure veins were also noted, but on account to the decidely schistose and fractured character of the enclosing rocks, these veins readily pass into the lenticular or sheeted types, due to the fact that the solutions from which the quartz was deposited, were naturally frequently diverted in whole or in part from the particular channels along which they might at any time be traveling, on account of the multitude of cleavage and fracture cracks which intersect these rocks, affording thus numerous routes for percolating waters. All types of veins are thus liable to bifurcate or branch out, and smaller veins frequently unite to form larger deposits. In places along lines of previous excessive fracturing, mineralized zones occur in which several of the vein types are represented; lenses, sheets, pockets and various irregular deposits of quartz may be separated by and include varying amounts of wall rock, and the whole be intersected by, or associated with, numerous stringers and fissure veins of quartz.

A notable feature of some of the veins is the presence in them of occasional feldspar crystals indicating their relation to certain pegmatites in the vicinity. In this connection Mr. McConnell says: "A few examples of typical pegmatite veins or dykes occur in the district, and in one case a coarse-grained pegmatite vein was observed to pass along its strike into a purely siliceous rock. The aqueo-igneous origin of the pegmatites, and their close genetic connection with certain classes of quartz veins, maintained by various writers, is supported by the facts observed in the Klondike district."

The quartz vens are in most places but slightly mineralized; pyrite and more rarely magnetite occur in places in sufficient quantity to produce a reddish coloration on the exposed and oxidized portion of the veins, and in a few places the quartz contains particles of galena, chalcopyrite, and native gold.

The Economic Importance of Quartz.

Often fair and occasionally even high assays are obtained, and in places the quartz shows native gold, but, except in possibly a very few insances, it is not known even approximately what average amounts of gold the quartz contains. From the various properties that have been examined however, the gold that does occur is always either associated with metallic sulphides or is at or near the contact between the quartz and schists; in the latter case the gold is generally found in both veins material and wall rock.

It would thus seem possible that some of the fractured zones that have become irregularly impregnated with quartz, may prove of greater value than the more clearly defined massive veins, since the former contain a greater area of contact-surfaces in the same volume or weight of material. However, the majority at least of the mineralized zones that have been examined, do not appear to be sufficiently persistent to allow of their containing sufficient quantities of pay-ore to make a mine; it is possible, nevertheless, that larger and more richly mineralized zones may yet be found. In a number of places several veins or mineralized zones which were noted in close proximity to each other could be worked conjointly. These would yield a considerable tonnage, and would become important producers if the bulk of the quartz will pay for milling. It is thought that, since the majority of the veins are non-persistent, the successful exploitation of the quartz of this district will largely depend on finding groups of veins or mineralized zones sufficiently close to allow of their being worked conjointly.

The deposits that have already been discovered in Klondike, in all probability represent but a small portion of the quartz that actually exists in the district, as bedrock is covered by superficial deposits in most places, except along the summits of the hills and ridges, and along the sides of the secondary valleys, where the bulk of the quartz occurs that has so far been found; other discoveries have been largely accidental and due frequently to placer operations. It is, therefore, probable, that future prospecting and development will disclose numerous deposits that are at present unknown.

More development should be performed, however, in connection with the quartz deposits of the district that have been already discovered, with a view to ascertaining their extent, and more systematic sampling and assaying should be performed in order to determine within reasonable limits, at least, the average values of the materials they contain. It seems probable that at least the upper weathered and decomposed portions of

a number of the deposits could be profitably milled, due to the fact that the district has not been glaciated, and a certain surface concentration of gold is to be expected, and in places is known to occur.

Prospectors and others interested in lode mining frequently do not sufficiently realize the importance of assays, and when these are made, in probably the majority of instances in Klondike district, they are from samples that are not representative of the deposits from which they are taken. Two reasons seem mainly to account for this condition; one is that it is not as convenient to have assays made in Yukon as in most mining districts, and moreover it is frequently realized how difficult it is to obtain really representative assay samples from free-milling deposits.

Mining Properties—General Statement.

Among the more promising quartz properties in the Klondike district, and those on which the most energy has been expended in development, are: the Lone Star group, near the head of Victoria Gulch, a tributary of Bonanza Creek; the Violet group, situated along the divide between Eldorado and Ophir Creeks. the Mitchell group, on the divide between the heads of Hunker and Goldbottom Creeks; the Lloyd group and neighbouring claims, situated along the divide between the heads of Green Gulch and Caribou Gulch, tributaries respectively of Sulphur and Dominion Creeks, and several groups of claims on Bear Creek near where joined by Lindow Creek. Of these the Lone Star was the only property on which any work, other than the necessary assessment duties, was being performed during the summer of 1911.

In addition to the above-mentioned properties, considerable enthusiasm has been aroused during the past two seasons over a number of claims staked on Dublin Gulch, a tributary of Haggart Creek which drains into the south fork of McQuesten River. This locality is not in the Dawson mining district, but is in the Duncan Creek mining district; it is, nevertheless, frequently spoken of as being in the general Klondike district and will be here so considered.

The Lone Star Group.

The Lone Star group is situated near the head of Victoria Gulch, a tributary of Bonanza Creek. This property is owned by a joint stock company with head office in Dawson and having acapitalization of $1,500,000; the President, Dr. Wm. Catto, as well as the Secretary-Treasurer, and the majority of the Board of Directors, also reside in Dawson.

On these claims two main veins, or really one vein and a mineralized zone, have been discovered, which have been, by the owners, designated respectively the "Corthay vein" and the Boulder lode" ; these occur in much metamorphosed sericite and chloritic schists. The Boulder lode strikes N. 50° W.,[2] dips from 70° to 80° to the S.W., and is in most places at the surface from 3 to 10 feet in width, containing 1 to 7 feet of quartz. This "lode" has been traced definitely along its outcrop for 400 feet, and quartz is exposed at various paints in the same general line of strike for 600 feet farther, indicating that this zone may persist for this distance. The quartz occurs prevailingly in lenses, sheets and irregular bodies ranging in size from those that are only microscopically observable to others 3 or 4 feet in thickness; these are interbanded or interfoliated with the schists, and generally agree with them in strike, but along their dips cut the planes of schistosity of the enclosing rock at various angles up to 90°. In places masses of practically solid quartz as much as 4 or 5 feet thick occur, but such a condition is rather exceptional. Numerous fissure veins or stringers less than 6 inches in thickness intersect the main zone in various directions.

The Corthay vein strikes N. 14° W., has an almost perpendicular attitude, and where it has been explored is much more regular than the Boulder lode; this deposit also resembles more an ordinary compound fissure vein, and consists mainly of quartz which is in most places from 3 to 6 feet in thickness.

The quartz of both the Corthay vein and the Boulder lode is but slightly mineralized, the only metallic constituents that were noted being pyrite and native gold. The pyrite occurs as scattered particles or in small bunches, and is in sufficient amount in places to give the quartz a rusty appearance where weathered. The native gold occurs mainly as occasional grains and nuggets both in the quartz and wall-rock, but prevailingly near their contact, and is in places quite well crystallized.

An open cut about 70 feet long, 10 feet wide, and having an average depth of approximately 15 feet, as well as 8 or 10 smaller surface cuts or pits have been dug at intervals along the strike of the Boulder lode. A cross-cut tunnel 310 feet long has also been driven, from which, when examined in September, 1911, about 40 feet of drifting had been run on the Boulder lode which at this depth of approximately 60 feet was much narrower than at the surface and contained in most places less than 2½ feet of quartz. A vertical shaft has been sunk through the schists and tapped the Corthay vein at a depth of 60 feet where the quartz was about 4 feet thick. Another shaft 40 feet deep has been sunk on the Corthay vein and was connected with a drift from the tunnel by a 30-foot upraise; a drift 70 feet long was also run from the bottom of this shaft.

A four-stamp Joshua Hendry mill has been erected on this property, and a gravity tramway 3,500 feet long has been constructed to convey the ore from the workings to the mill on the creek about 900 feet below. A power line 4 miles long was about completed in September, which was to convey power to the mill from the power line of the Northern Light and Power Company on Bonanza Creek, the cost of the power to be at the rate of three cents per horse-power.

Miners working on this property and in the vicinity receive $4 per day (10 hours) and board.

The manager of the Lone Star group claims to be able to mine and mill the ore from this property for $3.50 per ton. It is not known what average amounts of gold the quartz and adjoining rock there contain, but a number of promising assay returns have been received and the tests that have been made indicate that at least the somewhat decomposed superficial portion of the Boulder lode and possibly of the Corthay vein as well should pay to mill. No definite information was obtained concerning the remaining portions of the deposits.

The Violet Group.

The Violet group is situated on the divide between Eldorado and Ophir Creeks, about 5 miles from Grand Forks, and consists of four claims and a fraction, all of which are Crown-granted. It is claimed that $60,000 have been spent in developing this property which, however, was sold by public auction in September, 1910, and acquired by the present owner, Mr. H. H. Honen.

Three veins are reported to have been discovered on this property, but the bulk of the work has been done on one of these which strikes in a southeasterly direc-

This vein is in most places from 3 to 6 feet in thickness, and the quartz composing it is crystalline and contains considerable reddish feldspar, giving it a pegmatitic appearance. The quartz contains considerable iron, which, near the surface, weathers and gives the vein a rusty appearance; particles of galena were also noted. It is not known what amounts of gold this vein contains, but it is stated to average $10 to $11 per ton.

