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CIRCULATION

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CONTENTS

SILVER IN DEMAND AGAIN

A year ago most metals were cheap. The outbreak of war disorganized the market and the outlook was dark. Soon, however, the demand for metals became greater. Then the enormous orders for munitions brought about a revolution in the metal markets. Old customers put off their purchases, but new ones appeared. Then new and old customers both came into the market. Naturally the recognition of the increased use for metals resulted in higher prices. Most metals have been selling at good prices for months. Copper is in demand at 20 cents per pound. Lead is quoted at 5.25 cents, spelter at nearly 19 cents. Nickel is greatly in demand, and quotations are nominal at 45 to 50 cents per pound.

Some of the rarer metals are selling at very high prices. A sale of tungsten at $60 per unit was reported last week—an equivalent of $3,660 a ton for concentrates running 61 per cent. Quicksilver is quoted in New York at $105 per flask.

Iron and steel prices have been until recently quite low, the demand being poor and the future needs not anticipated. During the past few weeks the buying orders have been piling up and the result has been an advance in prices for which there is no comparison in the past decade of the industry.

Owners of silver mines have seen these rises in metal prices during the past year and have hoped that a similar recovery would show itself in the silver market. For months they have been greeted with quotations that have made them wonder whether their policy of waiting for improvement would be rewarded. Now in the past week the price of silver has risen with startling rapidity. It has taken silver longer than the other metals to find new markets. Apparently new and old purchasers are now bidding for silver.

With silver selling at 56 cents, the Cobalt silver district will likely experience such renewed activity as has made itself felt during the past few months in other metal mining districts. In Ontario the Porcupine gold and Sudbury nickel-copper mines are employing more men and producing more metal than ever before. The Cobalt silver mines have been, during the period of low prices, marking time. Now the production will be increased, more development done, and prospecting work resumed.

That plans for new work will now be undertaken at Cobalt is highly probable, though there may be some hesitation until the higher prices become established. Cobalt silver mining companies can take quick advantage of an improved market and if the demand for silver continues, Ontario's silver district will experience a busy winter.

MINING SCHOOL PROBLEMS

President William B. Phillips, of the Colorado School of Mines, in the November issue of the magazine published by that institution, calls attention to some Western mining school problems. Among other things, he says: "If we cannot link the actual practice in mine, mill and smelter, with the instruction in mining schools, something is wrong with the schools. I do not mean by this that any mining school should even pretend to graduate miners, millmen or furnace men. This is not the proper work of any such school." President Phillips considers that the great function is to train young men to think. "The training in such highly specialized matters as mining, ore dressing and metallurgy, is largely of a more or less prophetic nature. It is based upon the ability to forecast the future and to provide against its demands." Many will agree with President Phillips in his appeal for a thorough grounding in fundamentals. "There must be a thorough grounding and training in English, mathematics, chemistry, physics, mineralogy, the elements of geology, especially structural geology, metallurgy, commercial geography, social economy and history, and one or more foreign languages. I do not mention these things in the order of importance, but I do venture to say that English and mathematics are, by no means, the least important. And by English I do not mean the study of Milton, or Shakespeare, Ruskin or Emerson, but the acquirement of a good working knowledge of ordinary correct verbiage and phraseology, of correct spelling and correct grammar. By mathematics I do not mean calculus or the geometry of the Fourth Dimension, but I do mean arithmetic, algebra, plane and spherical trigonometry, and plane and solid geometry. Reliable statistics are lacking, but I believe that a large proportion of the scholastic troubles in mining schools are due to lack of thorough training in mathematics and English."

"A mining engineer should be of better and more thorough training than any other kind of an engineer, for he is called upon to know and to do more different sorts of things than any one of his ilk. He is, or rather should be, versed in civil, electrical, mechanical, hydraulic, mining and metallurgical engineering, have a working knowledge of one or more foreign languages, be able to speak and write the English language correctly, and to handle men."

In other words the mining engineer's training should include two or three years of general college work, followed by three or four years of more specialized study. The problem is how to condense it all into three or four years.

THE OIL FLOTATION PROCESS

Owing to the successful adoption of the oil flotation process by several large mining companies, flotation methods are attracting the attention of mining men everywhere. Our readers will therefore be interested in the paper by Mr. J. M. Callow, which is to be presented at the New York meeting of the American Institute of Mining Engineers, and which is published in this issue.

It has been found that minerals can be separated by treatment in machines with oil and acid. Certain minerals rise with the froth when the mixture is agitated, while others do not rise. By experimenting with various oils it has been found possible to make a very complete separation of the minerals in many ores. During the past few years metallurgists have made innumerable tests on hundreds of ores. The results in some cases have been excellent.

Concerning the discovery of the oil flotation process there are many stories. One story which has been given wide publicity is that the credit belongs largely to an observing Colorado woman, Carrie Jane Everson, who noted the selective action of suds while washing her brother's shirt. The Colorado Scientific Society has recently appointed a committee composed of George E. Collins, Philip Argall, and H. C. Parmalee, to investigate her claim to the honor.

It is said that over 165 patents have been granted to inventors covering various phases of the process. In the United States there are now scores of flotation plants in operation.

One of the greatest successes in the use of flotation process is the plant of the Britannia Copper Company at Britannia Beach, Howe Sound, British Columbia. In Ontario the process has been tried by the Mond Nickel Company for the treatment of nickel-copper ores, and is now being investigated by several of the companies operating at Cobalt. It is not unlikely that the accumulated tailings from the present concentration and cyanidation plants at Cobalt will eventually be treated by the flotation process.

According to a market letter issued by an enterprising New York firm of brokers, one of the largest silver interests in that city says in regard to the silver situation: "Mexico has produced practically no silver for months, and the Cobalt region has been unable to ship much silver, as its refining processes were dependent upon Germany, and that country naturally lent no aid to the Canadian region." Our New York friends will be disillusioned if the price of silver keeps climbing as it has during the past week.

By courtesy of the Ontario Bureau of Mines, we publish in this issue a report by Mr. Jas. Bartlett on the gold discovery made on the Rognon property south of Dryden, Ont. The Dryden district has been given a bad name by several failures there; but there is no good reason to conclude that none of the deposits can be profitably worked. Mr. Rognon's discovery seems to be a very important one.

GOLD DISCOVERY NEAR DRYDEN

By James Bartlett.

In the latter part of October, 1915, the writer spent a part of one day on the Rognon gold claims south of Dryden. Gold was discovered this fall on surveyed claims A. S. 14 and A. S. 15, the property of Ernest G. Rognon of Dryden, Ont. These claims are situated on the west side of Contact Bay, Wabigoon Lake, and are in unsurveyed territory about 60 chains south of lot 2, concession 1, Van Horne township. In summer the claims are reached by taking a launch from Dryden along the west side of Wabigoon lake to Contact Bay; in winter the wagon road leading from Dryden to the Redeemer mine will be used.

The vein in which the gold occurs has a strike of about N. 70 degrees W. and appears to dip to the north at 75 or 80 degrees. Stripping has been done along the strike of the vein at intervals for some 1,600 feet, and, although the vein is not continuous for this distance, the rock has been fissured and quartz deposited to some extent along considerable of it. The vein is narrow, varying from a mere crack to 24 inches. At one point near the east end it may be considered eight feet wide if some schist be included. The vein-filling consists almost entirely of quartz, much of which is pink to red in color, due to the presence of hematite. Earthy red hematite occurs at different points in the vein. No sulphides whatever are visible. Free gold was seen in the wall rock in a small prospect shaft, 14 feet deep, sunk on the vein. At this point the vein averages 18 inches in width. In sinking the shaft Mr. Rognon has obtained a number of remarkably rich and beautiful specimens of gold-bearing quartz.

In order to obtain some idea of the distribution of values at different parts of the vein, ten samples of quartz were taken for assay. As moils were not available, the samples were taken by chipping across the vein with a prospecting pick. They, therefore, should not be considered "grab" samples. The chainages stated below are approximations. The samples were assayed for gold by Mr. W. K. McNeill, Provincial Assayer, and the following values obtained:

No. 1—Gold, $7.20 per ton. Sample taken 60 feet from east end of vein. Vein at this point 8 feet wide with some rock included.

No. 2—Gold, $7.60 per ton. Sample taken 170 feet from east end of vein. Vein 12 inches wide.

No. 3—Gold, $13.20 per ton. Sample taken 265 feet from east end of vein. This is from prospect shaft at depth of about ten feet. Includes twenty inches of quartz and three inches of soft schist from wall.

No. 4—Gold, none. Sample taken 275 feet from east end of vein. Width, 16 inches; quartz and a little schist.

No. 5—Gold, $2.80. Sample taken 300 feet from east end of vein. Width, 22 inches of quartz.

No. 6—Gold, $0.80. Sample taken 565 feet from east end. Width, 13 inches quartz + 2 inches schist from walls.

No. 7—Gold, none. Sample taken 635 feet from east end. Width, 15 inches quartz + inch red hematite.

No. 8—Gold, none. Sample taken 720 feet from east end. Width, 14 inches quartz.

No. 9—Gold, $86.40. Sample taken about 1,200 feet from east end of vein. Width, 15 inches rusty quartz.

No. 10—Gold, $1.00 per ton. Sample taken about 1,500 feet from east end of vein. Width 18 inches white quartz.

The country rock is a fine-grained gray to pale green rock in which biotite was the only mineral which could be identified in the hand specimens. The schistosity is not marked a short distance from the vein. Thin sections were made from samples taken on both sides of the vein and were examined under the microscope by Mr. A. G. Burrows of the Provincial Geologist's staff. Mr. Burrows reports as follows regarding these samples:

No. 1 country rock, south side of Rognon vein.—A fine-grained rock. Under the microscope it is seen to be of igneous origin. The prominent constituent is plagioclase feldspar in rods, while a few broad crystals of plagioclase are also recognizable. In addition there are numerous rods of hornblende and flakes of biotite. Sample is a schist which has been derived from a diorite; name, diorite schist.

No. 2 country rock, north side of Rognon vein.—A dark, fine-grained rock showing under the microscope fine grains of a colorless mineral and numerous crystals of biotite.

The latter mineral is partly altered to chlorite. There seems to be a few obscure plagioclase crystals. The sample may be called a very fine-grained biotite or mica schist. The origin, whether from igneous or sedimentary rock, is uncertain, but is probably igneous."

About ten chains north of the vein a rock occurs which appears to be a volcanic breccia with tuff associated. About ten chains south of the vein is a large body of granite.

Further work is certainly warranted on these claims and it is to be hoped that this discovery may lead to a revival of interest in the district as a whole. Were this a new territory, the gold-bearing quartz recently found on these claims would undoubtedly cause a rush of prospectors into the district. Several companies operated to a small extent in the country west of Wabigoon lake several years ago, but, so far as can be learned, little trenching was done and a great deal of likely rock remains unprospected and open for staking.

RENEWED ACTIVITY AT COBALT.

Cobalt, Nov. 26.—The rise in the price of silver has set the managers of the various producing mines planning to increase production. The Timiskaming, which for a long time has had only 29 stamps of the mill running, will probably start the remaining 20 and begin running at full capacity. Coniagas, which has curtailed its operations almost to the limit, merely mining enough to pay running expenses and provide for further development; the Nipissing, Beaver, and others will, if the increased price is maintained, increase their production to full capacity. Sixty-cent silver would have a wonderful effect on the camp in this way, and would, according to a number of the mine managers, result in some producing records being broken.

GIFFORD.

Cobalt, Nov. 23.—It is understood directors of the Gifford Cobalt Mines are considering reopening the property, which adjoins the Beaver. The main shaft is down 200 feet. The property has been idle about six years.

THE UTILIZATION OF MINERAL PRODUCTS

At a meeting of the Royal Canadian Institute held in Toronto Saturday evening, November 20th, Mr. Geo. T. Holloway, chairman of the Ontario Nickel Commission, delivered an address on "The Relation Between the Chemical and Metallurgical Industries." He pointed out how chemists and metallurgists working together have overcome many difficulties. The Scotch shale industry, paralyzed by the discovery of large quantities of petroleum, recovered by the utilization of paraffin wax and ammonium sulphate and is still flourishing through the assistance of chemists. The continued existence of the Cornish tin industry is largely due to obstinacy and skill in obtaining everything possible from the ore, fighting against decreased values. Basic slags, formerly a waste product, have become a large source of revenue through use in fertilizer and cement manufacture. By-products of coal have become very valuable through development of processes of saving them cheaply and making a market. Cobalt is at present produced in large quantity with the silver of the Cobalt district, but new uses must be found for it. Chemists who have investigated the properties of cobalt and its alloys have helped to find such a market.

"The future of all mining, metallurgical and chemical processes depends on the ability to treat low grade materials. Rich ores are becoming rare and the country should make use of all, just as the Chicago packer utilizes all his products. The metallurgist and chemist can work together with the miner to reduce costs."

Mr. Holloway referred to the different conditions in old and new countries. England, except for coal, is largely dependent on imports, Canada having ample supplies of most materials seeks to find and open up new markets. In doing this we should seek to keep control of raw material and complete treatment as far as possible.

The industrial success of Germany is attributed to co-ordination of chemical, metallurgical and other industries. Mr. Holloway gave some account of the development of the aniline dye, alkali and zinc-lead industry.

The sulphuric acid industry is of very great importance to metallurgists, for metallurgy depends largely on the direct use of sulphuric acid or on the sale of it. The acid is used for so many purposes that prominent men have said they could measure the industries of countries by the amount of sulphuric acid used. It is especially interesting to note that much of the acid recovery has resulted from legislation prohibiting the discharge of SO_2 into the atmosphere. The sulphuric acid and alkali industries of England are dependent largely on the recovery of by-products saved under compulsion.

VANCOUVER CHAMBER OF MINES ANNUAL MEETING.

The annual meeting of the Vancouver Chamber of Mines was held in the Board of Trade rooms November 10th. Despite adverse conditions, the Chamber reported itself as clear of debt and at present on a sound basis.

The report of the executive committee was submitted by Mr. John Cunliffe. In the course of his report Mr. Cunliffe said:

"The ore exhibit and library have been open to members and visitors on all business days throughout the year, and nearly 3,000 persons took advantage of its privileges. These included miners, prospectors, owners of mineral claims, mine owners, and several investors, or agents of such, on the lookout for opportunities for investment. The data at the disposal of the Chamber were supplied in every case, together with the names and addresses of the owners of mining properties likely to meet their needs. The result of this information we are unable to say.

"Enquiries by correspondence for the year exceeded one thousand letters, etc., and covered a considerable part of the civilized world. Amongst others were letters from South Africa, Australia, New Zealand, Italy, the British Isles, Mexico, from most of the large cities of the East, Middle West of the United States and Canada, from the principal points of the Yukon, and the cities of the Pacific seaboard from Alaska to Mexico."

The following officers were elected: President, Prof. J. M. Turnbull, University of British Columbia; first vice-president, Mr. Robert R. Hedley; second vice-president, Mr. Nichol Thompson; hon. treasurer, Mr. James Ashworth; hon. secretary, Mr. John Cunliffe; and executive committee, Messrs. L. W. Shatford, M.L.A., R. S. Lennie, K.C., C. E. Cartwright, R. C. Campbell-Johnson, W. A. Blair, E. A. Haggen, A. McPhail, A. E. Hepburn, W. E. Bland, A. B. Buckworth, George H. Turner, Dr. Brock, G. S. Eldridge and James G. Powell.

BAR SILVER.

New York—There is an exceedingly strong undertone to bar silver in London and a sharp advance in the next few weeks would cause no surprise. Up to a few days ago, estimates were that £1,500,000 to £1,600,000 silver was in floating supply in London. Last week it was found that actual floating supply was less than £880,000.

India, usually a heavy purchaser of silver, has made no purchases thus far this season. Conditions in India now, except in one of the many provinces, are much more favorable, and it is expected India may come into the market again soon. China has unusually large stocks of silver owing to slack condition of business, but none is likely to find its way to London.

Trading in London is entirely on a cash basis and thus far small in character. The Bank of England has purchased a great deal of silver for coinage, and the continent has also purchased for similar purposes. These purchases have been small daily, but constant, and sooner or later will have marked effect.

In addition, there has been some curtailment of silver production, especially in Mexico, which represents about 30% of American production. This is having effect on shipments to London from New York, and American Smelting & Refining Co.'s stock of silver, melted but unsold, is understood to be sub-normal.

SENECA-SUPERIOR DIVIDEND.

The Seneca-Superior dividend declared payable December 15 will bring the mine's dividend payments to a total of 195 per cent. or $929,848.

STEEL COMPANY OF CANADA.

Hamilton—The Steel Company of Canada is doubling its capacity at Hamilton. Earnings of the corporation are establishing new high records, but it is not likely that any statements will be issued until March of next year.

A NEW INDUSTRY FOR NEWFOUNDLAND

By J. W. McGrath.

During the session of the Newfoundland legislature held last spring a bill was passed conferring large and important concessions upon a corporation known as the "Newfoundland Products Co." The company has been incorporated under the laws of this colony, and its personnel consists of the following persons: Thomas L. Wilson, of Woodstock, Ontario, and the members of the Reid Newfoundland Co. Mr. Wilson is well and favorably known in the manufacturing and industrial life of Canada, but his reputation rests chiefly on his discovery of carbide. The Reid Newfoundland Co. is so well and favorably known not only in Canada and Newfoundland, but also in the United States and the United Kingdom, that anything I may say would be superfluous; suffice to add, the Reid Newfoundland Co. is a class of people any country may feel proud of. Being the builders, owners and operators of the Newfoundland railway system and the large fleet of steamships plying on the different bays and around the coast line of Newfoundland, and largely connected with the commercial, industrial and social life of the country, they have been very important factors in the great material progressive advance Newfoundland has made during the past twenty-five years. In the hands of such men then, there is no reason to doubt that the Newfoundland Produce Co. will grow and expand to rival all other industries except the fisheries.

The chief and primary object of the company is to manufacture ammonia phosphate which is a fertilizer, and in addition ammonia, cement, woodpulp and lumber. The company proposes to establish a plant at Bay of Islands—on the west coast of the island—at a cost of $18,000,000, and the Newfoundland Government has leased to them for a period of 99 years the water powers in and upon Humber river and Junction brook together with an immense deposit of marble or limestone along the Humber river. To produce ammonium phosphate, five ingredients are necessary, namely,—phosphate rock, sand, coal, marble and pyrites—and it is assured that with the exception of phosphate rock, which at the beginning of operations will be imported from Florida, all the other elements can be produced in Newfoundland, and there is very just reason to think that deposits of phosphate rocks will also be found within the island. From the phosphate rock the sand and coke (the latter being made from coal), phosphoric acid is produced, and from the lime and coke a carbide is obtained, and this carbide with the nitrogen and pyrites produces ammonia, and the combination of the two, that is phosphoric acid and ammonia, produces the ammonium phosphate which is the fertilizer. From the pyrites, sulphur dioxide is produced, and the union of this with pulpwood produces woodpulp. The slag remaining from the finished product, ammonium phosphate, will be converted into cement.

In addition to the vast concessions in water powers, limestone and surface land granted by the Government, the Reid Newfoundland Co. have passed to the company vast areas of timber and pulp lands at Grand Lake, adjoining the location. The timber from these concessions will be utilized in the manufacture of sulphite pulp and sawn timber. The manufacture of phosphate of ammonia as a fertilizer in the manner as stated above is an entirely new process, and is covered by patents taken out by Mr. Wilson and secured to the company. The application of these patents renders the manufacture of the fertilizer the most economical of any process known to the world. For over a year or more a corps of engineers have been making the necessary survey of the Humber river with its tributaries, valleys and drainage. The work of survey has been directed by the well known firm of Messrs. Joseph Wallace & Co., of New York and London, ably assisted by the Reid Newfoundland Co.'s staff of engineers.

The work to date has cost $1,000,000, and has been most satisfactory; and reports show that a development of 120,000 horse power can be obtained on the Humber river. It is thought that it will take not less than three years from the beginning before the plant is established and at a cost of $18,000,000 before a dollar's worth of product is shipped. What the establishing of such an industry will mean to this country is not an easy matter to grasp at present. To produce the industry contemplated, when the business is in full swing, will require 239,805 tons of phosphate rock annually, or 657 tons daily; 600 tons of coal daily, or 219,000 tons yearly; 411 tons limestone daily, or 150,015 tons yearly, and 29,200 tons of pyrites each year. This will produce 120,000 tons of phosphate of ammonia, the value of which is $80 per ton, or $9,600,000 per year.

The fertilizer used to-day is a mixed one of ammonia, phosphoric acid and potash, costing about $40 per ton, but the fertilizer which will be produced by the Newfoundland Products Co. at their plant at Bay of Islands will be six times more valuable and will be sold to the Newfoundland fisherman-farmer at a rate which will not be more than one-half of the price he is now paying for fertilizer. In addition to the above, as a side line, the company will use 100,000 cords of spruce pulpwood yearly, from which will be produced 36,500 tons of sulphite pulp at a value of $1,825,000. To carry on such a large undertaking as this, an army of 3,000 men, of all grades, will be continually employed upon the plant at various rates of wages, no man getting less than $1.50 per day, even the most ordinary laborer. From the engineers' reports I gather the following facts as to the possible cost of establishing this plant:

Water power cost	$6,440,300
General work	2,564,000
Industrial plant	3,745,000
Phosphoric acid plant	900,000
Ammonia plant	450,000
Working capital	2,000,000
Railway revision	250,000
Total	$16,349,300

The amounts as itemized for the various structural works, with supervision and capital, are as follows:

Ten dams, at a total cost of	$1,597,500
Power houses	838,400
Penstocks, head gates and racks	771,200
Head gates	70,900
Wing dams	297,500
Storage dams	91,900
Water wheels	589,000
Electrical equipment	1,065,000
Miscellaneous	58,900
Transmission lines	612,800
Freight	59,500
Engineering and supervision	387,700
Total	$6,440,300

Construction and Equipment.	
Coke and gas works	$799,000
Lime quarry	75,000
Lime kilns for 250 tons production per day	142,000
Calcium carbide works	462,800
Carbide crushing works	71,400
Electrode carbon work	25,000
Saw mills	211,800
Sulphite pulp mills, electrolytic bleaching plants and wood preparations	1,568,300
Machine shops, iron and brass foundries, boiler and structural shops, forges, pattern shops and storage rooms	161,400
Engineering and supervision of foregoing items	228,300
Total	$3,745,500

Cost of General Work.	
Grading site and filling in foreshore	$263,600
Construction docks	270,600
Installation coal and other material, handling equipment and storage	692,000
Construction and equipment of storage warehouses, eight buildings	467,000
New location of railway and construction railway sidings	140,500
Railway equipment for use of the yard premises, locomotives, hopper bottom cars, flat cars and locomotive trains.	$113,000
Construction of bridges, tide gates, tidal basins and trackage	51,200
Railway station and general offices of the company and mill store houses	200,000
General transformer station	156,000
Water supply, sewerage, lighting and fire protection of industrial sites	65,000
Engineering and general supervision	145,100
Total	$2,564,000
Cost of phosphoric acid plant	$900,000
Ammonia plant	450,000
Working capital	2,000,000
Railway revision	250,000
Total	$3,600,000

In introducing the Newfoundland Products Co. Bill in the House of Assembly last April, the Premier of Newfoundland, Right Hon. Sir E. P. Morris, made the following statement: "It is impossible to conceive the developing influence of such an industry in the country. Not alone will it be a labor giving industry, but it will bring about the establishment of a city, and create a livelihood for thousands of families with consequent advantages to the whole country."

No more desirable location could be selected for a great industrial operation, being distant only a few hundred yards from the Humber river, whose novel scenery is amongst the finest in the world.

CHILE COPPER.

Consulting Engineer Pope Yeatman, of the Chile Copper Co., says. "Up to date the ore mined has been taken from the upper layers of the orebody, which was and is known to be of lower grade than the average of the mine. The work so far indicates that the expectations and estimates of the engineering staff of the company will be fully realized with the operation of the first unit on the average grade of the ore of the mine."

A RETROSPECT

By F. H. Mason.

The office calendar reminds me more forcefully each morning that the great exposition is swiftly drawing to a close. As I look back over the past nine months, it is with a feeling of satisfaction that something has been accomplished and the assurance that the mineral industry of Canada has obtained an advertisement that will forever remain in the memory of a large proportion of those who visited the Canadian pavilion. In looking back, too, it is gratifying to note the uniform approval of the Canadian mineral exhibit by those whose praise is of value. "What one would expect from Canada," said John Hays Hammond; "Excellent and highly instructive," said Thomas A. Edison; "Bully," exclaimed T. A. Rickard, with editorial terseness; "The finest mineral exhibit I ever expect to see," G. G. S. Lindsey wrote in the register, with pardonable pride of a participant. Thus it ran through the whole period of the exposition; I have not heard a discordant note.

But what is perhaps of greater importance, in a backward glance, is to note in which minerals visitors manifested the greatest interest. About which minerals the most inquiries have been made. In order to reply intelligently to this, one has to classify the visitors. Fully ninety per cent. of the people who passed through the Canadian pavilion neither knew nor cared anything about minerals; yet many of this larger proportion asked questions, and mostly inane questions, at that. These, of course, must be eliminated.

Of the intelligent questions, undoubtedly the largest number were about the hydro-magnesite, from Atlin, B.C. Magnesia is coming more and more into everyday use in a number of different ways, and the form of the mineral at Atlin—disintegrated material that can be handled by a steam shovel—appealed to the investigators.

The asbestos exhibit elicited an enormous number of questions—both sane and insane. There appears to be more misconceptions among intelligent people about this mineral than about any other. It is commonly supposed to be the most refractory substance known, and that anyone armed with a suit of asbestos could successfully defy Satan and all his hosts in the hereafter. Even when inquirers were assured that asbestos would not fulfil all these requirements, often they were not satisfied until they had a complete list of the producers and manufacturers of the material in Canada, and many begged hard for a specimen of this wonderful substance.

The ores of the rare metals, molybdenum and tungsten, came in for numerous inquiries; there was always a sharp demand for information about zinc and antimony ores, and, at one time, there were many inquiries for manganese ores.

The silver ores of Cobalt brought forth many demands for information, as did the ores of Porcupine, and the gold and platinum nuggets from British Columbia and Yukon Territory were always a source of interest.

The nickel case, which, by the way, was the most effectively arranged case in the exhibit, produced numerous inquiries, and some of the rarer nickel and platinum-group minerals, like polydymite and sperrylite from the Vermilion mine, Sudbury, Ont., added to the exhibit through the kindness of Mr. A. D. Miles, were a source of much interest to mineralogists.

With the big increase in the output of the Granby Consolidated Co.'s smelters, demand for information about the company's ores and about British Columbia copper ores in general increased considerably, and there is little doubt but that the attention of many people has been directed in that direction through the exhibit.

The mica case elicited many inquiries from manufacturers of electrical machinery—it is strange how persistently the name isinglass is used for this substance—and there were many suggestions from chemical manufacturers that a process should be devised for the extraction of potash from the excellent specimens of potash-feldspar exhibited. The building and ornamental stones came in for a fair share of attention, as, in fact, did nearly all the minerals, at one time or another, but those mentioned have received more attention than their fellows.

The members of the mineral department of the Canadian commission made a point of keeping in close touch with the nature and extent of the deposits from which the exhibited minerals came, and also of the uses of the various minerals and the processes they underwent to render the valuable constituents of service, and they were thus able to impart much valuable information to interested visitors. Another pleasing feature of the mineral exhibit is the way it has been kept up to date; many new exhibits, representing recent discoveries, having been added since the original installation.

RED ROSE GROUP, OMINECA, B.C.

It has been stated in British Columbia newspapers that the Red Rose group of mineral claims, in Omineca mining division of that province, has been bonded by Messrs. Hogan and McAdam, of Edmonton, Alberta, representing a syndicate. The following information of this property has been taken from a report by Mr. J. D. Galloway, assistant mineralogist for the province:

The Red Rose basin is a small basin or amphitheatre in the Rocher Deboule mountains. Rocher Deboule camp is situated in Juniper basin, at the head of Juniper creek, and is distant ten miles from Skeena Crossing. Juniper and Balsam are two small creeks which join and flow into Kitsequekla river, which in turn empties into the Skeena near Skeena Crossing.

The Red Rose group of claims, consisting of the Red Rose, Yellowhammer, Prosperity, Juniper and Summit, is owned by Peterson & Ek. The claims are situated on the northern side of Red Rose basin, and extend upward from the head of Balsam creek to nearly the top of the mountain at an elevation of 8,000 ft. The main vein is on the Red Rose at an elevation of 5,625 ft., and is known as the "Lower Showing." This would seem to be a fissure vein from 4 to 6 ft. wide occurring entirely in a grano-diorite formation, and is developed by a number of open cuts, trenches, and an adit 30 ft. long. In the adit the vein shows a width of 4 to 5 ft. of considerably oxidized and leached-out siliceous vein matter, and contains a considerable amount of pyrrhotite and some chalcopyrite. The sulphides occur mostly on the footwall in a fairly well-defined paystreak, which at the face of the adit is 30 in. wide. The remainder, or two feet, of the vein on the hangingwall does not contain any appreciable amount of sulphides and is mainly siliceous gangue, which is not a true quartz, but is an alteration and silicification of the granitic wallrock. The vein strikes N. 30 deg. W. and dips to the southwest at 45 to 50 degrees.

An average sample across the 30-in. paystreak returned the following assay value: Gold, 0.84 oz.; silver, 3.2 oz.; copper, 3.9 per cent.; while a sample across the two feet of vein matter on the hangingwall assayed: Gold, 0.02 oz.; silver, 1.4 oz.; copper, 2.1 per cent. At the time of visiting the property a severe snowstorm was in progress, so that it was hard to ascertain much about the surface exposures. Apparently, though, this showing is very close to the contact between the granodiorite and quartzites and argillites of the Hazelton group. The vein in the tunnel, above mentioned, is entirely in the granodiorite, but a number of other exposures of rusty material containing pyrrhotite and copper stain are evidences of the development of ore in and around the plunging contacts which the granodiorite makes with the older volcanic rocks.

Taking into consideration the assay results above noted, together with the very favorable conditions for the possible formation of a large orebody, there is no doubt that this property is well worthy of further development work.

The upper showing of this group lies up the mountain from the lower one at an elevation of 7,500 ft. The snowstorm alluded to prevented climbing to and examination of this working, but Mr. Ek supplied the following description: It is a large vein showing lenses or stringers of iron (probably pyrrhotite) across a width of 200 ft. In one place there is an 18-in. paystreak of copper ore. Very little development work had been done, but it was intended to drive a tunnel during the autumn at one of the best-looking places. A sample of the ore obtained from Mr. Ek, and said to represent an average of the 18-in. paystreak referred to above, assayed: Gold, 0.30 oz.; silver, 2.3 oz.; copper, 8 per cent. A sample, similarly typical of the iron occurring across the vein in many places assayed: Gold, trace; silver, 0.8 oz.; copper, 1.4 per cent.

ZINC FROM BRITISH COLUMBIA.

In October, the Standard Silver-Lead Mining Co. shipped much of the zinc concentrate that had accumulated at its mill near Silverton, Slocan lake, British Columbia, during the period that suitable arrangements for its sale were not in force. The Nelson Daily News published recently the following comment on district shipments of zinc ore during October: A comparative statement of shipments of zinc ore and concentrates during the month of October in 1914 and 1915, respectively, shows that this year there was an increase of 1,305 tons over the quantity shipped last year. This was due to the shipment of 1,836 tons from the Standard Co.'s mill at Silverton to Bartlesville, Oklahoma. The figures for the two years follow:

From	1914 Tons.	1915 Tons.
Surprise mine	...	80
Rambler-Cariboo mine	173	160
Standard mine	465	1,836
Hewitt mine	279	146
Totals	917	2,222

NOTES ON FLOTATION*

By J. M. Callow.