Three shafts, respectively 55 feet, 35 feet and 150 feet in depth, have been sunk on the property, and 300 feet of drifts have been driven; in addition, one open-cut 50 by 12 by 15 feet approximately, and a number of smaller cuts have been dug.

The Mitchell Group.

The Mitchell group is situated on the divide between the heads of Hunker and Goldbottom Creeks, and consists of about 27 claims which are owned by Mrs. Margaret J. Mitchell.

A number of quartz veins occur on this property, but as the surface of the ridge on which these have mainly been discovered is in most places covered with superficial materials, it is not known either how many veins may be present, nor even how many veins the known occurrences of quartz represent, as considerable stretches of bedrock are still covered between the different exposures. Quartz occurs in a number of small cuts or trenches more or less in alignment, that have been made on one part of the property at intervals throughout a distance of about 2,000 feet, yet this by no means proves that the quartz all belongs to the same vein; in places, trenches were sunk to bedrock across the supposed line of strike of this vein, and no quartz was encountered; and further, the exposures themselves are, in places, decidedly lenticular in form. For 600 to 800 feet, however, quartz has been found along a N. 5° W. direction wherever bedrock has been exposed to view, which is at frequent intervals; it would thus seem that for this distance either a fairly regular fissure vein or a nearly connected line of quartz lenses occurs. Other parallel lines of exposures were also noted, indicating that at least 3 or 4 veins, and, possibly, many more than this number, occur.

The quartz is all deposited in sericite schist, and whenever contacts between the quartz and wallrock were noted the quartz cuts the schist folia along both dip and strike. The veins range from a few inches to 7 or 8 feet, but are in most places from 2 to 4 feet in thickness; the quartz generally contains almost no metallic constituents, but in places exhibits considerable disseminated pyrite, which causes weathered surfaces to have a rusty appearance. A few particles of galena and native gold were also noted.

Only a few samples were taken from this property, but the results obtained from the analysis of these few all indicate that the white unmineralized quartz rarely carries more than traces of gold, which mineral almost invariably occurs either associated with the metallic sulphides or near the contact of the quartz and schist, and in either material.

The development work performed on this property consists mainly of a number of open-cuts, shallow trenches and pits, and also a shaft 80 feet deep, from which a 50-foot drift has been driven. The shaft was filled with water when visited, but a grab sample was taken from the dump, which assayed $5 in gold per ton; this is the highest assay obtained from the various samples taken by the writer from the Mitchell group, although much higher returns are believed to have been received from other samples taken previously. It, therefore, appears that, although the aggregate of quartz on this group of claims is considerable, by no means all the material will pay for treatment. The various veins should thus all be systematically sampled, to obtain an estimate of their probable average values, and determine approximately the veins and portions of these that will pay for mining and treatment.

The Lloyd Group.

The Lloyd group is situated at the head of Green and Caribou Gulches, tributaries respectively of Sulphur and Dominion Creeks, and consists of 17 Crown-granted claim owned by Messers, James Lloyd, J. A. Segbers, and Wm. Nolan.

A number of exposures of quartz 2 to 6 feet in width occur on this property, but in only a few places could the thickness of the veins, and their relations to the wall rocks be determined; the other known occurrences of quartz were either still more or less covered with superficial materials, or the various shafts, cuts, etc., that had at one time exposed the veins, contained considerable water or other materials that had drained or fallen in since the work was performed. One vein, however, was well exposed in a 25-foot shaft near the cabin; this deposit has an average thickness of about 3 feet, strikes N. 58° W., dips at angles of 60° to 70° to the N.E., and cuts across the foliation planes of the schist wallrock with every appearance, in the shaft at least, of being a typical regular fissure vein. The wallrocks everywhere observed are sericitic or chloritic schists.

The quartz outcrops on this property are in most places from 2 to 3 feet in thickness, and represent at least 3 or 4 veins and possibly more. In different portions of the claims exposures of quartz, approximately in alignment, were noted at various intervals extending throughout distances of several feet, but until more development has been performed it will be impossible to decide whether these lines of exposures each represent one continuous vein of several more or less connected lense-shaped deposits such as characterize the schistose rocks of that district.

The quartz is characteristically white and generally but slightly mineralized; however, in some places, the veins carry considerable disseminated pyrite which, where oxidized, gives the quartz a reddish, iron-stained appearance; occasional particles of galena were also noted.

Concerning the average gold content of the quartz, but little is known. The writer took only three samples from the different veins of the Lloyd group, and all yielded merely traces of gold. However, one of the owners of these claims had what he considered to be an average sample of one of the veins tested during the time I was in Dawson, and this gave $10.60 in gold to the ton; and other still higher assays are believed to have been obtained at different times. In this connection, however, it is to be remembered, as previously mentioned, how extremely difficult it is to get satisfactory results from assay samples of low-grade free-milling ores; the samples taken by the writer may not be at all representative of the veins from which they were taken. To obtain reliable information concerning such ores, either a great number of assays must be taken, or mill tests must be made.

Considerable prospecting work has been performed upon this group of claims, mainly as follows; about 10 shafts, having an average of approximately 30 feet,

have been sunk, the deepest of these being down 56 feet when visited in September; in addition, a number of open-cuts and trenches have been dug.

Bear Creek.

A number of quartz claims, probably 30 or 40 in all, owned by John Nicholas and others, have been located on the right limit of Bear Creek near the junction of this stream with Lindow Creek. The schistose bedrock at different points on these claims, contains deposits of quartz impregnated with more or less pyrite, and in places showing particles of native gold that is occasionally quite crystalline. It is not known what average amounts of gold the veins in this vicinity contain, but it is claimed that a number of promising results have been received.

OBSERVATORY INLET, BRITISH COLUMBIA

By R. G. McConnell, in Summary Report of Geological Survey," 1911

(*CONCLUDED*)

"In addition to the numerous trenches and tunnels, the mineralized area has been further extensively explored with the diamond drill by the Granby Company, the present owners of the property. A number of long bore-holes, starting from various points alng the main tunnel and from the surface, have been drilled and have yielded valuable information in regard to the general character of the deposit.

"**Size and General Character of the Deposits.**—The mineralized area, as shown by the various surface and underground workings, is of great extent, although it has not as yet been fully defined, both ends being still unknown. In shape it forms a right angle. The smaller arm, known as the first orebody, has a northeasterly strike and dips to the northwest. It has been traced from the main tunnel in a southwesterly direction for more than 600 feet, the width averaging about 160 feet, or including a siliceous band which borders it on the northwest, of nearly 200 feet. The longer arm, holding the second orebody, has been traced in a northwesterly direction for a distance of 1,500 feet, with an average width of about 400 feet. The deposit has been proved by a borehole to a depth of 514 feet below the main tunnel, or approximately 900 feet below the surface outcrops on the hill.

"While only a portion of the large area described contains valuable minerals in sufficient quantities to constitute commercial ores, the original rocks are everywhere either completely altered into greenish or less commonly brownish bicaoeous schists or replaced by quartz and iron and copper sulphides. The transition from the dark, slightly-altered argillites, which constitute the country rocks, to ore is usually fairly abrupt, often occurring in a few inches.

"A conspicuous feature of the deposit is the presence of a zone of whitish quartz schists, practically strongly silicified argillites, traceable part way around it. This siliceous zone forms the northwestern boundary of the southwestern or smaller arm, crosses the deposit, then bending at right angles continues to the northwest as the northwestern boundary of the larger arm. It was not observed on the southwest border of the larger arm or the southeastern border of the smaller one.

"The rocks in the siliceous zone vary in the amount of silicification undergone. In most places they are nearly pure quartz schists, but occasionally the zone consists of alternating dark and white bands. The width of the zone ranges from 30 to 60 feet and more. The dip where it skirts the smaller arm and crosses the deposit is to the northwest, but after bending to the northwest the dip, as shown by the boreholes, changes to the northeast. It thus forms the hanging wall of both arms.

"**Mineralogy.**—The metallic minerals present consist mainly of iron pyrite, some of it cupriferous, pyrrhotite and subordinate qualities of chalcopyrite. A little bornite, evidently secondary, was found at one point. The principal non-metallic constituents are quartz, some calcite, a greenish micaceous schists, probably largely chloritic, some brownish schists, and occasionally some hornblende.

"Pyrite is the most abundant metallic mineral present. It usually occurs in a granular condition, and in places near the surface breaks down into an iron sand. It is always associated with more or less quartz and large areas consist of pyrite grains separated by a thin siliceous matrix. It also occurs in grains and small bunches distributed through the secondary schists. Its distribution through the mineralized area is irregular, some portions containing only a small percentage, while others consist almost entirely of sulphides and quartz. The main tunnel, started some distance down the slope from the mineralized area to gain depth, passes through 380 feet of argillites, all somewhat altered and containing occasional grains and small bunches of pyrite, then through a pyritic zone 200 feet wide, beyond which is a second pyritiz area which continues to the end of the tunnel 120 feet. A drift to the left from a point near the end of the tunnel running about north for 300 feet, shows the continuation of the pyritic area for that distance, the breast being in granular sulphides mostly pyrite, embedded in a siliceous matrix. A drift to the left passes through sulphides and quartz for 100 feet, then through greenish chloritic schists only slightly mineralized for 120 feet.