The selective action of oils for lustrous minerals was first disclosed by Haynes in 1860. In 1885, Miss Carrie Everson elaborated this idea and also disclosed the fact that acid increased the so-called selective action. Her patent called for oils, either animal, vegetable or mineral, also for an acid or salt. The process was tried out on a practical scale in Baker City and Leadville, in 1889, and failed: first, because, as has since been shown, of the unsuitability of the ore to flotation; and second, because the invention was too far in advance of the times. Then followed the Elmore brothers, first with their bulk oil processes and later with their vacuum method. The basic principles of oil flotation were undoubtedly covered by the above inventors, the work done since their time being merely a building up on ground work laid by them. Different kinds of oil, different quantities of oil, and all the varying degrees of agitation, were all exemplified and practised by them in one phase or another, and the developments that have since been made are but elaborations of the fundamental principles laid down by Haynes, Everson and the Elmore brothers.

In 1902, the Potter-Delprat process was developed in Australia. In this process no oil was used, the mineral being raised by the generation of gas, brought about by the introduction of acid into the pulp. The mineral particles appeared on the surface of the separatory vessel, in the form of a scum or froth, buoyed up by minute gas bubbles attached to them. This no doubt first gave the suggestion of gaseous flotation.

In 1902, also, Fromont, an Italian, was granted a patent in which he combined violent agitation with oil and gaseous flotation, the gas being generated within the pulp, in much the same way as in the Potter-Delprat process.

In the same year, Cattermole came out with a unique method. First, the pulp was emulsified with a small quantity of oil, by violent agitation, and then submitted to a slow stirring action in a second machine. This granulated, or coagulated, the minerals that had been oiled into nodules which were afterward separated from the pulp by gravity. The defect of this process was that only part of the mineral granulated, the rest of it appearing on the surface of the pulp as a scum or froth, and so was lost in the tailings. This defect of the Cattermole process suggested the fundamental idea of the process afterward described by Sulman, Picard and Ballot in their patents, in which, instead of granulating part of the mineral, all of it was floated. This patent forms the basis of all the Minerals Separation operations. It was first exploited in Australia and in a short time replaced all other flotation processes in that country.

In 1904, MacQuisten brought out his ingenious tube process, which gave excellent results on the sandy portions of the feed, but was inoperative when slime was present. This was a strictly surface-tension method, and its inability to handle slime was a serious limitation. In 1912, Hyde introduced a modification of the Minerals Separation process into the mill of the Butte & Superior Co., Butte, Mont. This differed from the regular practice in that roughing and cleaning of the concentrates was done.

Callow Pneumatic Flotation.

Early in 1909, I did a great deal of work with the MacQuisten flotation process, and was instrumental in the tube-plant installation at the Morning mill at Mullan, Idaho. This work was followed by a large amount of experimenting on the different kinds of existing flotation processes, the outcome of which was the development of the pneumatic process.

The first application of pneumatic flotation for the treatment of ore was made at the mill of the National Copper Co., at Mullan, Idaho, which was designed and built by me. Construction was started on August 14th, 1913, and the plant went into operation about April

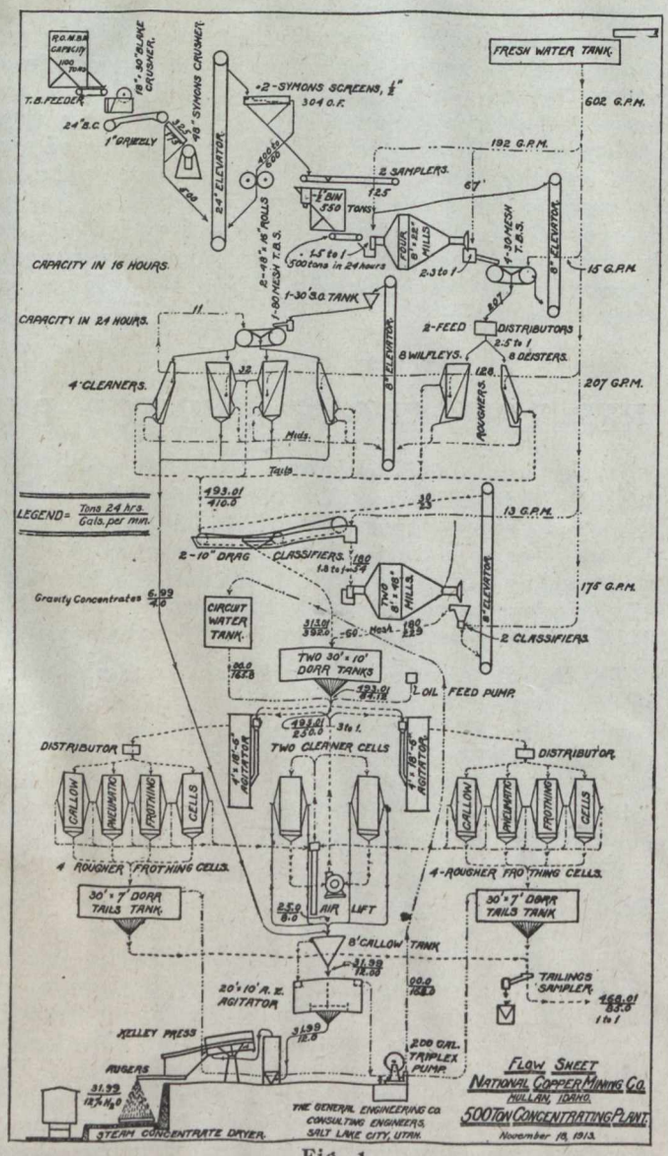


Fig. 1

10th, 1914. The flow sheet is shown in Fig. 1. It was a metallurgical success in every way from the start.

Since that date, the process has been adopted by nearly all the other mills in the Coeur d'Alene, treating lead and lead-zinc ore, notably the Gold Hunter, Morning, Hercules, Bunker Hill & Sullivan, Caledonia,

*A paper presented at the annual meeting of the Utah Section, American Institute of Mining Engineers, SaltLake City, Oct 4, 1915, and to be presented at the New York meeting, Feb., 1916.

Last Chance, Hecla, Standard, etc., a total of about 50 cells in all, treating from 1,500 to 2,000 tons of slime and fine sand feed per day. The same process too has since been adopted by the Inspiration Copper Co., the Arizona Copper Co., the Anaconda Copper Mining Co., the Magma and other copper companies, and by the Silver King, Daly-Judge, Duquesne, and El Rayo mining companies, on lead, zinc and other ores, making a total of some 680 cells operating, or in the course of installation, having a combined capacity of about 25,000 to 28,000 tons per day.

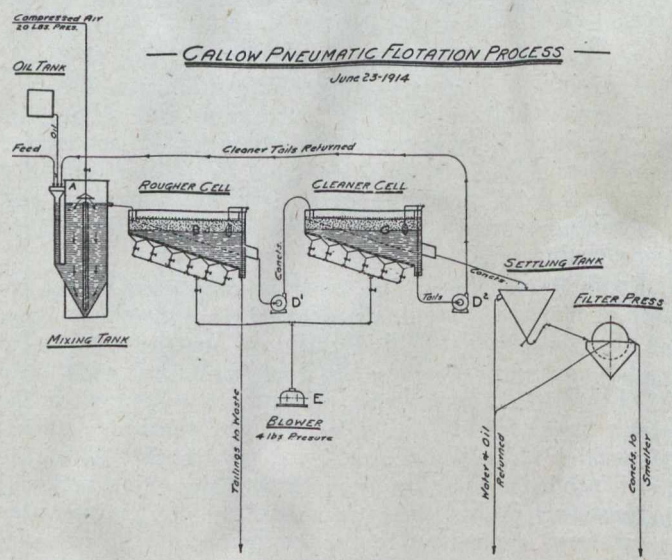


Fig. 2

Fig. 2 illustrates the various elements composing the Callow process in general.

Mixing.—In the mixer A, operated by compressed air, the oil, air and water are mixed and emulsified, the same type of apparatus being in common use in cyanide works. In cases where the oil, or frothing agent, can be fed into the crushing machine or tube mill, this mixer, or Pachuca tank, can be dispensed with, the tube mill discharging direct to the separatory cell.

It has been conclusively proved that agitation *per se* is not necessary to successful flotation by the pneumatic method. In one of the plants, a Pachuca mixer for each four roughing cells was installed. The pulp from a Dorr thickener was delivered to the Pachuca by a belt-and-bucket elevator, the oil being fed into the boot of the elevator. It was found that the mixing obtained in the elevator alone gave as good results as when the Pachucas were used; so the use of Pachuca tanks in this plant was abandoned.

The Separatory Cell.—The initial or roughing separatory cell B consists of a tank about 9 ft. long overall, and 24 in. wide, with a bottom inclined at from 3 to 4 in. to the foot; it is 20 in. deep at the shallow end and 45 in. deep at the other end. It may be built of either steel or wood, but wood construction is preferable.

Fig. 3 shows the cell in detail. The bottom of the tank consists of a porous medium made of four thicknesses of loosely woven canvas twill properly supported by a backing of perforated metal to prevent its bulging when under air pressure. Through this porous medium compressed air is forced by the blower E (Fig. 2). Porous brick, or any other ceramic material, that will give the necessary fine subdivision to the air, may also be used. Some of these have been tried out, but for practical and mechanical reasons the loosely woven canvas twill seems to serve all purposes better than anything else, and has been adopted as the standard porous-bottom construction.

The space underneath this porous medium or bottom is subdivided into eight compartments, each connected by an individual pipe and valve with the main air pipe. By this means the air pressure to each compartment can be regulated (by throttling the valve) to correspond to the varying hydraulic head within the tank, and so as to discharge a uniform amount of air throughout the length of the bottom and maintain a uniform aeration of the contents. A pressure of from 4 to 5 lbs. is generally used, each square foot of porous medium requiring from 8 to 10 cu. ft. of free air per minute.

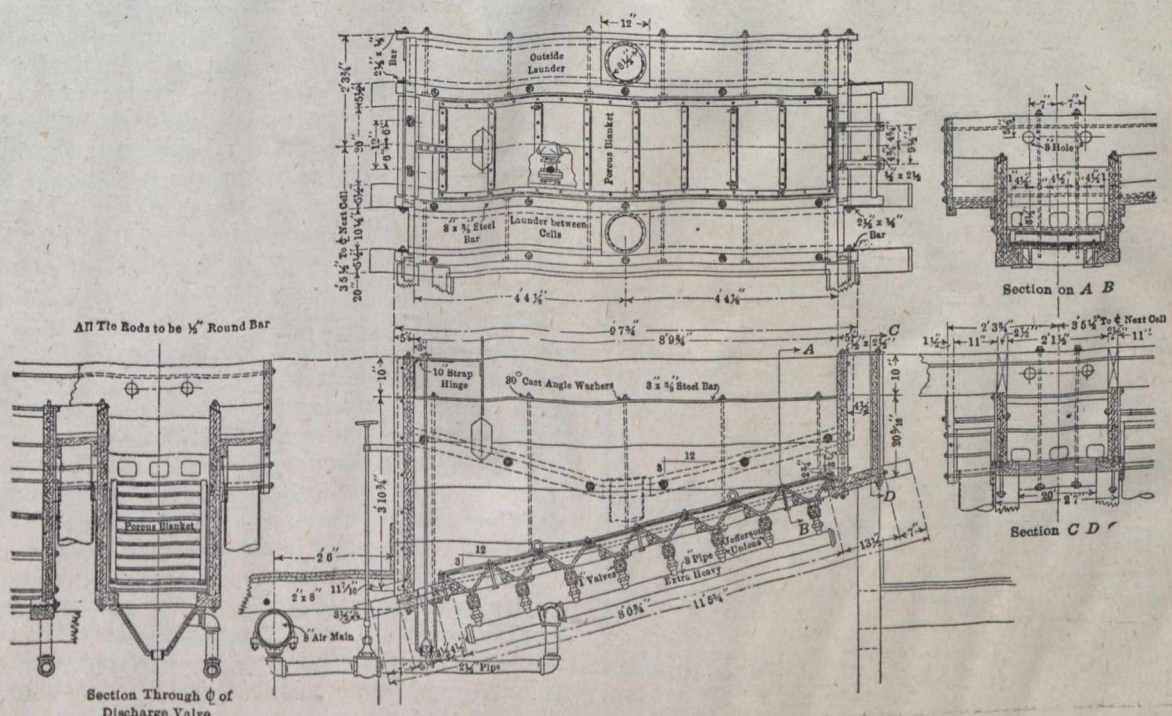


Fig. 3—Details of Callow pneumatic flotation cell

Each longitudinal edge of the tank is provided with a lip and an overflow gutter for the reception of the froth to be discharged. The lower end of the tank is furnished with a spigot discharge fitted with a plug valve, operated by a float, to maintain a uniform water level within the tank and thus, in turn, maintain a uniform and constant discharge of froth under all the varying conditions of feed supply incident to practical milling operations. The water level may, of course, be varied, but is usually maintained at about 10 to 12 inches below the level of the overflow lips.

The tailing is discharged through the spigot and the frothy concentrate is conveyed by means of the side gutters to the pump D^1 and thence to the cleaner separatory cell C. This cleaner cell is a machine of the same construction as the rougher. In operation, however, it is usually run with a lower air pressure than that used on the rougher. The tailing from the cleaner is returned by pump D^2 to the original feed, a closed circuit thus being maintained on this portion of the feed. The concentrate from the cleaner is the shipping or finished concentrate. Pump D^1 can well be eliminated by setting the cleaner at a lower elevation and conveying the rougher froth to it by gravity. Usually one cleaner serves four roughers.

Cells May be Used in Parallel or Series.—The machines may be run either in parallel or in series without any sacrifice in the capacity for a given number of cells.

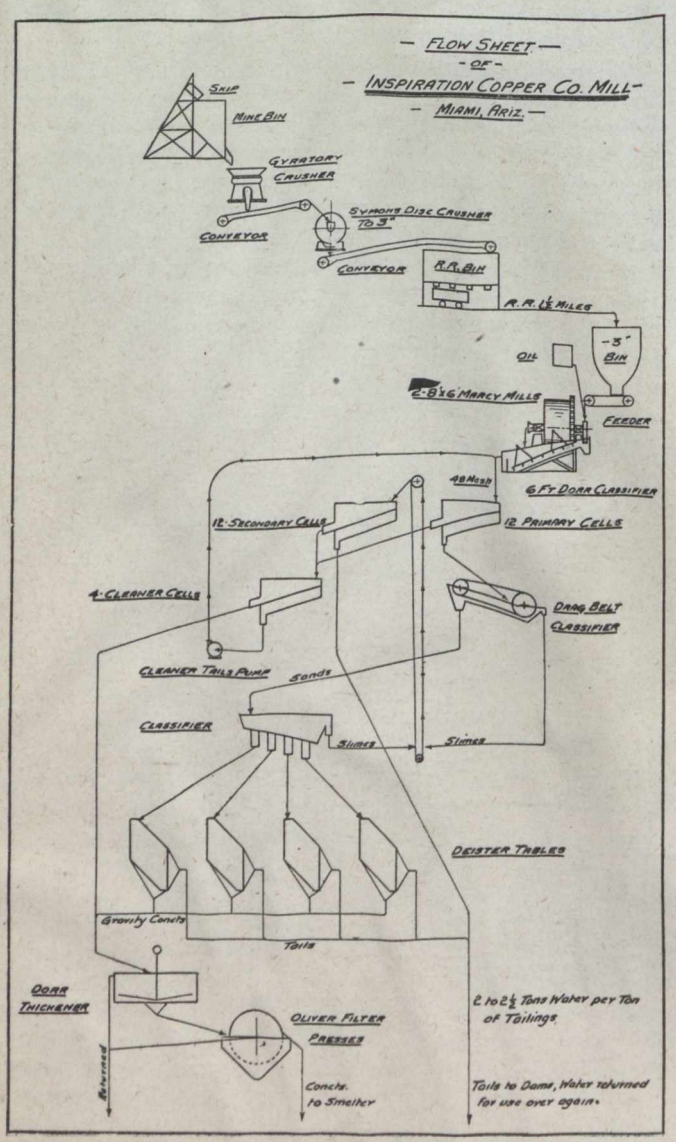


Fig. 4

Recent experience goes to show that on some ores the series treatment gives a slightly cleaner tailing; on others it does not. It is not necessary to extend this arrangement of cells beyond two cells in series. In a heavily mineralized ore this arrangement is decidedly advantageous, and in such a case the rougher concentrate might be of high enough grade to dispense with the re-cleaning operation. The froth from the second cell in the series might be returned to the original feed, in the same way that the tailing is returned from the cleaner when practising a roughing and cleaning operation. A number of such combinations are possible.