"The comparatively barren interval separating the two pyritic areas in the tunnel is not apparent on the surface, some of the ground overlying the lean portion being well mineralized with sulphides.

"Pyrrhotite, while much less abundant than pyrite, is common throughout the greater part of the mineralized area. It occurs intermingled with the pyrite and also forming comparatively large masses, usually specked with chalcopyrite.

"Chalcopyrite in grains, small aggregates of grains, in thin layers, usually accompanies the iron sulphides where the replacement is complete or nearly so, and also occurs in small quantities scattered through portions of the schistose areas. The proportion present, while variable, is always small and in certain areas seems to be absent altogether. The chalcopyrite is associated so intimately with the iron sulphides that there is little doubt that both are the products of the same period of deposition.

"Bornite was found at one point, but only as a surface alteration mineral, and it does not occur, so far as known, as a primary mineral of the deposit.

"Among the non-metallic minerals, quartz is the most prominent. A wide siliceous zone crosses and bounds portions of the mineralized area, and the large sulphide areas are all more or less siliceous. Calcite occurs occasionally, but is not prominent. Portions of the area included in the mineralized zone on the map accompanying this report consist of greenish micaceous schists often highly siliceous. These contain significant quantities of sulphides in some places and are nearly barren in others.

"**Ores.**—The iron sulphides in the Hidden Creek mine contain very low value in the precious metals. Out of a number of samples assayed in the laboratory of the Mines Department one showed 0.02 oz. gold to the ton, one 1.05 oz. silver, and the remainder only traces. The commercial value of the deposit must, therefore, depend mainly on the copper content. Chalcopyrite usually accompanies the iron sulphides, but in variable amounts. Some areas are nearly barren, while others contain sufficient quantities to constitute a log-grade copper ore—that is, ore containing up to three per cent. copper and, over limited areas, an even higher percentage.

"The most important body of commercial ore so far outlined by the company's boring operations occurs southeast of the siliceous zone previously described, as bordering the shorter arm of the deposit on the northwest and continuing along the larger arm. The siliceous zone is fringed by a band of ore usually from 20 to 25 feet in width and already traced for a distance of nearly 1,400 feet. A vertical borehole from the main tunnel apparently proves it to a depth of 514 feet below that level and it extends to the surface above, a variable distance, depending on the contours of the country, but probably averaging about 200 feet. The huge tonnage expected from this orebody will undoubtedly be greatly supplemented from other portions of the mineralized area. Workable ores are known to occur at a number of points, but the definition of their extent and quality awaits further exploration."

(**Note.**—It should be kept in mind that a full year's development work has been done at the Hidden Creek mine since Mr. McConnell examined the property and obtained data for his report. Another long adit has been driven, at a depth of about 150 feet below the 530-foot level above mentioned; all the workings alluded to by Mr. McConnell have been considerably extended, and much diamond-drilling has been done. A few weeks ago the Phoenix Pioneer stated the total amount of development work done on the Hidden Crek proprty to have been as follows: "Some 2,255 feet of cuts, 8,671 feet of drifts, and 1,051 feet of raises. The total of diamond-drill holes is given as 23,590 feet" The further extensive development of the property is in active progress, and much money is being spent in surface improvements, including buildings, railway shipping docks, development of hydro-electric power for mine and smeltery purposes, power equipment of mine, and work preliminary to the erection of a 200-ton-a-day smeltery. At the annual general meeting of shareholders in the Granby Company, held early in October, it was stated that "there has already been developed ore 'estimated in sight' to an approximate total of 5,000,000 tons, with an average copper content of 2.3 per cent. or 46 lbs. to the ton.)

"**Origin.**—The mineralized area at the Hidden Creek mine occurs in a larger predominantly argillaceous area surrounded and doubtless underlain, although at a considerable depth, by granitoid rocks, and cut by dikes and stocks belonging to the same period of igneous intrusion. The argillites were irregularly compressed and folded at the time of the invasion and the deposit probably occupies an area more than ordinarily crushed and fractured, although this has been masked by subsequent alteration and deposition, and is not apparent. A wide, broken zone, rather than a single fissure, is conceived to have afforded the means by which heated siliceous waters carrying iron and copper sulphides in solution ascended from the underlying batholith altering the argillites in their upward passage and replacing them with silica and sulphides as the pressure and temperature conditions became less severe.

"An origin of this kind would ally the deposit genetically with the loosely defined contact metamorphic group, although the ordinary contact metamorphic minerals, including the iron oxides, were not observed, and are either absent altogether or present only in very small quantities.

"Deposits of the contact metamorphic group, that is, deposits situated on or near the contact of igneous masses with sedimentaries and formed by ore-bearing solutions, either aqueous or gaseous, emanating from the cooling intrusive, vary widely in character. Ordinarily they are described as bunchy, irregular masses, made up mostly of iron oxides, and iron, copper, lead, and zinc sulphides, in a gangue of secondary silicates, mostly garnet, epidote, augite and tremolite. An examination of numerous occurrences at various points along the west coast indicates, however, that neither shape nor the presence of any or the majority of the compounds mentioned are essential features. The shape is dependent on the channel followed, and in a broken region perfect vein forms produced by the complete replacement of the country between parallel fissures are not uncommon. The constituents are also dependent on the character of the parent intrusive, on conditions of deposit, and possibly on the aqueous or gaseous character of the emenations, and gradations occur from masses of pure or nearly pure magnetite to others made up largely of tremolite and iron and copper sulphides, and in some instances of quartz and sulphides. The present classification, based only on a broad genetic relationship, is far from satisfactory. The name of the group is also misleading, as it included deposits far removed from the actual contacts."

Bonanza Group.

"This group is situated about three-fourths of a mile up Bonanza Creek, a small stream emptying into Goose bay about two miles below its mouth. Bonanza creek is a rapid stream about 20 feet wide, confined in a deep, narrow valley terminating below in a rock canyon 20 to 30 feet deep, excavated since the glacial period.

"The Bonanza group of claims, six in number, were the first claims staked in the district, and were explored to some extent by Mr. M. K. Rodgers before the discovery of the Hidden Creek group. Very little work has been done on them in recent years.

"The general character of the deposit on which the claims are staked are similar to that of the Hidden Creek group. The country rock is a dark, somewhat altered argillite cut by pegmatite and dioritic dikes, before it was mineralized, and by a later set of basic dikes it was mineralized. The argillites are altered

over a wide area into biotite and chloritic schists, some of it quite coarse, holding variable quantities of pyrite, pyrrhotite, and, in places, chalcopyrite. The sulphides are accompanied by some quartz, but this mineral is much less abundant here than in the Hidden Creek mine. The altered and mineralized area has a width of more than 500 feet, and is opened by short tunnels for a distance of 600 feet along its strike.

"The workings consist of three tunnels, one more than 100 feet in length, north of Bonanza creek, near the creek level, and two tunnels and some surface work on the south side. The most westerly of the tunnels north of the creek cuts, near its mouth, 10 feet of granular pyrite, beyond which are micaceous schists holding only a small percentage of sulphides. Little copper is present. A sample of the granular pyrite gave on assay 0.48 per cent. copper, 1.25 oz. silver to the ton, and traces of gold. Some pyrrhotite holding specks of copper occurs in the middle tunnel. The east tunnel passes through micaceous schists sparingly mineralized with pyrite.

"The two tunnels south of the creek expose schists holding pyrite in scattered grains and bunches, and occasionally some pyrite. Some good-looking chalcopyrite ore is exposed in a cut near the creek, but further exploration is needed to determine whether or not it occurs in workable quantities.

"The Bonanza ground looks favorable enough to warrant diamond-drill exploration similar to that in progress with such good results in the Hidden Creek property. The area of altered schists containing iron and occasionally copper sulphides is very large, and the present workings cover only a small portion of it.

"A large quartz vein, fully 10 feet wide in places, occurs on the North Star claim, one of the Bonanza group. It holds some pyrite and chalcopyrite. A sample assayed yielded only 0.48 per cent. copper and 0.20 oz. silver to the ton. Around Goose bay a number of large quartz veins occur; most of these seem to be barren or nearly so."

(**Note.**—The Granby Consolidated Company is now developing the Bonanza group of 12 full and fractional claims under option of purchase. It was learned last August that diamond-drilling had been commenced, and that indications then were favorable for the property proving under development good enough for the company to purchase it.)

Redwing.

"The Redwing, staked in 1909 by Joseph McGrath, is situated about two miles up Glacier Creek at an elevation of 1,820 feet above sea-level. Glacier creek is a short, rapid stream issuing from a glacier which fills the upper part of its valley; the stream empties into Goose bay near its lower end.

"The country rock in the vicinity of the claims is an altered silicified green-stone, passing in places into a schist, lying between the argillites and the granite. Granite occurs a short distance to the south, and a wide dike or spur crosses the valley at one point.

"The claim is staked on a conspicuous oxidized zone in the greenstone running up the northern wall of the valley. The zone has a width of more than 50 feet in places, contains some quartz stringers, and is paralleled on the east for some distance by a strong quartz lead. A basic dike, made up largely of hornblende and fresh plagioclase and showing a diabase texture, crosses it at one point.

"The mineralization is similar to that of the other occurrences described, consisting of iron sulphide with some irregularly distributed chalcopyrite. The only development work done consists of a tunnel 25 feet long, driven into the face of the cliff near the centre of the oxidized zone. This passes through the basic dike mentioned above, then through six feet of nearly solid iron with some copper sulphides, the latter in grains and fair-sized bunches, then through micaceous schists sparingly mineralized. Chalcopyrite occurs both in the tunnel and at other points in sufficient quantities to constitute a good copper ore, but development work is needed to prove quantity. Assays of the sulphides are stated to show some value in the precious metals."

Red Bluff Group.

"Looking up the wide valley of the Kitzault river from the head of Alice arm, a red patch shows prominently on the face of a mountain north of the river, distant about 4½ miles. A number of claims have been staked on the red area, and grouped together under the name of the Red Bluff group.

"A short visit to the showing was made in company with Mr. Young, one of the owners, but as little development work had been done, observation was limited to the general surface features. A rough trail leading up the valley of the Kitzault for some distance, then up a tributary stream from the north, has been brushed out to the foot of the red bluff.

"The rocks in the neighbourhood of the showing consist mostly of fine and medium-textured, greenish, tufaceous sandstones alternating in places with bands of finer-grained, dark, argillaceous rocks. The tufaceous sandstones occur in wide, practically massive bands, showing little stratification. They are not much altered and consist mainly of rounded and angular feldspar grains, some quartz, and fragments of volcanic rocks.

"The mineralized area is very large, fully 1,000 feet in width and raceable for a long distance up the steep slopes of the mountain. The rocks are fractured and the pyrite oxidized to a greater depth han usual, and no large mass of sulphides is exposed on the surface. Copper carbonates in small quantities occur at a number of points, and a specimen consisting mostly of white pyrite in a siliceous gangue contained small specks of bornite. Some pyrargyrite in small grains was also found with pyrite in one exposure. This mineral does not occur, or at least has not been found, in the other large iron croppings of the district. A crust deposited by a spring bubbling up near the centre of the deposit was determined by Mr. R. A. A. Johnston, departmental mineralogist, as allophane, a hydrous silicate of aluminum.

"The economic importance of this large pyritized area is uncertain. It contains some copper, and while the small amount of surface work which has been done has not exposed it in commercial quantities, the prospects certainly warrant further exploration. The presence of the rich silver mineral pyrargyrite, even in small quantities is important.

QUARTZ VEINS.

Aldebaran, Black Bear, Etc.

"Quartz veins rich in silver occur on a group of claims, including the Aldebaran and Black Bear, located three-fourths of a mile north of the head of Alice arm, on the lower slopes of the mountains bordering the valley on the west. They were located in 1906, and the controlling interest is owned by Mr. Frank Roundy.

"The principal showing is on the Aldebaran and consists of stringers of quartz cutting the argillites for a

width of about 6 feet. The central vein has a width of 6 to 8 inches and a drift has been started on it. It is well-mineralized, while the bordering quartz stringers are nearly barren. The strike is northwesterly, and the dip to the southeast at an angle of 45 degrees. The minerals consist of pyrargyrite or ruby silver in noticeable quantities, argentiferous galena, pyrite, chalcopyrite, and sphalerite. The vein, where exposed in the short tunnel, runs very high in silver, but has only been followed for a short distance. A small cut 100 feet from the tunnel in the direction of the lead shows a quartz vein 3 feet thick, and quartz also occurs in cuts 250 and 350 feet distant. It is uncertain if the small quartz veins in these cuts represent a continuation of the rich vein at the tunnel or are different veins lying in the same fractured zone. They contain some value, but are less highly mineralized, and no pyrargyrite was noted.

Molybdenite Group.

"The Molybdenite group of claims is situated north of Alice arm, about a mile east of the contact of the argillaceous series with the granite of the Coast range, and at an elevation of 1,100 to 1,400 feet above sea-level. The argillites are associated with some coarse feldspathic beds probably of tufaceous origin, and by pre-granite, altered, greenish dikes.

"The showing consists of a series of quartz veins and stringers following a fractured zone striking in a northeasterly direction and traceable for more than 1,000 feet. The strike of the veins as a rule is parallel to that of the zone, but occasionally the veins cross the zone diagonally. They vary in thickness from a few inches up to four feet.

"The quartz veins contain molybdenite sometimes in considerable quantities, in scattered flakes, small bunches, and in lines parallel to the sides. Other minerals present in small quantities are iron pyrite, galena, and blende. A strong quartz porphyry dike which crosses the trend of the lead is slightly mineralized with molybdenite and cut by small quartz stringers.

"A specimen of the molybdenite-bearing quartz, assayed in the the laboratory of the Department of Minpes, contained 2.60 per cent. of molybdenite and traces of gold and silver. The owners state that fair gold value has been obtained from places along the lead.

Waterfront Claim and Others.

"The Waterfront claim is situated on the north side of Alice arm, about half a mile from its head. It contains a strong quartz lead about 6 feet thick, which outcrops near the water level and is said to be traceable in a northwest direction across the claims. It contains grains of iron pyrite, galena, and sphalerite, but is only lightly mineralized. Pyrargyrite is stated to have been obtained from it, but none was seen by the writer.

"A galena showing on a branch of Lime creek in the mountains south of Alice arm, and a large iron showing high up, west of Goose bay, were not examined, as at the time of my visit (June 23-July 15) they were still buried in snow.

Maple Bay.

"Maple bay is a small indentation in the coast of Portland canal, situated due west from the head of Goose bay on Observatory inlet. The argillaceous rocks of Goose bay extend westward across the mountain range separating Observatory inlet from Portland canal, and crop out along the shores of the latter in a wide band in the vicinity of Maple Bay. They become more altered in their extension westward, and the dark argillites are represented by greyish and dark micaceous schists and the included greenstone bands, both clastic and massive, by chloritic schists.

"The schists are cut in places by quartz veins, and one of these was mined on a considerable scale some years ago by the Brown Alaska Company. The vein worked is situated about a mile from the beach in a N.N.E. direction, and at an elevation of 980 feet above it. A road from the beach to the mine was constructed, a wharf built, and a number of buildings, including bunkers, erected at the mine and wharf, and a compressor and boiler-house at the beach. All of these are now rapidly going to ruin.

"The principal workings consist of a long tunnel measuring roughly 980 feet. The quartz vein was followed for 550 feet. It was then either lost or gave out, as little quartz was noticed in the last 430 feet. The vein strikes a few degrees east of north and dips to the east at an angle of 45 degrees. It consists mostly of quartz with some enclosed schist, and ranges in width from 3 to about 12 feet. The principal metallic minerals noted are pyrrhotite, pyrite, and chalcopyrite. The percentage of chalcopyrite varies, and only in places is present in sufficient quantities to constitute an ore. Small value in the precious metals is reported.

"Some stoping has been done and the ore shipped to a smeltery on Prince of Wales island, southeast Alaska. The general tenor of the ore was not learned. The mine has been idle for several years."

Note.—Under the name of the Outsiders group, this property has been described in one of the reports of the British Columbia Department of Mines.

THE HISTORY OF THE NICKEL INDUSTRY IN CANADA AND THE UNITED STATES

The history of the nickel industry formed the subject of an address delivered last month by Mr. David H. Browne, metallurgist of the Canadian Copper Company, before the Undergraduates' Society of Applied Science of McGill University. The lecturer stated that although nickel was discovered in 1751 it is only within the last few decades that its production has become a distinct factor in the mineral industry of North America. Until 1890 the two principal producing countries were Norway and New Caledonia; but since that date Canada has assumed the lead, and now easily occupies the premier position. The history of the Canadian industry is intimately connected with the activities of three men, namely, S. J. Ritchie, of Akron, Ohio; Robt. M. Thompson, of New York, and an Englishman named John Gamgee. None of the three in the beginning was aware of the existence of the others. In 1876, Gamgee undertook to build for tropical service a hospital ship, on which it was proposed to maintain a low temperature by means of ice machines. In connection with