At the mill of the Inspiration Copper Co. (Fig. 4), the original feed goes to 12 primary roughers, the tailing from which is classified into sand and slime, the sand going to tables and the slime to 12 secondary roughers. The concentrates from both the primary and secondary roughers go to four cleaner cells, and the tailing from the cleaner cells is pumped back into the circuit.

Froth Formation.—The froth is generated as the result of injecting the finely divided air into the bottom of the already emulsified pulp; it continues to form and to overflow so long as it is furnished with pulp of the proper consistency, adequately mixed with the right quantity and kind of oil or frothing agent. Measured from the water level within the tank, the froth produced may be from 14 to 16 in. thick and will be more or less voluminous, coarse or fine grained, dry or watery, according to the character of the ore and the kind and quantity of oil introduced. The condition of the froth may be varied therefore by changes in the kind and quantity of oil used, and the quantity of air injected.

In some ores, rich in sulphides, and where a comparatively low-grade concentrate will suffice, the cleaning cells may not be necessary, but on low grade ores having a high ratio of concentration and when a concentrate of extreme cleanness and of maximum grade is required, a cleaner is desirable.

Pulp Density.—The pulp to be treated may be of varying density, from 2½ of water to 1 of ore, up to 5 or 6 to 1. For a mixture of sand and slime, the former ratio is preferable, but for a pure slime mixture (minus 200 mesh) the larger proportion of water is allowable. The particular density is not a matter of so much importance as the supplying of pulp of uniform density, since each variation in the density of the pulp requires a readjustment of the oil supply, the quantity of oil increasing in proportion to the increased volume of the pulp, independent of its solid contents.

Capacities.—A normal capacity for each standard roughing cell is 50 tons per 24 hours. This, of course, will vary according to the nature of the ore. In one plant, which practises gravitation previous to flotation, only the fine sand and slime being treated, the rate is 50 tons per rougher cell. The Inspiration Copper Co. practises flotation as the prime process, each 800 ton section employing 24 roughing cells and four cleaners. The cells in this case are run in series, the primary cells treating the original feed and the secondary cells treating only the slime from the primary tailing after the sand has been removed. This gives an average of 33.3 tons per roughing cell. The Arizona Copper Co.'s plant (Fig. 5) will treat the slime and re-crushed sand from previous gravity treatment; out of an original tonnage of 4,000 about 3,600 tons will

be treated by flotation. This will be handled on 63 roughers run in parallel, and 18 cleaners, or an average of approximately 57 tons per roughing cell, or 45 tons per cell for roughing and cleaning.

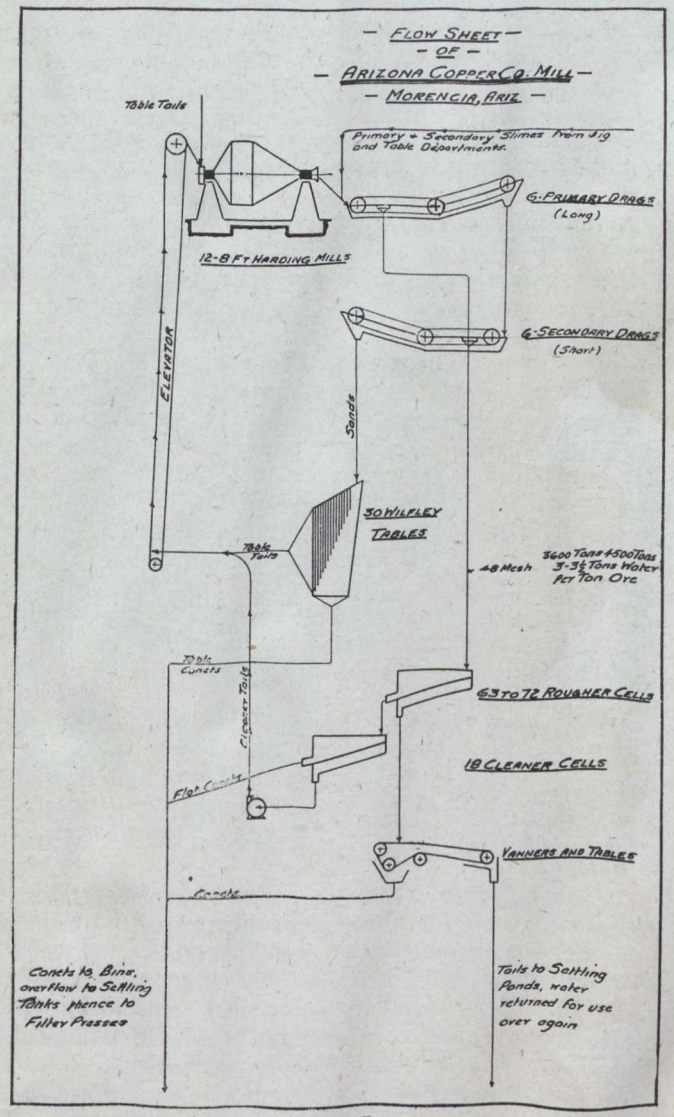


Fig. 5

Some tests have shown little difference in recovery, whether running 45 tons to the cell or 65; but that the recoveries commence to decline as soon as the tonnage exceeds 75 tons. In the Coeur d'Alene, on zinc-lead ores, 35 tons per cell is an average capacity. The flow sheet of the Daly-Judge mill (Fig. 6) shows the arrangement for treating a zinc-lead ore in the form of a fine sand and slime feed.

Oils Used.—The oils used may be broadly divided into "frothers" and "collectors." The pine oils are good frothers and coal tar and its various subdivisions are good collectors. On some ores, crude pine tar will in itself combine the properties both of frothing and collecting; on others, this may have to be enriched by the addition of some one of its more volatile constituents, such as refined pineoil, turpentines or wood creosote.

Generally speaking, the coal-tar products are poor frothers, and to get a sufficient volume of froth to insure a high recovery, it is often necessary to add refined or crude pine oil, creosote, etc. At the Inspiration mill, for instance, the mixture is 80 per cent. crude coal tar, 20 per cent. coal-tar creosote; at another plant on similar ore 45 per cent. El Paso coal tar, 40 per cent. coal-tar creosote, 10 per cent. creosol and 5 per cent. pine oil. At Daly-Judge a mixture of 40 per cent. crude coal tar, 40 per cent. creosote and 20 per cent. pine oil was used. In the Coeur d'Alene on zinc ore straight wood creosote was used; on the ore of the National Copper Mining Co., plain turpentine will work, but pine oil is better.

At Inspiration, from 1½ to 2 lb. of mixture per ton of ore was used; at Daly-Judge, 1 to 1½ lb.; and at the National 3/10 lb. of oil is sufficient. In the experimental work at another plant the oil consumption was approximately 1 lb. of mixture per ton; but since the entire plant has been in operation, and the circuit water reclaimed and used over again, the oil consumption has dropped to 0.35 lb. At present the proper kind or kinds of oil and the quantity requisite can only be determined by experiment; no scientific way has thus far been found.

Character of Froth.—The froth made by the pneumatic process has the distinctive characteristic of being unstable or ephemeral; that is, it quickly dies when

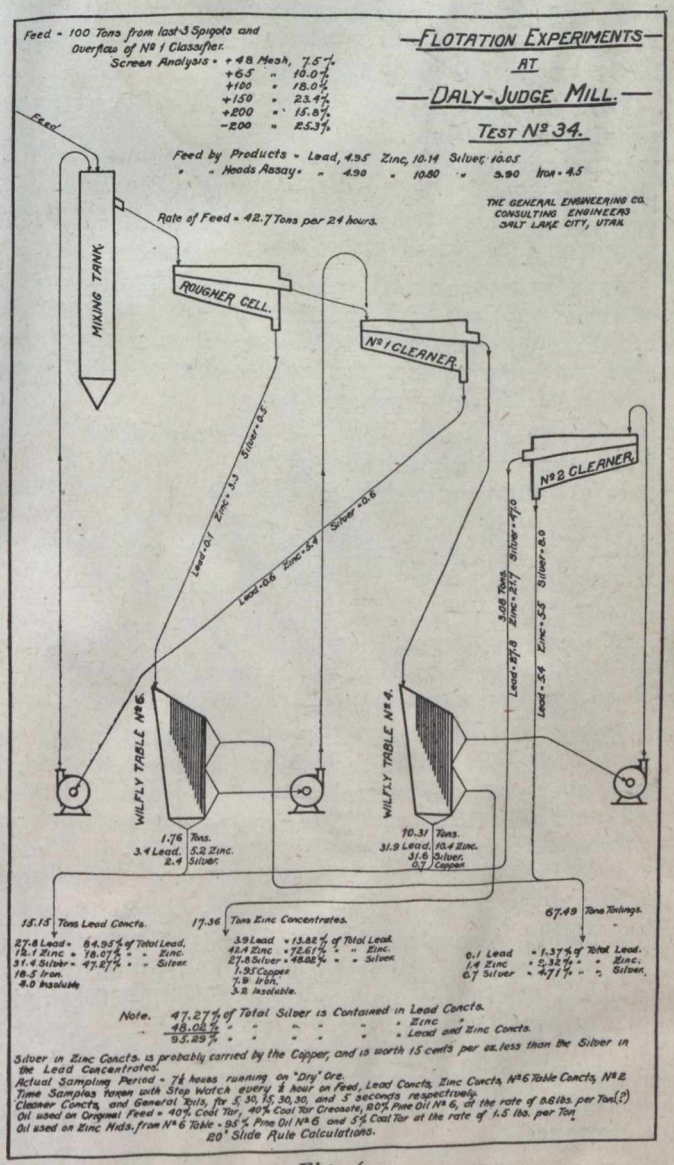


Fig. 6

removed from the action of the injected air. The bubbles composing the froth are generated under a hydraulic pressure varying from 15 to 40 in.; upon rising above the water to the froth level, the bubbles

burst by reason of the lower pressure of the atmosphere. On bursting, they release the mineral attached to them, which is caught up by the bubbles following immediately behind. The stability of the bubbles depends to some extent, upon the oil used and the nature of the gangue in the pulp treated. Pine oil makes a brittle froth which dies immediately on arriving at the surface. Creosote and light oil make a more elastic envelope which at times will expand into bubbles 3 to 4 in. in diameter before bursting. Pine oil bubbles are rarely over ¼ to ½ in. in diameter. Castor oil, olive oil, candlemakers' oil (oleic acid), palm oil, sperm oil, and other oils of a lubricating nature, have in general been replaced by oils more or less soluble or miscible in water—such as turpentine pine oil, and all the coal and wood-tar distillations. The extremely volatile oils, such as naphtha, gasoline, ether and alcohol, seem to be of little use except as means for making the pitchy ingredients of coal and wood tars more soluble or miscible.

A large, coarse and elastic bubble seems necessary to the recovery of coarse-grained mineral, but for the very fine and colloidal mineral, a small and comparatively brittle bubble is necessary.

Power.—The National Copper Mining Co., using approximately 950 cu. ft. of air at 4 lb. pressure, and treating 500 tons per day on eight roughers and two cleaners, required 35 h.p.; this shows a requirement of 3.5 h.p. per cell, equivalent to 12.53 tons per horsepower or 1.25 kw. hour per ton.

Another company using approximately 9,600 cu. ft. of air at 5 lb. pressure and treating 2,400 tons per day on 48 roughers and 12 cleaners, requires 210 h.p., equivalent to 3.5 h.p. per cell, 11.45 tons per horsepower, or 1.56 kw.-hour per ton.

The experimental plant of the Inspiration Copper Co., using approximately 950 cu. ft. of air at 5 lb. pressure and treating 200 tons per day with four roughers and one half-size cleaner, required 24 h.p.; deducting 4 h.p. for two 2-in. centrifugal pumps the figures become 4 h.p. per cell, 10 tons per horse-power, or 1.79 kw.-hour per ton.

A maximum figure would be 2½ kw.-hour per ton of feed, using 5 to 5½ lb. air pressure, generated by Roots or Connersville positive blowers.

Costs.—Oil—The oil mixtures generally in use cost from 1.25c. per lb. up to 3c. per lb., depending on the percentage of creosol and other high-priced oils used; on most ores, 1½c. per lb, is a safe average figure, and a consumption of 1 to 1½ lb. or from 1.25c. to 4.5c. per ton of feed, averaging 2½c. would be a safe estimate.

Labor.—This will vary, of course, with the size of the plant. At one plant consisting of 60 cells, two men per shift operate the entire plant, equivalent to a cost of 1¼c. per ton. One man per shift on a 250 ton plant means a cost of 5.4c. per ton maintenance. Assuming a life of three months per blanket, a capacity of 50 tons per cell, and an allowance for repairs to blowers, motors, pumps, etc., we have ½c. per ton as a liberal allowance.

Power.—With power at 1c. per kilowatt-hour, and a consumption of 2½ kw.-hr. per ton, the cost would figure 2.5c. per ton of feed.

Summarized the estimated cost on a 2,000 ton flotation plan, or larger, would be approximately as follows:

	Per Ton. Cents.
Labor	1.25
Oil	2.50
Maintenance	0.50
Power	2.50
Total	6.75

On a plant of 250 tons the extra labor costs per ton would bring it up to approximately 10c. per ton of flotation feed.

Actual figures from a large plant treating over 2,000 tons by flotation gave 6.1c. per ton; the flotation feed in this case represents 60 per cent. of the crude ore tonnage, making the cost 3.5c. per ton of crude ore treated.

Theories of Flotation.

So far no satisfactory explanation of flotation phenomena has been advanced. At my instigation and under my direction, a large amount of research work has been done in an endeavor to formulate some logical explanation of the phenomena, and perhaps to find some scientific way of conducting flotation experiments in place of the empirical methods now in vogue. Although the latter object has not yet been attained, still these experiments have resulted in the formulation of a theory that appears to be well grounded and that may prove of interest and value to others engaged in this art.

Much work has been done at the Mellon Institute at Pittsburgh under the direction of Dr. Raymond C. Bacon, and lately by James A. Block at the station of the U. S. Bureau of Mines in Salt Lake City. The result of all this work is summed up in the following statement:

In considering the connection between flotation phenomena and the physical properties of the minerals concerned, there are two parallelisms:

First.—It has been noticed for some time that the minerals which floated were not easily wetted by water, while those which were easily wetted did not tend to come up with the froth. This is the basis of about the only theory so far widely circulated; it was well stated by Hoover in his book, Concentrating Ores by Flotation.

Second.—There is a parallelism between certain electrostatic characteristics and the flotation properties of ores.

In the first mentioned theory, surface tensions and contact angles should be considered. Certain minerals, such as galena, will float on the surface of still water, while gangue particles, since they possess a greater adhesive attraction for the water than the water's cohesive attraction for itself, will be drawn through the surface film into the interior, and sink because of their greater specific gravity. These properties of flotable minerals and gangues are increased by the presence of oil and acid. Oil sticks to galena with greater tenacity than it does to silica, and an oil surface is still less easily wetted than a galena surface. The acid in the water causes a still greater difference in the various surface tensions. This, it seems, is without question the explanation of the action in the MacQuisten process, in which the ore particles are lifted to the surface, where they can be removed by skimming off the surface layer of the liquid.