this enterprise, the difficulty presented itself that at the pressure employed ammonia gas leaked through cast iron. To overcome this a series of experiments with various alloys were conducted by Gamgee at Washington; and here he met Ritchie, who proposed the use of an alloy similar to meteoric iron. As a direct result the remarkable properties of nickel steel were discovered. But it was not for many years later that the value of the discovery was applied. Meanwhile Mr. Robert M. Thompson and his partner, Mr. W. E. C. Eustis, were engaged in developing a deposit of nickel ore in Oxford township, Quebec, but efforts to smelt the ore proving ineffectual, they abandoned the nickel enterprise and engaged in copper mining and smelting at Capelton. At first the matte was sold to copper refiners at Phoenixville, Pa., but later the partners decided to establish their own refinery, which was accordingly built at Constable Hook, New Jersey, and became known as the plant of the Oxford Copper Company. Shortly thereafter the partnership was dissolved, Mr. Eustis retaining the mines at Capelton, while Mr. Thompson became sole proprietor of the Oxford works, and as such, a buyer of copper ores. This was in 1885, about which year copper was discovered in the Sudbury district. In the year 1882, Mr. Ritchie became associated with others in the building of the Central Ontario Railway, to open the iron ore deposits of Hastings County. He subsequently advised the extension of this line to form a connection with the Canadian Pacific, and with this in mind visited the Sudbury district in 1885. Here he acquired options on a number of what appeared to be valuable deposits of high-grade copper ore, on the strength of which he returned to Cleveland and organized the Canadian Copper Company. At that time the existence of nickel in this field was unknown. At this point, the lecturer remarked: "We have now the three threads of the nickel industry coming together and uniting. Mr. Ritchie, with his company ready to sell copper ore, which they did not know contained nickel; Mr. R. M. Thompson, coming forward to buy these ores, supposing them to contain nothing but copper and being himself prejudiced against nickel by his disastrous experience at the Oxford mine, and Mr. Gamgee, who had at this time vanished, but had left on Mr. Ritchie's mind an impression destined to have memorable results." Mining was commenced by the Canadian Copper Company in 1887, and 167 carloads of picked copper ore were shipped, part to the Nichols' chemical works and part to the Oxford works. The Nichols' chemical copper works being unable to make refined copper from the ores consigned to them, sent them to the Oxford works, where the same difficulty was experienced, investigation resulting in the discovery of the prsence of nickel. The problem then was, first, to remove this metal, to slag it out and leave marketable copper, and, second, but a far less important consideration, how to make nickel and how to make it profitably.

At this date the control of the nickel business was in the hands of the Societe le Nickel, operating the New Caledonia mines, owned by the Rothschilds, and practically controlling the nickel trade of the world, which then (1887) represented less than 1,000 tons a year. The New Caledonia ore was smelted with gypsum or alkali waste, yielding a nickel-iron matte, the iron being subsequently slagged off, leaving a pure nickel sulphide, from which the pure metal was obtained by roasting and reduction. A little nickel, from the nickel-copper ores of Norway, was also produced by the Vivians at Swansea, whose process was guarded with careful secrecy, while in the United States, ores from the Lancaster Gap mine, in Pennsylvania, were treated by Mr. Joseph Wharton, of Camden, N.J., in the production of nickel and cobalt on a limited scale. In 1882, however, Mr. Wharton was forced to abandon his enterprise by the Societe le Nickel.

"In general," to again quote verbatim, "it may be said of the nickel business at the time that it was suffering from an over-supply, and that its control was very lightly held by the French company. When, in this condition of the market a large supply of ore was thrown into the hands of men who knew absolutely nothing about the technicalities of the business or the conditions of the market, the outlook was at least doubtful and discouraging."

Meanwhile, Thompson had contracted to receive and the Canadian Copper Company had contracted to deliver, several thousand tons of ore containing about 15 per cent. copper. It was imperative that some means could be devised of slagging off or separating the nickel, and it was found that by repeated reverberatory smeltings the nickel could be successfully oxidized. Thus, a large amount of nickel-copper slags were accumulated, some of the copper being recovered in marketable form. After purchasing the Tatro patent for the treatment of nickel ores, the Oxford company continued its experimentations and finally discovered that if a copper-nickel-iron matte were melted with carbon and an alkali sulphide, two products were given: first, a "top" or lighter upper portion containing the major portion of the copper and iron with some nickel, and, second, a "bottom" or heavier portion containing the major portion of the nickel with some copper and iron; and that a comparatively clean seperation could be effected by repeated re-smelting of these products with more alkali-sulphide.

In the year 1888 the Canadian Copper Company decided to erect a smelter and to consign their product to the Oxford company in the form of nickel-copper matte, instead of as ore. This smelter was blown in on December 23 of that year. The furnace building was 35 x 40 feet, and contained one small Herreshoff furnace, 3 ft. 6 in. x 6 ft. at the tuyeves. In 1889, the company produced 8,450 tons of matte, which contained about 1,600 tons of copper and 1,200 tons of nickel. In this year the nickel production of New Caledonia was 1,332 tons, and consequently it was necessary to create a market for the new supply. In May, 1889, the Iron and Steel Institute published a report on the properties of nickel-steel, and Mr. S. J. Ritchie, recalling his own experiences in connection with the experiments of Gamgee, directed the attention of General Tracy, Secretary of the U. S. Navy, to the report in question. Investigations by both the United States and Canadian authorities followed, and resulted in a decision to adopt nickel-steel armour for the United States warships. Congress voting the sum of a million dollars to be devoted to the purchase of nickel. But while the investigations were in progress both the German and French nickel companies made overtures, which were rejected, to obtain control of the Sudbury nickel deposits.

In this year, 1890-'91, several other undertakings, notably the Vivians and the Dominion Mineral Company, commenced operations in the Sudbury district; but the smaller organizations were very soon driven out of business by the action of the French Nickel Syndicate in reducing the price of nickel to 1s. 1d. per pound. In fact, at one time, the Canadian Copper Company had over 9,000 tons of matte stored in the

smelter yard, and as the banks refused to accept overdrafts, the company would have been in difficulties but for the directors, who pledged their private fortunes in support of the enterprise. It was not until 1894, eight years after its organization, that the company found itself in a position to pay a dividend. This distribution was at the rate of 8 per cent. Meanwhile the company had decided to endeavour to refine its own products, and entered upon a series of experiments to attain that purpose. Among those engaged to undertake this work were Mr. Jules Garnier, who had erected nickel refineries in France, and Dr. Carl Hoepfner, both of whom, however, failed. The Mond proces was also investigated under option, but was not considered to be adopted to conditions in Canada. From 1892 to 1902 the Canadian Copper Company conducted a long and costly series of experiments in Cleveland, and finally succeeded in developing an electrolytic process which yielded satisfactory results, although not equal to those afforded by the Oxford process, and consequently it was abandoned.

In the year 1902, the International Nickel Company was organized, acquiring the interests of the Canadian Copper Company, the Anglo-American Iron Company (which, in addition to ironfields in Hastings County, owned valuable nickel properties to the west of Sudbury), the Oxford Copper Company, the American Nickel Company, the Wharton Refining Works at Camden, N.J., and the Nickel Corporation of London and the Societe Miniere Caledonienne. "This organization," Mr. Browne remarked, "brought miners, smelters and refiners to mutual understanding and made the way for many economics that could not heretofore have been effected. The strong competitors of the International Nickel Company are the old Societe le Nickel, with its New Caledonia ore deposits and its five refineries at strategic points in England, France and Germany, and the Mond Nickel Company, with its mines and smelters some 20 miles west of Sudbury and its refinery at Clydach in Wales. One of the first moves of the International Nickel Company was the gathering of the scattered furnaces of the Canadian Copper Company into one modern smelting plant. This smelter, which was modelled after the best copper smelting plants in the United States, was blown in in July, 1904. It was not, however, perfect in design for the requirements of copper-nickel ores, and only after two or three years of work and study were defects entirely remedied. Since then important additions and improvements have been made to the plant, which, although not so stated by Mr. Browne, is now recognized as a model of its kind in the world.

The company produces every year several thousand tons of copper and nickel in the form of a Bessemer matte, containing 80 per cent. copper-nickel. This matte enters the United States duty free, and is refined at the Oxford Copper Company's plant in New Jersey, where the necessary salt cage, oil, fuel, coal and chemicals can be obtained at figures very much below their cost in Canada, and where also ocean freights and competing railway connections reduce the cost of shipment to a minimum.

PERSONAL AND GENERAL

Mr. Alexander H. Smith, of the firm of Carter and Simth, 488 Confederation Life Building, Toronto, is examining properties in Eastern Ontario and will return to South Porcupine about December 1st. Mr. W. E. H. Carter, of the same firm, is in the West.

Mr. Benedict Crowell, of Crowell and Murray, Cleveland, Ohio, spent a week in Toronto recently in connection with some mining litigation.

Mr. J. B. Tyrrell sails shortly for London, England.

Mr. Ralph S. G. Stokes, of the Canadian Mining and Exploration Co., New York, was in Toronto last week. Our readers will remember Mr. Stokes as a frequent contributor to the technical press.

Mr. John Rooke-Croowell, late of California and Mexico, has accepted the position of manager of the Cordova mine, Hastings County, Ont.

At the Mann mine, Gowganda, really remarkable progress is being made. Under Mr. G. R. Rogers' supervision, the mine has produced more than $100,000 worth of silver since January of this year. This includes only the high-grade ore. Much mill rock has been produced. This will be treated when the projected mill is completed. The mine is only partly equipped and not more than 25 men have been employed. Hence the results obtained are unusually satisfactory.

Mr. John J. Penhale has returned to Sherbrooke after a month's absence in New York.

Mr. L. M. Adsit, manager of the Eustis mine, Eustis, Que., was in Montreal last week. The company is about to employ the Elmore oil process in connection with the treatment of the ore. The plant is being manufactured in Toronto.

On the eve of his departure from Cape Breton, Mr. M. J. Butler, C.M.G., formerly general manager of the Dominion Steel and Coal Corporation, was presented with an address and a testimonial by the Provincial Workmen's Association, while the district superintendents and other of the colliery officials presented him with a gold watch, suitably engraved.

The Maritime Mining Record remarks that much satisfaction is expressed by the employees of the Dominion collieries at the appointment of Mr. D. H. McDougall to the general managership of the corporation's coal and iron mines.

It is with very deep regret that we record the death which occurred on the 14th inst., of Mr. R. T. Hopper, of Montreal. Mr. Hopper had been identified with the mining industry for thirty-five years, first in connection with the manufacture of Portland cement, and later in the mining and production of asbestos and marble. He was a charter member of the Canadian Mining Institute, in which organization he took a keen and active interest. That his services to the society were valued is attested by the fact that he served as a member of Council for no less than nine terms, a record so far unequalled. A man of warm sympathies, generous-hearted, broad-minded, loyal and upright in character, the death of "Bob" Hopper, as he was affectionately termed among his intimates, is a sad loss. He fought an uphill fight against odds for thirty years. That having achieved success he should not live to enjoy its fruits seems hard, for he was but fifty-four when he died. Yet he had the consciousness that he left behind him the record of a clean and useful life.

The death occurred recently in Winnipeg of Mr. William Ogilvie, formerly Governor of the Yukon, and since associated with gold dredging in that territory. Before his term as Governor, the public service in the Yukon was disgraced by the corruption and thievery of its officials. Mr. Ogilvie removed this stigma, and by his own conduct set an example of efficiency and honourable dealing that has not been forgotten.

SPECIAL CORRESPONDENCE

NOVA SCOTIA

Dominion Coal Outputs.—The October output by collieries was as follows:

No.	Tons.
1	53,041
2	71,448
3	11,694
4	36,068
5	20,834
6	25,427
7	19,414
8	13,065
9	38,180
10	20,013
12	31,899
14	33,632
15	18,446
16	17,064
21	9,867
22	2,251
	422,343

No 1 Colliery had the best month for two years, and all the Lingan collieries exceeded their previous records, as did also Nos. 21 and 22 collieries. The total output for the month exceeded by 11,000 tons the best previous monthly production.

To the end of October the production for this year compares with 1911 as under:

	Cape Breton Collieries. Tons.	Springhill Collieries. Tons.	Total Dom. Coal. Tons.
10 months, 1911 ..	3,322,291	194,965	3,517,256
10 months, 1912 ..	3,743,705	350,491	4,094,196
Increase	421,414	155,526	576,940

During the first half of November, outputs have also been high, except during the first few days. To the sixteenth inclusive the production from the Glace Bay collieries totalled 220,000 tons, and the Springhill tonnages were also very good. On several occasions the Springhill output has exceeded 1700 tons, and on the 13th it reached 1782 tons, the largest day's output obtained at Springhill for a good many years.

It is hoped that the weather conditions this season will permit of navigation in the St. Lawrence river until a much later date than usual, and the Dominion Coal Company expect to despatch steamers up the river leaving Sydney 20th November, or possibly a few days later. In any case, the St. Lawrence shipments will be much larger this year than ever before. It is confidently expected that the Coal Company's St. Lawrence shipments in 1912 will reach over 1,600,000 tons, or 400,000 tons in excess of any previous season. In addition to this it is intended to send considerable quantities of coal to Montreal during the winter via Portland.

The combined output of the Dominion Coal Company's collieries will hardly reach five million tons in 1912, but it will go very close to that figure, probably 4,950,000 tons, or over 700,000 tons better than 1911.

Practically every one of the Nova Scotian collieries will register an increased output in 1912, and the Commissioner of Mines will be able to make up for his Government the largest royalty payment yet recorded.

The Bettington boilers at the Waterford Lake Power plant of the Dominion Coal Company are completed. At the first trial the No. 1 boiler gave a steam pressure of 50 lbs. within twenty minutes from the starting of the flame, notwithstanding that the brickwork was all damp, and that the crevices of the firebrick in the combustion chamber were not "slagged up." It is one of the features of this boiler that the brickwork of the combustion chamber is said to need no renewals after the first lining is provided, as the lining is automatically renewed by the deposition of molten slag. It is as yet too early to say what results may be expected from this entirely new type of steam-raiser, but the initial trials have so far been such as to justify sanguine hopes.

The tendency of modern steam-raising appliances seems to be in the direction of boilers fired by dust-fuel or gas, as enabling more perfect combustion than is possible by the burning of coal in the mass. Such boilers are also more easily regulated and can be operated with the minimum of manual labour. They can also be started at any time quickly from a cold state, without the necessity of banking fires.

Professor Bone, late Livesey Professor at the University of Leeds, and now Professor in the Imperial Institute of Science and Technology, London, is the inventor of a boiler which generates steam from the surface combustion of a mixture of air and gas upon various refractory surfaces. This boiler has given efficiencies as yet unparalleled by any other type of boiler, but your correspondent is unale to say whether Prof. Bone's invention is yet on the market. A great deal will be heard of this boiler in the future, and it is claimed that it will have a revolutionary effect on steam-raising practice.

The Dominion Coal Company's new Baum washer is completed and has been in operation since the middle of September. Work is now proceeding on the provision of large storage capacity for the washed product. A series of hoppered pockets are being constructed in reinforced concrete, which, when completed, will be capable of storing six thousand tons of washed slack-coal. The washed nuts which the washer separates from the slack-coal are an excellent product, and are without doubt the best blacksmiths' coal ever put on the market in Canada. Once the quality of these nuts is known and appreciated they will be in great demand.

A drilling crew with a Keystone churn drill have been occupied for several months past in boring for coal within the limits of the City of Sydney. A depth of somewhere over 400 feet is said to have been reached, but no signs of coal have been noticed. Seeing that the locality of the borehole is in the carboniferous limestone, outside the crop of the millstone grit and nearly seven miles outside the crop of the lowest workable seam in the productive coal measures, it does not seem probable that any coal will be struck. The parties interested are said to represent United States capital. They do not seem to have been well advised from a geological point of view. There are a certain number of people in this vicinity—as probably in every other coal country who affect to despise the findings and maps of the Geological Survey, and elaborate theories of their own that are at once the amusement and the despair of every practical mining engineer to whom they are propounded. Although actual working of coal seams and new openings will oftentimes necessitate slight alterations and corrections on the Geological Ordnance, there has yet to be discovered any serious error in the general plotting of the measures in the Cape Breton sheets, at any rate. Just why people will spend good money on looking for coal in such unlikely localities as the one referred to is difficult to understand.

ONTARIO.

COBALT, GOWGANDA, SOUTH LORRAIN

Nipissing.—During the month of October the Nipissing only mined $99,040, as their sorting plant at the Meyer had been closed down. The ore there was being held in reserve for the time when the low grade mill wuld be ready and the new washing plant there was not opened until the beginning of this month. The production this month will be above the average. The shipment of ore was slightly larger than usual, namely, $322,640. Development work at shaft 73 continues to give satisfactory results. The southeast branch of the main vein at the second level was drifted on for 110 feet and the ore averages 2,500 ounces over a width of three inches. At the third level this vein shows an inch of cobalt with small silver values. Another branch vein has been drifted on at the same level for 150 feet. It shows 2,000 ounce ore over a width of two inches and the face is still in good ore. Other branch veins show fair ore for a width of one to two inches. In the winze below the third level to the west good ore continued for 56 feet, though the Keewatin came in at a depth of 40 feet. On the main vein itself the east face at the third level still shows high grade ore. Eighty feet of drifting have been done on the faulted extension, and altogether 600 feet of drifting have been done at the third level with the face still showing well. Exploration work at shaft 64, shaft 56, near the Savage, and 63 shaft is proceeding satisfactorily. The discovery on the Seneca Superior lease at Cart Lake is considered important. The Nipissing possesses nearly all the territory round this lake and will proceed to develop here on a larger and more ambitious scale than heretofore. The conglomerate formation here is deep and now that the existence of a high grade vein here has been definitely established, the prospect for the whole vicinity is quite promising. At shaft 64 sinking has reached 477 feet. No level will be cut until the 650 ft. level is reached when exploration work will commence.

Seneca-Superior.—There appears to be no doubt now as to the value of the discovery on the Seneca-Superior lease of Peterson Lake. The vein has been drifted upon for 80 feet now and its width and values hold well. Two shipments of screenings will be made this month, the Peterson Lake Company marketing the ore and taking 25 per cent. of the gross receipts.

Bureau Returns.—The returns from the Ontario Bureau of Mines for the first nine months of the year show that the production is approximately a million ounces less, while the value is over a million dollars more owing to the fact that the average price of silver has been a little over seven cents an ounce higher. The figures for the first nine months of 1912 are 22,231,451 ounces, valued at $12,707,826. The ratio of decrease, if continued to the end of the year, would show a total loss of a million and a half ounces for the present year, as compared with 1911, and a gain of $1,671,135 in value, or 30,500,000 ounces.

English Capital in Casey.—Encouraged by the phenomenal success of the Casey Cobalt, several English syndicates having claims in Casey township are attempting to do a little prospecting. The difficulty lies in the fact that there is a very heavy overburden of clay above the conglomerate rock and that wherever there is an outcrop the Casey Cobalt has purchased the claim. The Casey Cobalt itself once attempted to do a little exploration work in a gully where it was hoped that the overburden would be light, but found that they did not strike bed rock until the drill had penetrated through 91 feet of the most fertile Temiskaming clay. Undaunted by this serious handicap one English syndicate is operating a diamond drill.