With reference to the second parallelism, it has been noticed that extremely small amounts of certain colloidal impurities, such as saponin or tannin, were de-

trimental to flotation; while others, such as Congo red and methylene blue, did not interfere, and were, if anything, beneficial. In classifying these, the injurious ones generally came under the head of what physical chemists call electronegative colloids, while electropositive colloids were not harmful. Suspended particles will generally migrate when placed in an electric field, and this classification comes naturally from the direction of their migration. This migration is called electrophoresis, or electrical endosmose, and is the result of the formation of contact layers around the particles by the liquid containing them, very similar to the formation of surface films when liquids come in contact with air. These contact films almost invariably have a difference of potential between their inner and outer surfaces. An air-water contact film has, for instance, a difference of 0.055 volts, and other contact films have similar charges. This causes the particles to act like charged solids, and to be attracted by electric charges of opposite sign.

The charges on solids and non-miscible liquids can be conveniently studied on the stage of a microscope.

This work naturally led to the study of the charges exhibited by various ores and minerals, and in that work an interesting parallelism was observed; namely, that flotable minerals seemed to have positive charges and non-flotable gangues, negative charges. Some gangues were found with positive charges, but they were characteristically hard to handle, having a tendency to come up with the froth. These charges sometimes vary with the acidity or alkalinity of the liquid, and this variation is not inconsistent with the effects of acidity or alkalinity on the flotation of ores.

It has been noticed that these electrostatic properties depend on the condition of the surface of the particle and not upon the composition of the mass. For instance, lead oxide which is ordinarily negative, or neutral, when covered with a sulphide coating, takes upon itself a positive charge.

Recent investigations on the coagulation and deflocculation of slimes, on the coagulation and dispersion of colloids, and along similar lines, show that these contact film charges, although small, have an important bearing on the dispersion or coherence of particles suspended in liquid mediums. In fine suspensions and in colloidal solutions, these charges may often be neutralized by the introduction of oppositely charged ions, precipitation generally taking place whenever these charges fall below certain limits. Oppositely charged contact films have a general tendency to coalesce, while similarly charged films, if their charges are great enough to overcome natural cohesiveness, do not seem to coalesce, but to repel each other, and if the weight of the particles is small enough in relation to their size and surface, permanent dispersion will take place, the particles distributing themselves through a liquid in much the same manner that gas will fill a container.

In view of the above observations, **it seems possible that flotation is the result of difference in polarity in the charges on the various ore particles, and on the bubbles.** Since oil contact films and air contact films have both been proved to have negative charges, the positively charged minerals will adhere to either. The bubble mantles in a flotation machine are undoubtedly composed of oil, or of oil in emulsion, since pure water alone will not froth. The same forces, then, that cause oppositely charged colloids to agglomerate and precipitate, cause the minerals to adhere to the oil-covered bubbles; and the same forces that keep the particles of an oil emulsion dispersed, keep the gangue particles repelled from the bubbles.

Expressed briefly, the theory is as follows:

That oil flotation is an electrostatic process. It is a scientific fact that when a solid particle is suspended in water, the water will form around the particle a contact film which generally possesses an electric charge, the amount and polarity depending upon the nature of the surface of the particle and the electrolyte in which it is suspended. The presence of these charges can be demonstrated by the fact that the particles possessing them will migrate when placed in an electric field. It has been demonstrated that flotable particles have charges of one polarity (positive), and that non-flotable particles have charges of the opposite polarity (negative); that the froth is charged negatively and so attracts the positively charged or flotable minerals, and repels the negatively charged or non-flotable ones. It is this, it is believed, that causes the flotable minerals, galena, sphalerite, etc., to adhere to the froth, and the gangue minerals, silica, etc., to remain in the liquid where they can be discharged as tailing.

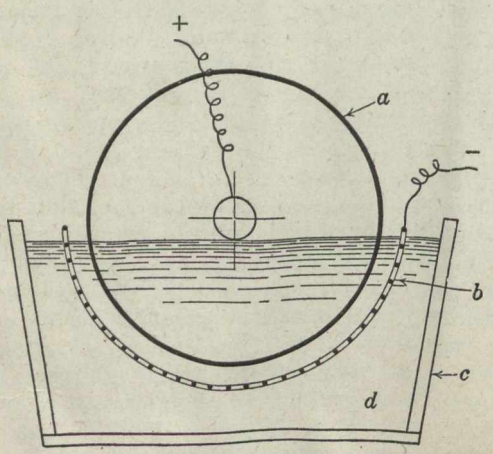
Discussion.

James A. Block, Salt Lake City, Utah.—As I have done some of the experimental work upon which this theory has been based, a brief outline of some of my experiments might not be out of place. During the last few months I have tested about 50 samples of ores, etc., the flotation characteristics of which I knew. Some of these were samples of froth and tailings from plants in actual operation, but most of them were samples taken from laboratory tests going on at the plant of the General Engineering Co., and at the station of the U. S. Bureau of Mines, Salt Lake City. In all of these experiments, no real exception to the theory was found. All of the tailing samples produced in actual flotation showed a negative polarity; all of the ores with the so-called "bad gangues," except one or two, showed some positive polarity, and these exceptions could be explained by the extreme dryness and scaliness of the gangue minerals; and all of the froth products showed positive polarity when the samples were fresh. It was often true that after standing some time, these froth samples would reverse, especially when they contained considerable oil, but this reversal can be explained if we assume that the oil forms a coating around the particles upon standing.

The question might naturally be asked, "can these electric charges be put to any practical use?" A machine* used to purify clays employs very similar charges on the constituent particles of clay. This machine (see Fig. 7) consists of a revolving cylinder, made of conducting material, such as iron, about half immersed in a clay pulp in a trough. At a distance of about ½ in. from the immersed side of the cylinder is a coarse wire screen. A direct current of about 50 volts was applied to the cylinder and the screen, the cylinder being the anode and the screen the cathode. The cylinder attracted the negatively charged kaolin, while the screen attracted the positively charged pyrite, ferric hydroxide, and aluminum hydroxide. It was found that a product running only about 17 to 20 per cent. moisture could be scraped off the upper side of the cylinder, which revolved slowly, while the impurities fell through the screen to the bottom of the trough. The objection to

*Transactions of the English Ceramic Society, vol. xii, pp. 36 to 64 (1912-13).

the process was the high cost of the power needed, which averaged, as I remember it, over 30c per ton of product, but the process is undoubtedly of interest in that it shows that these electrostatic charges are dependable



a Revolving cylinder
b Wire screen
c Wood trough
d Clay pulp

Fig. 7—Apparatus used in purifying clays

enough to be put to practical uses. It is also of interest in that the polarity of the charges noticed on various minerals checks the results of the experimental work upon which this theory is based.

Oliver C. Ralston, Salt Lake City, Utah.—Perhaps the most interesting part of Mr. Callow's paper is the reference to a theory of flotation founded on the electric charges of the ore particles, oil droplets, air bubbles, etc., involved.

For some time I have had a growing conviction that possibly the particles dealt with in the flotation of sulphide minerals were acting according to certain laws laid down in colloid chemistry. One of the characteristic things about either suspension or emulsion colloids is that their individual particles are charged with one or the other sign of static electricity. It is known that the amount and signs of these charges can be controlled by the amount and character of electrolytes put into the water in which the colloids are dispersed, and in turn the properties of the colloidal suspension are greatly changed with this change in the electric charges on the particles. The question has been whether the comparatively coarse suspensions of ore can be compared with suspension colloids, or whether they were too coarse to allow the electric charges on the suspended particles of mineral to produce any measurable effect.

This question has been answered fairly definitely in my laboratory during the past year, for it was found that the electric charges on the particles of what we call "slimes" and "fines" are of considerable importance in the control of the rate of settling of such slimes in water. With this much definitely settled, and with a great amount of literature available in the realm of colloid chemistry dealing with the electric charges on particles of such things as quartz, galena, and sphalerite, and on oil droplets and air bubbles, it was easy to find a combination of circumstances which might explain flotation from this new viewpoint. At about this time George W. Riter made the prediction that the depths of electrostatics would have to be thoroughly sounded before flotation phenomena could be entirely understood. He seemed to have the idea at that time that the charges on the particles were generated by friction in the flotation machine, in much the same way that a piece of sealing wax becomes charged when rubbed with flannel; but we know from colloid chemistry that these charges of electricity arise whenever two substances of unlike dielectric constants come into contact.

Further work along the line of controlling the charges of the ore particles, thereby controlling the rate of settling of the particles in water, has convinced me that the charges are of considerable importance and the results of this work will be reported soon. Mr. Callow told me last spring that he had much the same conception of the matter as I, and had the Mellon Institute in Pittsburgh working on it for some time. Mr. Callow sent a man to the Salt Lake laboratory of the U. S. Bureau of Mines to try out some methods of measurement which I had proposed and which had not been used in Pittsburgh; some of the results are presented in Mr. Callow's paper. His work adds certainty to the conjecture that the electric charges on particles of minerals suspended in water are of importance in flotation phenomena. Mr. Callow has outlined one way of explaining just how these electrical effects come into play in flotation and I have outlined a second in an article in the Mining and Scientific Press. The knowledge that when flotation conditions are good the froth has a positive charge and the rejected gangue a negative charge, that the oil droplets and the air bubbles are negatively charged, and the sulphide particles positively charged is highly interesting. We have here electrical effects which are parallel to flotation phenomena, and the conclusion that they are connected with each other seems justifiable. Just exactly how they are connected is not yet clear and may prove difficult of solution.

It is to be hoped that further work will be done along this line in order that a theory of flotation may be found, which will afford a more rational control of flotation testing, and an extension of the process to the treatment of any kind of minerals.

MICA AT THE TETE JAUNE, BRITISH COLUMBIA.

Now that railways are being operated through the northern portion of Cariboo mining division, British Columbia, mineral occurrences in that part of the Province are attracting attention. The following notes relative to mica in the neighborhood of what has long been known as Tete Jaune Cache, some 30 or 40 miles west of the Yellowhead pass through the Rocky mountains, have been taken from a short report made by Mr. J. D. Galloway, Assistant Mineralogist for British Columbia:

The occurrence of mica near Tete Jaune has been known for many years, but practically no systematic prospecting or development work has yet been carried out. A number of claims have been staked from time to time and many are now held by annual assessment. I went to Tete Jaune at the end of September with the intention of examining some of the properties. On arriving there it could be seen that the mica claims, which are situated high upon the rocky ridges of the mountains at altitudes of from 5,000 to 7,000 ft., were covered with snow. I waited four days for the weather to improve, but it rained steadily in the valley and snowed in the hills. It was impossible to see anything of surface showings with such an amount of snow, so the attempt to see the claims had to be abandoned.

The following general description has been compiled from information obtained from Mr. Jowett, stipendiary magistrate, and from owners of claim: The mica

showings occur in the range of mountains above the south bank of Fraser river. The watershed of this range here forms the boundary line between Cariboo and Quesnel mining divisions. A very large pegmatite dike, or series of dikes, said to be 25 miles long and varying in width from 25 to 1,800 ft., is intrusive into the older rocks along the axis of the range, and extends from below Tete Jaune to Albreda summit, near Canoe river. This pegmatite, of course, is not exposed continuously along this length, but is sufficiently so to indicate that the different outcrops are linked together, at least not far below the surface. This pegmatite is the usual typical one, consisting of large crystals of mica, feldspar and quartz, with, in places, a fine-grained intergrowth of feldspar and quartz. The mica occurs in sheets up to 19 in. square and with a thickness, of numerous sheets together, of an inch to two inches.

The Albreda group of claims was worked for a short time in 1914, and in seven weeks three men took out from a surface quarry about two tons of mica which was taken down to Tete Jaune, where it was seen by me. This mica has a slightly brownish color, but in the thin sheets is quite transparent. It is to some extent stained with iron and the sheets are often striated and flawed; it is certainly good commercial mica, but is not of the highest quality. About 50 per cent. of the two tons taken out could be trimmed into pieces of 2 by 5 in., with, of course, some larger than that; the remainder would average about 2 by 3 in. It has an excellent cleavage and is not brittle, and could easily be trimmed as desired. It is mainly a muscovite mica, but some of it is considerably stained with iron.

A group of claims on the south side of Sand creek is owned by a French company, which during the summer of 1914 did some work, including driving a short tunnel. Other claims are held by Vancouver people.

It seems to me that these mica deposits are well worth careful investigation, and it is hoped that time will be available for a thorough examination next year.

GRANBY CONSOLIDATED.

The Granby company had been credited with the ability to lay down its copper in New York at about 8½ cents per pound, but the quarterly statement shows the figure to be 11.9 cents per pound. The company's Grand Forks property has been known to be a high cost producer, but the new Anyox mine was expected to bring the average much lower than that shown in the September 30th quarter.

Officials of the company explain the situation as follows: Cost at Anyox was 7.939 cents per pound; at Grand Forks 10.91 cents, to which must be added freight, refining, selling and general eastern expense. These brought the Anyox figure up to 9.4 cents and Grand Forks to 12.4 cents, or an average of 11.9 cents per pound, after all credits for precious metal values. In other words, while Granby's report showed the expense of producing 12,000,00 pounds of copper to have been $1,823,827, an indicated cost of over 15 cents per pound precious metal credits amounted to $384,000, or 3.2 cents per pound.

The Grand Forks property is of lessening importance in Granby's operations, and its high cost is not surprising. High costs at Anyox were due in part to the installation of the fourth furnace at the smelter and the new agglometator, expense of which was charged to operation.

Future costs at Anyox are expected to be much more satisfactory, as construction is practically finished. Furthermore, an increased recovery of about four pounds copper per ton of ore is possible with the new agglomerator. This should, of course, have a decided tendency to lower costs.

While Granby's report for the September 30th quarter showed net profits of $486,435, the actual results have turned out to be considerably better. The preliminary figure was based on an inventory value of 15½ cents per pound for 8,385,100 pounds of unsold copper, which has since been disposed of for $168,000 more than the inventory value. In other words, net for the quarter was $654,000 instead of $486,000 as shown by the report.

COLLECTIONS OF THE EMPLOYEES OF THE DOMINION COAL CO. TO THE CANADIAN PATRIOTIC FUND.

Collections through the payrolls of the Dominion Coal Co. on behalf of the Canadian Patriotic Fund were commenced during November, 1914, and with the end of October twelve months have gone by, during which time the aggregate contributions of the workmen have totaled $8,025.16. The collections for the month of October totaled $936.00, this being the highest figure obtained since the collections were commenced. The amount of eight thousand dollars does not include any of the larger sums which were contributed to the Patriotic Fund by officials of the company when the campaign for funds was first inaugurated, but is altogether made up of small sums contributed monthly. It is interesting to note that the monthly contribution has steadily increased notwithstanding the steady diminishment of the company's employees by recruiting.

The amount collected for the Machine Gun Fund totals $8,000. The workmen of the Dominion Coal Co. have therefore contributed $16,000 to patriotic purposes during the year, and from among their ranks some 1,500 men have gone to the front.

KENNECOTT COPPER.

With 167,972 shares standing in his name, Daniel Guggenheim leads the list of Kennecott Copper Corporation stockholders. During the few months intervening since the company was formed its shares have been distributed to more than 800 persons. On the other hand Braden Copper Mines Co., to be taken over by Kennecott, has in excess of 2,600 stockholders; but this company has been in existence for years.

Three holding concerns will figure in the proposed merger, all being dominated by the Guggenheims. Kennecott was owned entirely by the Alaska Syndicate, an equal partnership divided between the Guggenheims and J. P. Morgan & Co. A portion of the Guggenheim participation was several years ago turned over to Kuhn, Loeb & Co. M. Guggenheim's Sons are believed to have been the controlling factors in Braden, which finds confirmation in the large holdings standing in names of Guggenheim employees. The Guggenheim Exploration Co. will dissolve after distributing its assets and turning over a block of 404,000 shares of Utah Copper to Kennecott.

EUROPEAN MINING FINANCE*

By J. L. Gallard.

Considerable progress has been made during the last few decades in connection with the formation of companies to develop mining properties, and London, the world's chief money centre, has assisted in no small degree the attainment of that progress. The other European money centres have, of course, contributed also, but not nearly to the same extent as London. Here, as elsewhere, the promotion of mining propositions has for the present been checked by the great European War now in progress and maybe some considerable time will elapse before anything like the former activity is witnessed again. There are the important facts to be remembered, however, that the war is dispersing huge quantities of the products of the mining industry; that when peace reigns once more mineral products will be needed in great quantities in connection with the re-establishment of other industries; and that although the supply of capital for purely speculative enterprises will not be so great as before, legitimate schemes having for their object the opening up of fresh mineral resources are hardly likely to be left without support.