Beaver Discovery.—In cross-cutting at the 650-foot level the Beaver has opened up a 2-inch vein of 2,000 to 3,000 ounces ore in country farther west than they have ever found any good vein before. The Beaver is stoping and developing ore on eight levels, and is now cutting a station at the 700-foot level, the deepest working in camp. The exploration work in the diabase has been, on the whole, encouraging. Wherever veins enter the diabase they do not, or very rarely, lose their silver values, but the vein is split up into three or four stringers and the wall rock between these stringers carries a good deal of heavy leaf silver. Several veins that have never been worked at the upper levels have been found and are being developed at the 650-foot level, and both here and at the Temiskaming it seems pretty well established that veins do not necessarily lose their values when they are found in the diabase sill below the Keewatin. The 700-foot level of the Beaver will show whether the ore holds good for some distance away from the diabase-Keewatin contact; if it does, there is reason to hope for depth in this portion of the camp, as it is estimated that the diabase sill is from 600 to 800 feet thick.

Buffalo to Refine.—When the Buffalo mill starts running about the 20th of this month, another mine will be refining right on the premises the ore they mine in the drifts. The Buffalo mine is designed after the Nipissing high grade mill. It is intended to concentrate in the present mill and tram the product over to the smelter, where it will be refined and eventually shipped out as bullion. The refinery will have a capacity of between 300 and 400 tons per month.

Strike at Townsite Settled.—The Cobalt Townsite strike has been settled. The men did not at any time officially receive the support of the Western Federation and after two weeks of inaction they themselves voted to go back to work at the same hours and at the same wages.

PORCUPINE AND SWASTIKA

Gold Outpots.—The figures submitted by the Bureau of Mines for Ontario show that the gold mines of the Province have produced in the first nine months of the present year 53,488 ounces, worth $1,117,335, or more than double in value that for any preceding twelve months. The bulk of this has come from the Dome and the Hollinger. Other contributors were the Vipond and the McIntyre, also of Porcupine; the St. Anthony, of Sturgeon Lake; the Cordova mines, of Hastings county, and the Olympia, of the Lake of the Woods. Mr. A. A. Cole, the original Porcupine optimist, has just estimated in a report submitted to the commission that the camp would have produced two million dollars this year, but that was before the strike, and industrial strife will for a time, at any rate, upset all calculations and stop the output.

Powell Progress.—It is stated that while doing assessment work on the Powell claims in Deloro township a 2-foot vein of quartz has been struck. A test pit was put down on it and at 9 feet it was 8 feet wide with some native gold in it. It is also reported that assessment work on the Scottish Ontario has discovered another vein worth while developing, but there is no sign of the British company resuming underground operations.

Alexo.—The owners of the Alexo mine at Iroquois Falls have elected to continue their own development in spite of a tempting offer from an American syndicate

Altogether the company has shipped this year 1,920 tons of nickel from their little mine, and they intend to keep it up all winter. They will instal a small two-drill compressor and a 65 horse power boiler. At present all the ore is being mined by hand labour, the gang never at any time having exceeded eight men. The work so far has been all on the surface. Surface work this summer showed that the vein was broader than at first anticipated, where it has been opened up between the two shafts for a distance of 250 feet. All the ore has been shipped to the Mond Nickel Company at Victoria Falls, and owing to its high grade a better price has been obtained from the English company. When the small plant is installed underground work will be started. The undertaking so far has been quite self-sustaining and has shown a profit over and above all expenses, development and contemplated plant.

Dane Copper.—Development at the copper property of the Dane mining company has been disappointing. Underground operations have been abandoned on the lens of ore where the plant and camps were established and two diamond drills are operating on other properties. The ore was rich but very spotty.

In anticipation of the coming of the railroad into Elk Lake there has been a whirlwind of activity on almost all the prospects in the camp. The Beaver Extension is sinking a new shaft to cut into the ore-body found by the original operators. It was found impossible to operate from the old shaft. At a property known as the Cobalt Frontenac, in Tudhope, much excitement has been aroused by the report of gold in a drift. It is stated that the values run as high as $40 per ton. At Gowganda the prospects are not as rosy as last year. The Millerett, the first consistent producer in the camp has shut down after making a good profit over and above all expenses. The Mann is still making good progress. The Miller Lake O'Brien continues to be the sheet anchor of the camp and is looking very well, indeed. The Hudson Bay Mining Company had a disappointing year, but will continue operations this spring. They hope to get better values at a lower level.

Plenaurum and Pearl.—Excellent progress is being made with development on the Plenaurum and the Jupiter on Pearl Lake. The Jupiter is now working, but the one drill deeming it best to feel its way very carefully round the intricate fault and problems of that property. The winze below the 200-foot level of the Plenaurum is in excellent ore, while the vein is three feet wide. Drills are running on four veins in the long cross-cut below the lake and the results are very promising.

BRITISH COLUMBIA.

Ainsworth Mining Division.—In Ainsworth camp, work is in progress on the No. 1 and other properties under bond to the Consolidated Mining and Smelting Company of Canada, and on the Silver Hoard, the latetr being operated by Spokane men. Smeltery receipts from the Silver Hoard to the beginning of November were about 150 tons of ore, and more was being got out for shipment. No. 1 and other properties in the vicinity are awaiting the completion of the aerial tramway, now in course of construction down to Kootenay lake before more ore will be shipped. Of these properties, the general manager of the company reported at the end of the last fiscal year: "Options have been taken on a number of properties in Ainsworth camp. Some of these have been operated at intervals for a good many years, but most of them have been closed down for some time. These properties are the Highland group, No. 1 group, Maestro, Banker, Tiger, and Libby (adjoining the Highland group). Development and prospecting is being carried on on all of these groups, in the case of the No. 1 with very satisfactory results. In the other cases the work is not yet far enough advanced to give any definite results." That was the position several months ago; no additional information has since been made public.

At the Blue Bell, across Kootenay lake from Ainsworth, now that suitable equipment has been provided for exploiting the ground below the main adit level, a good tonnage of ore is being mined—about 200 tons a day being sent to the concentrating mill. The total quantity milled this year to November 1 was rather more than 20,000 tons, and it is estimated that production will be maintained at the rate of about 6,000 tons a month throughout the winter.

Mr. C. E. Caldwell, of Kaslo, states that approximately $50,000 will be the total value of the production in 1912 from the Utica mine, on Paddy's mountain, a few miles from Whitewater, this estimate including the expected production of November and December. The silver content of the ore is stated at 173 to 188 oz. and the lead 7 to 15 per cent. Production has lately been at the rate of two cars per week.

Leasers have been at work in the upper part of the mine, but toward the end of August they stopped mining and sacking ore to get in supplies for the winter, build a house near the entrance to the tunnel, and construct a wire tramway. It is intended to work the mine through the winter. Many improvements have been made on the property, which now has wagon-road communication with Kaslo by telephone.

The branch railway from Three Forks to Bera lake has been extended to Whitewater, and transportation facilities thereby been provided for the Retallack Co. property, formerly the Whitewater group. Development work is being continued in parts of the mines of this group, and preparations being made for shipment of ore whenever conditions shall be favorable for a resumption of production.

SLOCAN CITY MINING DIVISION.

It was lately reported at Slocan City that at the Ellis Silver Mining Company's Eastmont Mine, Ten-mile creek, another shoot of ore had been entered.

Somewhere about 200 feet of drifting has been done in the Lily B. In the course of this work pockets of ore of fair grade have been found occasionally.

Preparations were being made during the first part of November to rawhide ore down from the Black Prince mine to the Arlington road, whence it will be hauled to Slocan City for shipment, thence by rail to the smeltery at Trail. Mr. J. C. Moen has been engaged for about two years in developing this property, and now it is stated he has sufficient ore in sight to allow of rawhiding being continued throughout the winter. Eight or nine men will be kept at work at the mine. The ore from this mine is "dry" ore, and it is believed there is an excellent showing of ore that will run high in silver.

Some very high-grade ore has been shipped from the Meteor this year, and the lessees, Messrs. Barber, Wafer and Jameson, have about another car ready to send down to Slocan City. It is expected that work will be continued at this mine all the winter and shipment of ore will be practicable throughout that season.

The Neepawa has been leased by Mr. E. Shannon, of New Denver. Mr Beckett is pushing on with the development of the Slocan, Daisy, and Bird group, from

which he has obtained very encouraging assay returns, chiefly in gold.

On Lemon creek, Mr. Andrew Sostad has eight or nine men at work on the Kilo and the Chapleau 10-stamp mill. Ore from the Kilo is said to average about $14 a ton in gold, and some 25 tons a day is being put through the mill, running one shift. Prospects are thought to be promising for a revival of mining on Lemon creek, where there are a number of mineral claims it is believed will pay well for development.

STATISTICS AND RETURNS

COBALT ORE SHIPMENTS

The shipments of ore for the week ending November 23 include a remarkably large shipment from the Seneca-Superior lease of the Peterson Lake property, of which the owners receive one-quarter. Another newly-opened mine, the Penn-Canadian, sends out a large car of high grade, mostly concentrates from the mill, which has lately been started. The Penn-Canadian was the Cobalt Central.