Before proceeding to deal with the requirements and methods of British promoters of mining companies, it may be of interest if I illustrate the very important part European countries and their foreign possessions play in connection with the mineral production of the world. Quite complete and up-to-date statistical data relating to the output of the various parts of the world are not available, but information is given in a portion of the report recently issued by the British Home Office which enables one to gain an idea of the position. For instance, in the report mentioned, there is a table of statistics which shows the number of persons engaged in mining and quarrying at home and abroad. This compilation is incomplete, inasmuch as no figures are published by several countries, viz., Bolivia, Brazil, China, Persia and Turkey; so that the total of nearly six and one-half millions in the table probably falls considerably short of the real aggregate. However, the figure is instructive, especially when one analyses the returns and discovers that European countries and their foreign connections represent just over five millions, or 77 per cent. of the total. Turning then to the statistics relating to the annual production of the most important minerals, we find that nearly 63 per cent. of the world's output of gold is contributed by European countries and their colonial possessions, and that of this 63 per cent. the British Empire is alone responsible for almost the whole. More than half the total number of mining employees being engaged on coal mines, the output of that mineral naturally ranks first—a long way first—as regards quantity; and here also we find European influence strong. Although America produces more coal than the United Kingdom, the latter, together with other European countries and their possessions abroad, figure for rather more than 60 per cent. of the aggregate for the whole world. They also contribute over half the iron. On the other hand, North America has the "pull" as regards petroleum, and also produces more than half the world's output of silver and copper.

While rough calculations such as these are interesting, they do not, of course, fully illustrate the scope of the subject of European mining finance, which is, in fact, as wide as the geographical distribution of the world's mineral resources. Political boundaries do not greatly concern mining financiers, who, as a rule, are ready to seize upon a likely thing in any country, literally "from China to Peru." **The promotion of mining enterprises is, in fact, largely a matter of opportunity coupled with financial resources and more or less technical knowledge.**

Conditions change from time to time in the world of mining finance, just as they do in other spheres of activity. One year, perhaps, sees an increase in the number of gold mining companies formed, another year copper rules the roost, or, maybe, alluvial tin schemes predominate. To a large extent the class of mining companies promoted is determined by the swing of the pendulum on the London Stock Exchange, where, by the way, sentiment always plays a part. Mining financiers of standing, being in a position to bide their time, are usually prepared to consider schemes and take over the good ones, whether they happen to coincide with the Stock Exchange fashion of the moment or not; whereas the smaller fry, with limited, and possibly very attenuated, financial resources, can hardly afford to do so. The latter, however, generally manage to get hold of something when a Stock Exchange boom is on, and this accounts for the flotation of "prospects," which, in the absence of great speculative excitement, would stand little chance of attracting public money.

In London the promotion of mining companies of any size is undertaken, as a rule, by one or other of the numerous exploration or prospecting syndicates, or companies, which have been formed specially to deal with business of this kind. Mere "prospects" are not run after. A developed mine, having some ore actually in sight and a satisfactory outlook, stands probably the best chance of being taken up. It is true that many of the now well-known mining companies operating on the famous Witwatersrand gold field were formed and provided with working capital before the sinking of a shaft on their ground had even been commenced, but that field has always been regarded as unique in having a comparatively regular reef formation. Apart from this, mining promotions were more readily made on slender data in those days than they are now, except, perhaps, in boom times. Another type of proposition likely to be given careful consideration by mining financiers of standing in London—who, by the way, include some well known citizens of the United States—is the mine, which, after being worked in the somewhat distant past, was abandoned for metallurgical reasons or because metal prices fell to too low a level to permit of the property being profitably exploited any longer. Evidence must be provided, however, that it was not left because the lode pinched out at depth, and it must not be a very deep water-logged mine. In the case of a property whose workings extend only a short distance beyond the oxidized zone and where the nature of the formation lends itself to the testing of the sulphide zone by means of bore-holes, and the old records indicate that the former workers gave up on account of their being unable to treat the sulphide ore, then the presence of water in the old workings would not be regarded as a great drawback; and, providing satisfactory terms could be

*A paper presented at a meeting of the International Engineering Congress, 1915, in San Francisco, Cal., Sept. 20-25, 1915.

arranged, the proposition would, in all probability, be taken up with a view to the formation of a company.

Many mines are taken up, in the first instance, under option. Of these, the proportion that comes eventually before the mining public is probably not very great. Many are optioned, but few are called. In this connection, the interesting case may be cited of a mining finance company whose shares rose to a high price on the London Stock Exchange last year, solely on the strength of the fact that it appeared to have secured a piece of business having great potentialities. Before that business was secured, however, the management had investigated and turned down between four and five hundred other propositions!

What has become of the rejected, someone will wonder. Well, they will probably be, if they have not been already, offered elsewhere, and very likely some of them will eventually appear before the mining public; for when a Stock Exchange boom is in progress, as previously mentioned, properties find a market much more easily than in normal times. It does not necessarily follow that all the rejected were worthless. Some no doubt had considerable merit, but the vendors probably opened their mouths too wide, and the fact of their having been turned away may have done good by modifying their ideas of values.

The question of price is one of the great difficulties in connection with the placing of mining properties. Vendors usually think that their geese are swans, and are, consequently, apt to regard the people who are considering the question of financing the mines as nothing better than thieves and robbers. No doubt this attitude accounts for many a promising mine being turned down—at any rate, temporarily.

The Financing of Mines.—Having secured the offer of what appears to be a promising mining proposition and arranged for a working option, the exploration or finance company with which the financiers are associated will start work thereon, and if at the end of the option period the results are satisfactory, the option will be exercised and the mine taken over. Probably the vendors will have stipulated for a share interest in any new company that may be formed to acquire and work the mine, in addition to a cash payment. Market conditions being propitious, a new company probably will be formed. Sufficient working capital may be guaranteed by the parent exploration company and its associates, themselves, taking up shares at par, in which case it may be thought unnecessary to incur the expense of making an appeal to the public by means of a prospectus. Instead of issuing a prospectus, it may be decided to have the shares introduced on the Stock Exchange through the medium of a firm of brokers. (The prospectus and non-prospectus methods will receive further consideration in a subsequent portion of these notes.) In the event of an offer of shares to the public being decided upon, there will be underwriting arrangements to fix up, and these will probably be made with friendly mining groups and Stock Exchange firms. Underwriting commissions are not always payable in cash. Sometimes they take the form of an option for a period on a portion, or on the whole, of the unissued shares at par, or some other fixed price. A good clue to the quality of the proposition whose shares are offered to the public is often afforded by the size and nature of the commission payable to the underwriters.

As regards the capitalization of mining ventures, there is no definite rule as to size. But there is a rather common failing, namely, that however large the nominal capital of a company may be, it more often happens that the working capital is inadequate than the reverse. Too often the size of the capital is determined, not by the immediate and prospective requirements of the mine, but by the rapacity of the vendors and the promoters, who are guided to some extent by their judgment of the capacity of the public at the time. Of course there should be some relation between the size of the mine, its ore reserves, its possibilities of extension, its financial requirements, and the amount of capital the public is asked to provide in order to pay the vendors and to furnish resources for the working of the property. But hard and fast rules cannot be laid down which would meet the requirements of all, or even a fair proportion of mining finance schemes. No two mines are exactly alike, nor have any two groups of mining financiers exactly the same ideas.

Several companies in recent times have followed the lead of a number of the South African gold mining concerns and have raised large sums of money on debentures. In some cases, these debentures carry conversion rights, that is to say, they can be exchanged for shares in certain fixed proportions. This gives the holder of debentures a chance of securing some return in addition to the fixed rate of interest, and if the company is successful it stands to get its debenture debt reduced automatically by the conversion rights being exercised. In a recent case, debentures were offered for subscription, carrying, in addition to conversion rights, an option on shares at par for a fairly lengthy period. If these options are exercised, the company will, of course, receive a further supply of capital.

The debenture method of raising money has an advantage over that of issuing cumulative or participating preference shares. Dividends on shares can be paid only out of profits, and the earning of profits usually means the attainment of a fairly advanced stage of operations. Debenture interest, however, can be paid out of capital, pending the attainment of the productive and profit-earning stage. Of course, it is not every mining concern that can justifiably raise money on debentures; and this method, like many others, is liable to be abused. One or two cases have come under my notice where the so-called debenture bonds offered for subscription were really no better than ordinary shares; the high rate of interest they carried should have been enough to warn off the public.

Limited Liability Companies.—The financing of undertakings by means of companies is, by the way, almost as old as the hills. Mr. H. C. Hoover, in one of his many instructive notes to the translation of Agricola's "De Re Metallica," mentions that the ancient Greeks formed companies to work the silver mines of Laurion, and that company organization was very common among the Romans, who speculated largely in the shares. From these ancient methods of conducting operations on co-operative lines have been developed the methods in present-day use, apparently the chief modification being the adoption of the principle of limited liability. Even now, this principle is not universally adopted throughout the British Empire; but it is probably safe to say that nearly the whole of the British capital invested in mines at home and abroad is represented by shares in companies having the word "limited" at the end of their titles, though some of them may be private and not public limited companies. Other European countries have their own mining companies formed on a similar principle, and large interests are also held there in undertakings which have

been registered either in Great Britain or in British colonies under the limited liability system.

"Limited liability" means, of course, that the holder of a share is not legally liable for calls amounting to more than the face, or nominal, value of that share. In the event of more capital being required, when all the company's shares are issued and are fully paid up, some scheme may be devised for "raising the wind"—a reconstruction involving a fresh assessment being the common plan—but the holder of a fully-paid share can refuse to assume any further liability. In that event, he is entitled to have his interest in the concern bought out, but in practice this rarely means that he gets anything worth having. At the same time, the holder of a partly-paid share remains legally liable, so long as he holds that share, for the amount of the outstanding calls, and even forfeiture of the share does not release him from this liability.

Mining and the Stock Exchange.—Mining for tin, copper, lead and blende had been carried on in Great Britain for centuries; the huge deposits of coal and iron had attracted large amounts of capital; and millions had been found for the exploitation of gold mines in South Africa, America and Australia; but previous to the great South African boom of 1895 the mining section of the London Stock Exchange was a small and unimportant affair. Many brokers, as well as people outside the Stock Exchange, looked askance at anyone who talked of dealing in mining shares, which was regarded as gambling and a vice, and it was not until the year mentioned that public interest in mining ventures became widespread. A remarkable change then came over the scene. Continental as well as British investors poured enormous orders into London for South African shares, and ever since that memorable time the investment of money in mining enterprises has assumed a different aspect—at any rate, amongst the British public.

Statistics published by the Mining Journal of London, relating to the incorporation of new mining companies, show that in the ten years, 1893-1902 inclusive, the number of companies registered in London was 5,482, and their aggregate capitalization was £582,915,449. Of these, 950 companies, capitalized at £56,234,626, were for operating in Great Britain, and were for the most part connected with iron and coal mining. The other 4,532 companies, with a total capitalization of £526,680,823, were formed to carry on operations abroad. In the year 1895 close upon 150 companies, with a capitalization of about 18¼ millions (£18,250,000), were formed in England in connection with the South African gold mining industry; while in 1895 and 1896 some 700 companies were registered in London, with a capital aggregating £72,000,000, in connection with the gold mining industry of Western Australia. The comparatively small number relating to the Transvaal is explained by the fact that the majority of companies which were formed to exploit the "banket" beds of the Witwatersrand gold field were registered in the Transvaal, not in London. The mining claims there, after being taken up by local syndicates or by finance companies like the Consolidated Gold Fields of South Africa, Limited, were floated off and the shares of the separate companies were placed on the market, usually at a substantial premium. Several of the mines at Kalgoorlie, Western Australia, were originally floated in Adelaide, but later British companies acquired the interests of the Colonial concerns.

No doubt there are still some people who regard dealing in mining shares as a form of vice, while probably some of those who indulge in speculative purchases would frankly admit, if asked, that to them it is merely a form of gambling. But the old prejudice has worn down under the pressure of a growth of knowledge respecting mining matters. It has come to be more generally realized that the mining industry has played an important part in connection with the civilization and material progress of the world, a part it is still destined to play; and one of the chief requisites of the mining industry, of course, is capital. I have heard it deplored that mining and speculative activity in shares should be so linked up together. Idealists have gone further and have contended that the mining industry should be entirely disassociated from the Stock Exchange. How then would the requisite large sums of capital be found? Eliminate the chance of making profits by dealing in shares, and probably only a very small proportion of what may be termed the mining public would be ready to embark its capital in mining ventures. Few of those who provide capital for the opening up of mines do so with the intention of simply holding on to their shares until they die or until the company they are interested in ceases to exist. Human nature being what it is, and the millennium being still in prospect, mines and share-speculation will probably continue in association; and it seems to me that the best thing to do in the circumstances is to try and educate the mining public, so that it will be able to discriminate between good, fair, poor, and absolutely worthless propositions.

Mining Prospectuses and the Public.—One outcome of the growth of public interest in mining shares during the last twenty years is that mining prospectuses are, as a rule, more carefully compiled nowadays. In the so-called "good old days" more was thought of presenting an attractive "front page" than of providing essential data as to the mine. By an attractive front page was meant an imposing list of directors, and an imposing list of directors meant a number of titled individuals. Such things as "ore reserves" and "profit in sight" were hardly thought of then. Now, more information is expected about the mine whose shares are offered for subscription, and a company is not cold-shouldered because the directorate does not include a duke, a marquis, a lord or a baronet. The appearance on a board of directors of one or more well known mining engineers is much more important, and if, in addition to such a directorate, there is a technical committee, composed of mining and metallurgical experts, so much the better. Then as regards the inside of a prospectus, a report of the property, solely by the vendor's engineer, is not sufficient. An independent engineer's report should be forthcoming, and, assuming that the mine is already opened up to a certain extent, he should provide an estimate of the quantity and average value of the ore fully and partially developed. It will then be possible for the potential purchaser of shares to form an idea of the reasonableness, or otherwise, of the consideration payable to the vendors. If it is an alluvial venture, an estimate should be provided of the available yardage and its metal contents; the latter based on the results of the bores or pits, the number of which should be stated.

Fine phrases which really mean nothing are, unfortunately, not always left out of modern mining prospectuses; while every now and then one comes across a document containing extravagant statements printed in large type, which, the promoters no doubt fondly hope, will make up for the absence of convincing data.

A fair number of the public, however, now know at least a few of the tricks of the trade, having learnt a little by experience—costly experience, it is to be feared, in many cases. But there are many, apparently, who are unable to profit by experience, and so long as a gullible class of people remains in existence the promoters of dubious and downright shady schemes will ply their trade with more or less success. As the saying goes, "you can fool all the public some of the time, but you can't fool all the public all the time." It is those who can be fooled more than once who help to keep a market boom going.

The credulity of a portion of the mining public is really amazing. It is curious how able men of business seem to lose their business acumen once they get outside their own particular line. I have heard of numerous cases of men in responsible positions in the world of finance and industry who have lost money over mining propositions they ought never to have touched. A glowing report on an alleged mine in a remote part of the world, written by a man they never heard of before, but brought before their notice by a plausible individual able to conjure up visions of easily-gained riches, will often charm money out of the pockets of ordinarily cautious and capable business men. A fine assay result seems to be especially efficacious in such cases. In their haste they overlook the obvious fact that one specimen does not make a mine. It is also curious that once bitten does not make them twice shy. If a market deal goes against them, they will very likely "average" their shareholding in the concern, regardless of a change for the worse in the condition of the mine; while in the event of their being badly treated by the directors, who, perhaps, have withheld material information, they will probably not kick up a fuss, for the reason that they do not want to advertise the fact that they have been foolish. Unfortunately, people like these help to sustain the very promoters and directors the world of mining finance could do best without.