The bullion shipments for the week were confined to the one mine, the Nipissing, which sent out 76,007.20 ounces of silver, valued at $47,574|50.

The ore shipments for the past week in tons were:

Peterson Lake	2 high, 1 low	114.13
Cobalt Lake	1 high.	33.00
Townsite	1 high.	25.15
La Rose	1 high. 1 low	34.60
Penn-Canadian	1 high.	'4.45
Crown Reserve	1 high.	29.61
Totals	9 cars.	320.34

A new shipper was added to the ranks when the Seneca-Superior shipped a car of low grade ore. The shipments for the week ended Nov. 16 comprised nine cars of high and one car of low grade. The City of Cobalt Mine made its re-appearance with one car of high. The bullion shipments were again up to the average. The totals are as follows:

La Rose, 2h.	130.249
McKinley, 1h.	57,700
Kerr Lake, 2h.	122,317
Peterson Lake (Seneca-Superior lease 1L.	60,800
City of Cobalt, 1h.	54,000
Hudson Bay, 1h.	61,878
O'Brien, 1h.	65,980
Wettlaufer, 1h.	60,520
Total	613,520

The ore shipments for the week and year to date, in tons:

	Week Nov. 15.	Year to date.
Bailey.	.....	21.57
Beaver.	.....	663.75
Casey Cobalt	.....	255.15
City of Cobalt	27.00	914..99
Buffalo.	.....	989.50
Cobalt Lake	.....	827.88
Cobalt-Townsite	.....	1,641.37
Chambers-Ferland.	.....	427.83
Coniagas.	.....	1,874.33
Crown Reserve	.....	388.21
Drummond.	.....	383.05
Hudson Bay	30.98	631.20
Kerr Lake	61.15	712.22
La Rose	65.10	3,113.15
Lost and Found	....	27.80
McKinley-Darragh.	28.25	2,307.43
Nipissing.	.....	1,735.62
O'Brien.	32.99	325.b3
Penn-Canadian.	.....	63.45
Provincial.	.....	22.22
Right of Way	.....	242.82
Temiskaming.	.....	884.56
Trethewey.	.....	474.69
Wettlaufer	30.26	406.96
Colonial.	.....	6314
Dom Red. Co.	.....	56.64
Peterson Lake (Seneca Superior)	34.40	34.40
Totals.	306.72	19,487.49

The bullion shipments were as follows:

	Ounces.	Value.
Nipissing.	36,044.10	$16,258.03
Drummond.	970.64	611.42
Crown Reserve	42,568.85	26,605.53
Nipissing.	97,466.40	60,701.67
Totals.	140,905.99	$87,918.62

The year's bullion shipments to date are as follows:

	Ounces.	Value.
Nipissing.	3,468,358.07	$2,105,011.01
Crown Reserve	427,518.47	242,614.11
Temiskaming.	38,782.00	23,165.10
O'Brien.	188,617.94	112,873.61
Nova Scotia	49,010.00	31,800.00
Buffalo.	82,157.00	48,914.54
McKinley-Darragh.	80,327.00	6,069.37
Kerr Lake	21,463.19	13.081.95
Trethewey.	20,637.08	12,416.16
City of Cobalt	5,659.94	3,133.20
Colonial.	1,698.00	1,018.00
La Rose	69,849.00	41,030.88
Wettlaufer.	3,280,62	2,003.14
Cobalt Lake	5,256.88	2,989.75
Right of Way	505.50	273.00
C. Townsite	6,282.55	3,867.00
Drummond.	3,513.54	2,169.42
Casey Cobalt	940.00	574.00
Dom. Red Co	75,972.46	46,760.03
Miscellaneous	16,672.56	11,050.14
Bailey.	14,050.50	8,816.65
Penn-Canadian	445.00	282.69
Totals.	4.570,904.95	$2,718,825.75

B. C. ORE SHIPMENTS

A feature of last week's ore production returns for the Kootenay and Boundary districts was the number of properties which returned to the list of producers after having been absent for periods ranging from a week to two months. Among these was the Standard, the Rambler-Cariboo, the Whitewater, the Nickle Plate in the Rossland district, the Jewel, the Molly Gibson, the St. Eugene and the Hudson Bay. For the week the production was 49,476 tons and for the year to date, 2,209.042 tons. Smelter receipts for the week were 43,561 tons and for the year to date, 1,984,376 tons.

Production and smelter receipts for the week ending Nov. 16, were:

East Kootenay.

St. Eugene	98	572
Monarch, milled	425	10,700

Other mines		28,019
Total	523	39,291

Slocan and Ainsworth.

Standard	119	7,457
Utica	79	759
Rambler-Carbioo	17	901
Whitewater	57	931
Bluebell	94	2,393
Standard, milled	400	16,999
Van-Roi, milled	1,100	51,400
Bluebell, milled	200	3,500
Other mines		14,561
Total	2,066	97,992

Nelson.

Molly Gibson	192	2,195
Yankee Girl	62	149
Hudson Bay	60	768
Mother Lode, milled	500	12,750
Queen, milled	400	15,500
Granite-Poorman, milled	250	12,350
Molly Gibson, milled	300	7,500
Second Relief, milled	250	5,250
Other mines		7,911
Total	2,014	64,369

Rossland.

Centre Star	3,066	139,942
Le Roi	910	40,552
Le Roi No. 2	482	22,767
Nickle Plate	35	75
Inland Empire, milled	90	1,800
Le Roi No. 2, milled	300	8,600
Other mines		206
Total	4,883	213,942

Boundary.

Granby	22,734	1,114,609
Mother Lode	7,640	330,020
Unnamed	234	10,302
Rawhide	6,884	220,880
Napoleon	513	10,789
Knob Hill	52	1,781
Jewel	45	74
United Copper	100	1,435
Surprise	128	5,150
Nickel Plate, milled	1,500	67,100
Jewel, milled	200	2,800
Other mines		28,598
Total	39,990	1,793,538

Consolidated Co.'s Receipts.
Trail, B.C.

Standard	119	7,457
Utica	79	759
Rambler-Cariboo	17	901
St. Eugene	98	572
Knob Hill	52	1,781
Centre Star	3,066	139,942
Le Roi No. 2	482	22,767
Le Roi	910	40,552
Whitewater	57	931
Jewel	45	74
Molly Gibson	192	2,195
United Copper	100	1,435
Yankee Girl	62	149
Surprise	128	5,150
Hudson Bay	60	768
Bluebell	94	2,393
Nickle Plate	35	75
Other mines		61,501
Total	5,596	279,402

B. C. Copper Co.'s Receipts.
Greenwood, B.C.

Mother Lode	7,640	350,020
Unnamed	234	10,302
Rawhide	6,884	220,880
Napoleon	513	10,789
Other mines		18,374
Total	15,231	590,365

Granby Smelter Receipts.
Grand Forks, B.C.

Granby	22,734	1,114,609

TORONTO MARKETS.

Nov. 25 (Quotations from Canada Metal Co., Toronto).
Spelter, 6.35 cents per lb.
Lead, 5.25 cents per lb.
Tin, 52 cents per lb.
Antimony, 12 cents per lb.
Copper, casting, 18½ cents per lb.
Electrolytic, 18½ cents per lb.
Ingot brass, 11 to 15 cents per lb.
Nov. 25—Pig Iron (Quotations from Drummond, McCall & Co., Toronto).
Summerlee No. 1, $26.00 (f.o.b. Toronto).
Summerlee No. 2, $25.00 (f.o.b. Toronto).
Midland No. 1, $23.00 (f.o.b. Toronto).
Midland No. 2, $22.00 (f.o.b. Toronto).

GENERAL MARKETS.

Coal, anthracite, $5.50 to $6.75 per ton.
Coal, bituminous, $3.50 to $4.50 for 1¼-inch lump.

Coke.

Nov. 22—Connellsville Coke (f.o.b. ovens).
Furnace coke, prompt, $3.90 to $4.00 per ton.
Foundry coke, prompt, $4.00 to $4.50 per ton.
Nov. 22—Tin (Straits), $49.65 cents.
Copper, Prime Lake, 17.70 cents.
Electrolytic copper, 17.50 to 17.62½ cents.
Copper wire, 19.00 cents.
Lead, 4.50 cents.
Spelter, 7.50 cents.
Sheet zinc (f.o.b. smelter), 9.00 cents.
Antimony, Cookson's, 10.15 to 10.25 cents.
Aluminum, 26.00 to 27.00 cents.
Nickel, 45.00 cents.
Platinum, ordinary, $45.50 per ounce.
Platinum, hard, $48.00 per ounce.
Bismuth, $2.00 to $2.25 per pound.
Quicksilver, $41.00 per 75-lb. flask.

SILVER PRICES.

	New York cents.	London pence.
November 8	62⅝	28 15/16
" 9	62¾	29
" 11	62⅜	28 13/16
" 12	62½	28⅞
" 13	62⅝	28 13/16
" 14	62¾	29
" 15	62½	28⅞
" 16	62¾	29
" 18	62⅞	29 1/16
" 19	62⅝	28 15/16
" 20	62¾	29
" 21	62⅞	29 1/16
" 22	63	29⅛