Prospectusless Companies.—Many companies which are really dependent upon public support for the provision of working capital do not issue prospectuses. Their shares are "introduced" on the London Stock Exchange, generally at a premium, and by means of advertisements in the papers public attention is called to them, though no shares are directly offered for subscription. This method has advantages from the promoter's point of view. For one thing, and it is not the least important, this method enables the promoter to dodge the Companies Act. British Company Law requires a prospectus to set forth certain essential details, such as the terms of the underwriting of the issue, the consideration payable to the vendors, the participation of any intermediary vendor, the minimum subscription on which the directors will proceed to allotment, and the personal interest in the promoting or underwriting syndicate of each of the directors. Moreover, the directors are jointly and severally liable for the accuracy of the whole contents of the prospectus. The memorandum of Articles of Association of the Company must also be printed on the document. By getting his company's shares "introduced" on the market—through a firm of brokers to whom blocks of shares are optioned at rising prices—the promoter avoids the necessity of making such disclosures. Usually, printed slips giving brief particulars of the enterprise are circulated in the market, but these slips are unsigned and apparently no one can be held legally responsible for their contents. One would think that members of the Stock Exchange would, in their own interests, make full inquiries into any scheme they are asked to "father," but evidently they do not invariably do so, or they are easily satisfied.

Of course, in the case of companies whose shares have not, for some good reason, come to the London market until the undertakings have been in existence for some time, the non-publication of a prospectus assumes a different aspect. The shares of a well known American mine, for instance, might not be dealt in in London until a British financial group thought fit to acquire a block of the stock and make the "introduction" on their own account. In such a case, however, records of the company's operations would no doubt be available, and a summary of these would appear on the printed slips issued in market circles "for information only." Records of actual performances are a very different thing to the matter one frequently finds on the slips.

Mining Finance in Other European Centres.—Although France, Germany and Russia each has its own mining industry, and citizens of the two former countries have interested themselves in mining abroad, the promotion of mining companies in those parts of Europe has not attained nearly the same stage of activity as in Great Britain. Germany is one of the oldest mining companies on the earth, but in that country the mines are mostly run by the State to employ men and to keep other industries going. There is, I understand, a tax on mining scrip in Germany (a tax based on the face value of the scrip), the imposition of which was regarded, at the time, as a piece of grandmotherly legislation to restrict speculation. But it has not prevented German investors from interesting themselves largely in the shares of South African gold mining companies. With the object of avoiding payment of the tax, a good deal of the mining scrip belonging to Germans, mostly in the form of bearer shares—a form uncommon in Great Britain and her colonies, where registered shares are usually held—has been deposited with firms and individuals in London.

The French, although they have not shown as much enterprise as they might in working the mineral deposits of their own country, have engaged to some extent in mining abroad—in Russia and in South Africa, for instance. But it is not an easy matter to get a mine financed directly in France, where only a small élite really knows much about this class of business. There are banks and a few firms in Paris which will, through the medium of one of their subsidiary corporations, consider the acquisition of mining properties; but one who should know informs me that high-class financiers there still look askance at mining ventures. Although considerable numbers of South African shares have been placed amongst investors in France, there is not at present a really large public for mining shares in that country. The French law is strict as regards prospectuses, and this direct method of applying to the public for subscriptions is generally avoided. The method usually adopted is much the same as that employed in London when shares are placed without a prospectus being issued. In Paris, the introduction of shares costs a substantial sum of money; in many cases the expense has been considered prohibitive. In the first place, a sum of money has to be deposited with the French "Fisc" authorities, who retain a percentage in respect of every share dealt in; then the firm which makes the introduction of the shares on the Coulisse, the unofficial market, takes a big fee and options on shares; and the provincial brokers who are em-

ployed are given shares, at a discount, to dispose of amongst their clients, on the understanding that if any of the shares they sell come back to the market within, say, three months, they lose their commission on the sale of such shares. It is impossible to place any shares, on a large scale, amongst the public in France without a market quotation being obtained for the shares; and from this follows the expenditure of money amongst the newspapers.

The Russians are not credited with much mining knowledge, but it is said that they will follow a good lead and buy mining shares. "Ore reserves" and "profit in sight" are unfamiliar terms to them, and they will call a "mine" what is merely a "prospect." A number of Russian mining propositions have been financed in Great Britain during the last five or ten years, and the probability is that more will be done in this direction in the not distant future. It is usual, though the method has not been invariably adopted, for a British-formed company to hold the bulk of the shares of a Russian-formed company, the former being the holding and the latter the operating company. This method is considered to have several advantages. Anyway, it is necessary to have a Russian manager at the mine. When it comes to negotiating with the Government and dealing with labor questions, the fact of there being influential Russians on the board of a local company should certainly prove advantageous; while from the share-dealing point of view there is the fact that the dual arrangement means two markets, one in Petrograd and one in London. The technical control of the mining and metallurgical operations, however, is not left to Russians. This is usually in the hands of engineers in London, who make periodical visits to the properties. The option method of financing mines has been taught the Russians by the British; but the latter might adopt, with advantage, probably, in many cases, one of the provisions of the Russian Company Law which requires the founders of a company to subscribe not less than one-tenth of the shares, in the case of a million roubles capital or less, and when the capital exceeds a million roubles, one-twentieth of the shares over and above that number.

The Future of Mining Finance.—The more actively the world is searched for mineral deposits, the smaller becomes the chance of promising new propositions being located; and the prospect of those who every now and then cry out for a new mining field having their request granted is rendered gradually still more remote. But it may easily happen that before the fresh fields and pastures new are located, mining financiers will find some of the fields already known to them affording fresh scope for their activity. In this connection two points come to mind at once. In the first place, the famous Witwatersrand gold field is not yet fully developed. Mr. R. N. Kotze, Goverument Mining Engineer, Union of South Africa, in course of the evidence he gave before the Dominions Royal Commission, in April last, said that the quantity of payable ore in the undeveloped areas of the Witwatersrand was equal, in all probability, to the quantity remaining in the producing mines. (His estimate under the latter heading was 587,000,000 tons.) And he estimated the capital requirements at, roughly, £50,000,000. Then there are the great mineral resources of Russia. British capitalists have already interested themselves, more particularly during the last few years, in these, and are looking forward to the time when they will be able to take a more active part in connection with the development of the Russian mining industry, which, according to people well acquainted with that country, is likely, after the war, to assume a much more prominent position than it has attained up to the present. So far as the early future is concerned, the prospects of activity in the world of mining finance are not bright, on account, of course, of the European War. But there is still plenty of scope for the mining financier, and when peace reigns once more he will find business to his hand.

Some of the more recent developments which have been noted in connection with mining finance and company organization in London encourage a feeling of optimism in regard to the future. Evidence is forthcoming that in some quarters directorates are now being more carefully selected, and that better technical control at headquarters is being provided. These factors must result in improved technical management of the mines. The more widely improvements such as these are adopted, the smaller will become the danger of "scandals," which do harm to the mining industry by checking the supply of public money for legitimate schemes, and the more difficult it will become for the purveyor of "wildcats" or "fakes" successfully to ply his nefarious trade.

CANADA COPPER CORPORATION.

Canada Copper Corporation has put into reserve 9,000,000 tons of ore averaging 1.8 per cent. copper, in addition to which 2,000,000 tons of "probable ore" has been located. Exploratory work continues with three diamond drills in operation.

Not only does the Canada Copper Corporation own a big copper area upon which it is pushing devolpment work, but it also controls the British Columbia Copper Co., which is operating one of its three furnaces and showing a fair profit.

Before production can be inaugurated at the new property milling facilities must be provided, it being the intention of the management to erect its own mill with a capacity for treating 2,000 tons of ore daily. This will necessitate new financing.

The method of financing has not been determined, nor the amount, but it will provide for the elimination of the outstanding $600,000 debentures which still have eight years to run.

Engineers report that there have been developed to date at Copper Mountain 8,900,000 tons of "proven" ore averaging 1.75 per cent. copper and 2,000,000 tons of "partially" proven ore averaging 1.75 per cent., or a total of 10,900,000 tons, and an estimated recoverable value of 20 cents per ton in gold and silver. Erection of a 2,000-ton plant is recommended. Canadian Pacific engineers are assured of the advisability of running a spur to the mines from Princeton, 12 miles.

Work at the old properties in the vicinity of Greenwood, B.C., was resumed last August and a fair profit is being realized as a result of the smelting operations now in progress. The Greenwood ores are smelted direct, whereas the Copper Mountain ores are of the disseminated porphyry type and will require concentration by flotation process.

It is estimated that a maximum of $2,000,000 will be required to place the property on a 2,000-ton basis. It is estimated that cost of production during this stage will not exceed 8.5 cents per pound of copper after crediting recoverable gold and silver values and the cost of production from the deeper ores will not exceed 10.5 cents per pound.

THE MINES OF THE BRADEN COPPER CO.*

By H. R. Graham.

"El Mineral Teniente", property of the Braden Copper Co., is situated on the rugged slopes of a part of the main Andean Range in latitude 34° South, and longitude 71° 20′ West, at an altitude of about 8,000 ft. The property consists of about 100 claims covering roughly 1,200 acres. The mine is a very old one, dating its history back to the 18th century, when a Spanish lieutenant endeavoring to reach the Argentine from Chile in order to escape the long arm of the law, discovered a high grade vein in that part of the mine now known as Teniente No. 1. The mine operations up to 1906, however, were on a very small scale, and consisted of a gopher system of mining rich veins, concentrating the contained metal by hand sorting, and transporting it about fifteen miles by mule-back for direct smelting. At that period the operations of the American company commenced in earnest, and from that time on the mine has gradually been enlarged, until it has attained its present 3,000 to 3,500 ton daily output.

Geologically, the property is peculiarly interesting inasmuch as it consists of a series of irregular lenses formed about the periphyry of an old volcanic plug, slightly tilted to one side. On one edge the surface has been so eroded, as to have lost completely its mineral values; for active mining operations about four-fifths of the circumference of the crater is left. The volcano itself would rank as a fairly large one, having a diameter of about three-quarters of a mile, and a roughly circular outline about two and a half miles long. Supposedly of Tertiary origin, the country about the mine consists of andesitic flows, through which, at the time of some gigantic volcanic upheaval, the tuff plug now occupying the crater, was forced. The great pressure tore apart and shattered the andesite flows, much as a missile thrown through a plate-glass window would affect the glass. The uprising hot alkaline carbonate waters, containing mineral sulphides in solution, found the cracks and minute fractures in the andesite an ideal place to precipitate, upon the lowering of temperature and release of pressure, and found their way for some distance out into the shattered rocks away from the crater.

The materials close to the volcanic centre were so thoroughly shattered that they formed a brecciated deposit, making a most favorable point of deposition; and it is in the brecciated portions of the lenticular orebodies that the greatest values are found. The mineral sulphides, however, formed ore even in the blocky andesite at some distance from the crater. Generally speaking, the materials with which the miner is interested, are the tuff, composing the volcanic plug, a combination of volcanic mud and contained agglomerate; the breccia, essentially of tourmaline ground-mass with inclusions of angular andesite fragments; and the andesite, mineralized except close to the breccia contact, or at such points as fumarolic vents have been formed. The actual contact between the tuff and breccia is not always distinct, but if one remembers that the tuff includes rounded fragments of porphyry, and the breccia, angular fragments of andesite, the difference is easy to detect.

The contact between breccia and andesite is easy to note as a rule, but on the Teniente side the gradation from shattered andesite to andesite breccia, is a most perplexing one. The breccia does not always appear as an intermediate material between the tuff and the andesite, but in these cases where tuff and andesite contact, the ore width is not so great nor the values so rich. At various places in the mine old fumaroles are encountered, in which oxidation has taken place at depth, and at times small chambers containing heads of wire copper coated with oxide, are found in company with the usual black sulphides and oxides and yellowish iron stains of limonite.

The limit of ore on the crater side is generally the tuff, although sometimes false contacts—thin tongues inserted into the breccia—occur, on the inside of which there is good ore bearing breccia. On the country-rock side, the limit of ore has to be determined by assay, but is also detectable by the lessening of the fractures and the blockier, more massive appearance of the andesite.

The copper values occur in both breccia and andesite, essentially as primary sulphides in the form principally of chalcopyrite, which is roughly 75 per cent. of the copper mineral, and also as bornite, secondary chalcocite, an undetermined black sulphide between tetrahedrite and enargite, and some of the carbonates, silicates, sulphates and oxides of copper. Zinc blende, iron pyrites, magnetite, galena and occasionally native copper are also found. Tourmaline, quartz, calcite, ferromagnesium carbonates and the usual products of devitrification, chlorite, kaolin, etc., are also found, as well as the plagioclase, biotite, hornblende and pyroxenes of the different classes of andesite.

The topography, due to violent igneous origin of the region, is very steep and rugged, devoid of vegetation, particularly liable to strong winds, heavy snows and snowslides. It is this topography which at one and the same time aids mining, drainage and ventilation, by allowing the mine to be opened by adits, and still makes difficult the operation, by its lack of safe room for buildings and storage of supplies, and by its difficulty of access.

Great care has to be exercised in the choice of building sites, as we have found by experience that the Cordillera guards its wealth rather jealously, and one bad storm is sometimes enough to change all previous slide paths and wipe out even buildings that have stood up for years.

The surface plant consists of a power house, with necessary compressors for a steady compression of 6,500 cu. ft. of free air to 100 lb. pressure; motor generator sets, for the transformation of about 600 kw.; and switchboard installation for handling of about 1,500 kw. at a 2,300 voltage. Power is sent from the sub-station at the Canon Diablo, three kilometers distant, by two separate pole lines, which are subject to winter breakdowns due to slides.

The machine shop is fully equipped with lathes, a shaper, drill presses, pipe machines, shears and a punch, and takes care of mechanical repairs. A blacksmith shop, complete with forges, an air hammer, rolls, drill sharpeners, etc., attends to all heavy work and drill sharpening.

The carpenter shop, with saws, a planer and a woodworking machine, does all the carpenter work. And

*Extracts from an article published in "Teniente Topics," July, 1915.

the bodega, almacen and bakery see to the supply of necessary materials, both for the work and living.

All water necessary for plant use, drinking, washing, and sanitary purposes, is secured from the so-called Teniente lakes, some 500 meters from the Fortuna No. 4 tunnel, and is supplied to the upper levels by pipe lines from a pump on this level.

All power, light, telephone and air lines are carried underground to avoid snowslide and wind danger. Communication is secured between all levels both by underground workings and by aerial tramways, by means of which supplies are delivered. An electric railroad connecting the lowest level of the Mine No. 5, with the coarse ore bins at the mill delivers the mine ore, and at the same time brings up the greater part of the supplies. The aerial tramway, connecting the mine and mill now called Sewell, in honor of the late persident of the company, is used almost entirely as a store delivery system, but in cases of emergency can deliver ore. It is at present motor driven, handling ore occasionally.

The equipment, consisting of the necessary motors, compressors, shop tools, haulage motors, cars, drills and accessories, were all sent from the United States; the labor has been practically all Chilean.

The main townsite, populated by some 1,000 people in winter, and about 1,500 to 2,000 in summer, is accommodated on the several small hills bounding the snowslide gulches, and is called the "Pueblo Hundido." It consists of a general office building, hotel, engineering office, assay laboratory, three staff houses, three cottages, one large stone building accommodating several families, and about ten rows of buildings composed of two-room family quarters, men's bunk houses and boarding houses.

On the upper levels of the mine live between 500 and 800 people, who are housed either in large rooms cut in the rock, or else in wood and calamina houses perched on the hillsides.

The mine has three principal orebodies: the Fortuna, the Regimiento and the Teniente, with a total tonnage of about 90,000,000 tons, developed and probable, with good prospects for largely increasing this tonnage by future development. The two smaller orebodies, of secondary importance, but included in this tonnage are: the Centinela, and the Bornite. The Teniente orebody is now being developed to an operating stage. The full extent of ore in this section has not as yet been determined.

The Fortuna orebody, from which all the ore at present is being won, is operated by the principal levels; Fortunas Nos. 2, 3, 3½, 4 and 5, and by sub-levels Nos. 2½, 3¼ and 4½. With the exception of levels Nos. 3½, 4 and 4½ shrinkage stoping operations have been nearly completed, and caving is now in progress.

The mining divides itself, naturally, into three important operations, viz.: Development—finding and proving what deposits there are and their extent. Stoping—the preparatory weakening of the great orebody; and Caving—the final step in the ore recovery. All these operations are now going on in the mine.

Development work consists of driving adits along the contact of the tuff with breccia or andesite in order to locate the ore; and then when once located, to determine the tuff contact, or one side of the ore, by crosscutting, and also the limit of commercial ore on the opposite side. Once ore is reached, these crosscuts are put in about every 34 meters, and in this way, blocking out every 100 feet, the plan area of the ore at that level is determined. The extent of ore was first determined in the Fortuna on the No. 2 level, then blocked out on the No. 3 level in the same manner, and the ore between them proved up by inclined raises running from the tuff to the limit of the commercial ore and back, to ultimately connect to the level above. The tuff side is commonly known, because of its inclination, as the hangingwall, and the limit of commercial ore as the footwall. After a block of ore is outlined, the crosscuts used in developing the body are utilized as starting points for the actual mine operations. In these crosscuts small raises, at from seven to eight meters centres, are driven up into the ore at 45° until the face of the raise reaches the far side of the stope. In some cases, this is ten meters on the incline in the old system; in the present Teniente system it will be about five meters. When this drive is completed, a timber chute with an arc gate is erected. A machine of the standard hammer drill stoper type is put to work; and these various raises are connected, one to the other, by a belling out process, which ultimately leaves a series of circular holes. These at last extend across the orebody, the hole on the hangingwall side showing tuff, and the hole on the extreme footwall end assaying the commercial limit.

In the meantime, in the pillar left between each two of these sets of openings, an inclined raise has been driven, and at a point about twelve meters vertically above the level a horizontal working, known as cruzado, is driven from the raise to the room formed by the joining of all the chute holes. This room is known as a stope. It is really a big underground room, of a width depending on the kind of rock, but generally 22 ft., and a length dependent on the width of the orebody, but ranging between 60 and 350 ft.

Stoping.—Once the cruzado is connected the chutes are allowed to fill up with broken ore, and after that all communication between stope and level is by these cruzados. The stope is filled with broken ore to within about six to eight feet of the back, and then trimmed into shape by means of carefully placed holes with the hammer drills. Pipe lines are run up the inclined manway raises, and by means of wire wound hoses, air is supplied to the rooms for ventilation and for the operation of the hammer drills. Once the stope is "lined up," machine drillers start work in the ratio of about one drill to every 40 ft. of stope length. An average drill shift consists of fifteen 5 ft. holes per machine, which should break with one and a half sticks of ordinary 34 per cent. Gelignite per hole, about 60 tons of average stope rock. On the principle that each cubic meter of rock in place occupies 1¾ cubic meters when broken, it is possible then to draw out 24 tons for each 60 tons broken, and leave the same 6 to 8 ft. between the unbroken back and the broken ore pile. No holes are drilled in the centre of the stope; but each drill, safely placed at the extreme wall of the stope, drills one vertical hole, and one slightly inclined hole toward the centre of the stope. Then at a 5 ft. distance, the miner drills two more similar holes, and continues thus until his shift is over. By alternating this process from one side day shift, and the other side night shift, a great deal of rock in the centre of the stope is robbed of its side supports, and has to fall by itself, which tends to cheapness. All stope work is done on contract price per foot of hole. Additional men are employed to deliver steel to the stopes; mechanics repair machines and keep air lines in shape; and on the level below, hand trammers of motor haulage cars continually draw off the excess break to leave the working space necessary between the back and the ore pile.

This stoping operation goes on continually, raising higher and higher on the broken rock, until the back

reaches a point some 30 ft. below the level above, at which point a final blast to fill the stope is placed, and the work discontinued. The raises in the pillars are continued to connect to the level above for ventilation, and as one pillar raise is run in the hangingwall end, and in the next pillar in the footwall end, each stope always has at least two entrances and a continuous natural ventilating draft. The drillers load and blast their own shots, and each shift at 15 minutes before quitting time, has all its holes ready to spit. When the raising of stopes is finished, the stopes are left filled, until caving operations above have been completed.

The best arrangement of stopes as developed here, to suit the ground, and as will be used in the Teniente, is to have a seven meter stope and a five meter pillar, which in the case of bad ground can be changed by narrowing up the stope and increasing the pillar, without having to change in any way the level workings. Chutes are best spaced about seven meter centres, and it has been found by experience that fifty meter differences in elevation between levels are most easily worked. Each stope has its crosscut immediately under it, and running parallel to it, i.e., across the width of the orebody.

In the beginning of operations no timber except chute sets and a slight amount of material for crossings and station sets is needed; but when stoping operations cease and caving begins, more timber is necessary to hold open the haulage drifts. As the whole success of caving depends on the superincumbent pressure that can be brought to bear on the unbroken pillars, it is necessary to secure weight as quickly and as evenly as possible, and that means heavy ground on the haulage ways. These ways then have to be timbered, relieved, caught up, angle braced and kept in repair.

The process of caving consists of cutting off the pillar at the footwall and hangingwall by means of small stopes, or by running raises in which great blasts are exploded, either electrically or with fuse, and then by running a pillar drift along the bottom of the pillar immediately above the level, and blasting a series of pits here, the pillar is completely cut off and has to fail. If by any chance it tends to arch, this arch is broken by a heavy blast. The material resulting from the chute blasting is pulled out, and the pillar caves down to occupy the space left.

The most important consideration is the securing of even weight, and then an even pulling, so that the extraction is not spoiled by waste admixture. Definite data are kept on every chute; its expectancy above the level figured, and its extraction calculated when waste definitely appears. Careful chute sampling is done on the caving level, and chutes running below commercial grade are abandoned unless it is known that the chute has ore above it. In case there is known ore above, and the waste is merely a little fine material that has sifted through, the chute is run, the material sent to waste, and samples taken until it runs ore again.

Active caving is taking place on the Fortuna Nos. 2, 2½ and 3 levels, and in the small orebody on the Fortuna No. 4 level known as the Bornite, caving has been fully completed, and the full percentage of the estimated tonnage has been recovered. Fortuna No. 4 and Fortuna No. 5 are at present essentially haulage levels, to transport the tonnage from above in the mine out to the mill. Fortuna No. 4½ is now opening up a continuation in depth of the Bornite orebody below Fortuna No. 4, and on the Fortuna No. 5 level advance headings are being driven under both Fortuna and Teniente sides of the crater to prepare for increased operations.

LAKELSE VALLEY AND HOT SPRINGS

In a lengthy report on Skeena mining division, in British Columbia, Mr. W. M. Brewer, of Victoria, gives much interesting information concerning many mineral claims and other mining properties he visited. The following excerpt relates to some hot springs in the Skeena country, and the region in which they occur:

Lakelse river flows from Lakelse lake northwesterly into Skeena river, which it enters at about 83 miles from Prince Rupert, and 12 miles below the Grand Trunk Pacific railway station at Terrace. Lakelse valley also includes the valleys formed at the mouths of Eliza and William creeks which empty into Lakelse lake at its head.

The valley in places is four or five miles wide and forms really the southeastern extension of the wide depression, which extends from Ayansh, on Nass river, to tidewater at the head of Kitimat arm, with quite low summits between Nass and Skeena rivers and tidewater. Looking from the summits of the mountain range at the head of Eliza creek, a full view of this magnificent valley can be obtained, stretching from northwesterly to southeasterly farther than can be seen with the aid of a powerful field glass.

Lakelse valley is bounded on the northeast by a high range of mountains known as the Thornhill mountains, in which head Eliza and William creeks with their tributaries. This mountain range forms a portion of the watershed of Zymoetz river, and is also the dividing line between Skeena and Omineca mining divisions.

Ferries across Skeena river have been built from both Copper City and Terrace, while good wagon roads extend up Lakelse valley to the south end of Lakelse lake, where the hot springs are situated, a distance of about 18 miles. These springs cover an area of about half an acre, and the water near the centre has a high temperature. The elevation is 300 ft. above sea level and 16.53 ft. above Lakelse lake. The springs were discovered in 1894 by M. C. Kendal, a prospector, while making a trip from Kitimat arm to Skeena river, but their existence was known to Indians at a much earlier period. Superstition is said to have caused the Indians to avoid the locality in early days, and to have marked a dividing line beyond which the Skeena River Indians never travelled to the southward, nor the Coast Indians to the northward.

The owners of the springs have erected a commodious log building for a hotel and bath house. The water is brought from the springs in an open wooden flume 1,200 ft. long, and during my visit the temperature of the water as it flowed into the bath reached 118 degrees Fahr. A sample of the water taken by me from as near the centre of the spring as it was possible to reach analysed as follows: Total solids, 83 grains to the gallon, principally lime, with a little soda and magnesia in the form of chlorides and sulphates, but contains no lithia or potash.

COPPER ADVANCES IN PRICE.

Inquiries and orders in great volume continue to pour in on United States selling agencies who are beginning to sell well into future months. One concern is sold out through February. United States domestic consumers have entered the market in force, being only poorly provided with the metal. Wire makers as well as brass founders are taking increasing tonnages. Foreign demand continues brisk and one large selling agency on November 20th declined foreign orders totaling 3,000,000 lbs., because they did not have the metal to deliver.

GOLD DEPOSITS OF DUTCH GUIANA

By J. B. Percival.

Dutch Guiana offers at the present time grand opportunities for the investment of capital in the mining industry both alluvial and quartz undertakings. The gold placer mines are rich and only enterprise aided by the necessary capital is required to secure enormous profits. Gold is found in almost every part in the hinterland of the colony, from the Cerantyn river on the west to the Maroni or Maronyne on the east.

The annual returns from one placer alone for the last twenty years has been three hundred and fifty pounds troy weight. These returns have been produced entirely by hand labor and by the most primative methods of sluicing and "timming."

Most of the placers now operating have been worked for years by the natives and have all paid handsomely; many of the proprietors are to-day rich men and live in ease and comfort.

The mountains around these placers are marvels in richness, but they have never been touched by the pick or shovel, and only experienced miners in combination with up-to-date machinery is required to produce millions of dollars worth of the precious metal.

From the Cerantyn river on the west, which separates Dutch Guiana from Demerara, to the Marini river on the east, which in succession from the Tumae Humae mountain range to the Atlantic ocean from the boundary line between Dutch Guiana and Cayenne, the gold belt, which varies in width from fifty-five to one hundred and fifty miles, is thickly strewn with placers whose auriferous alluvial clay and gravel is rich beyond imagining.

In this country the mineral wealth is greater than all of the other products of the region combined, and the prediction is freely made by the most skilled experts that this country will form the theatre of one of the greatest gold excitements in the history of gold discovery.

Capital invested in the mining industry of Dutch Guiana is not only absolutely safe, but is almost certain to bring immense profits. Owing to the peculiar character of the region in which the gold placers are situated, and the strict nature of the governmental supervision, it is impossible for wild-cat schemes to prosper or for concessions to be made the basis of unwholesome speculation.

Under the just laws and regulations governing the mining privileges there is no opportunity for the practice of fraud or deception, a circumstance which is certain to invite capital and promote the development of the mining industry.

For a great many placers in Dutch Guiana the future prospects are bright. The richest spots in the placers which have been worked since 1878, do not seem to be exhausted, in fact they appear good for another forty years. The gold productions are satisfactory and many placers yield surprising quantities.

The annual production of the whole colony during the year ending with December 1st, 1914, was about $500,000, and all this was the outcome—as mentioned before—of hand labor.

Dutch Guiana may not be well known to Canadians generally, but they certainly are aware that South America is rich in gold-bearing quartz veins and it stands recorded where fabulous wealth has been taken out of mines in South America.

For instance, the El Calloa mine in Venezuela, the most famous in the world about forty years ago, is but a very short distance from Dutch Guiana. This was one of the richest quartz mines ever discovered. The mine was discovered by four Jamaica negroes forty-five years ago. This was not, however, an original discovery, for the mine had been worked years before by the Indians. Three of the negroes sold their interest to a party of Corsicans for a nominal price; the other, by good luck, held on to his fourth share. When the Corsicans discovered the great richness of the mine, they looked about for capital to work it. They sent two of their number to England who sold thirty-two shares at $2,000 per share. With the capital secured, $80,000 in all, they built a small stamp mill and put in the necessary machinery and began operations. In a short time the shares which had been purchased for $2,000 each, were worth $500,000, and the mine, originally worth $80,000, rose in value to the extent of millions. In a few years, however, the shareholders took out in clear profits something like $25,000,000. The monthly output of gold was 40,000 ounces.

El Calloa was a quartz mine, and there are similar rich quartz mines running through Dutch Guiana. A recent discovery in the "Mindrinettee" district has just revealed a rich body of quartz averaging 16 feet in thickness, and traceable for about two miles along an east and west course. Developments have been carried out, and the vein proves everything that was expected of it, and every sign of improvement in values appear as sinking operations proceed. A small mill is kept running and handles twenty tons in twenty-four hours. The return of the last clean up after sixty hours' run was 28 pounds troy.

Origin of the Dutch Guiana Gold Deposits.—As far back as 1814 Le Blond, a French geologist, suspected the existence of gold-bearing quartz veins in the gneiss districts of French Guiana or Cayenne. These were later on discovered, but not until the end of the nineteenth century were they submitted to closer examination. Levat, a French mining engineer, was one of the first who endeavored to explain the presence of gold-bearing quartz in the Guianas. He looked upon the quartz as the result of contact phenomena, and according to him, the placers encircled granite masses which occur in the gneiss formation. He asserted that the placers were richest in those spots where diabase and diorite rocks were found.

For instance, from the geology of the Saramacca placers, where large quantities of alluvial gold have been produced, it is quite evident that no granite masses occur, while diabase and diorite may be looked for in vain.

The district here described does not therefore bear out Levat's theory.

Many mining men—the writer included—are of opinion that the volcanic rocks of the colony contain the primary gold-bearing quartz, since gold has been repeatedly found in them in paying quantities. Professor Harrison, however, supposes that: "The gold depositions follow the weakened or ruptured zones of certain pressure planes in the basic dykes, in their

contact with the older acidic rocks, or in common through both." According to Lungwitz's sketch on the Omai mine—British Guiana—it is probable that the above-named gold depositions are the secondary results of the quartz veins.

On the Saramacca placers gold quarts occurs in considerable quantities, notwithstanding that volcanic matter is about entirely absent.

F. C. Lincoln, in his article of 1911, showed that no placers of commercial value ever have produced from the primary contents of eroded igneous rocks.

This is also the case in Dutch Guiana, and the theory that the gold originates from those rocks can hardly be applied to the Saramacca district. Throughout the colony mining has been limited to the quartz veins only, and all the alluvial gold which have been examined, consist chiefly of quartz gravel, to which particles of gold still cling, mixed with sand and a little clay. All this points to the fact that the primary ores must be sought after in the quartz veins.

J. E. Spurr, in his theoretical survey of the genesis of gold ores in the colony comes to the conclusion that the quartz veins are the primary bearers of the gold, but that their existence in turn must be considered as the last phase of the volcanic movements of the sursoundings. The presence of basic and acidic volcanic rock could then still be a remnant of the above-named volcanic actions.

Volcanic rocks of any importance have been looked for in vain in the placers of the Saramacca. To the east of the concession, however, two small diabase veins crop out, and still further to the east diabase and diorite rocks crop out occasionally, but of gold there is no trace. To the westward of the placers there is a small quartz vein, containing a great quantity of tourmaline, but no gold. That there is some connection between the quartz veins and the eruptive rocks of the country remains possible, but that their mineral contents is the result thereof is highly improbable.

The latest valuable article dealing with the recorded occurrences of primary gold is from F. C. Lincoln. According to this paper, the facts lead to the following theory—quoting the resume in the "Mining Magazine," Vol. 5, No. 1:—"Gold has not been found in volcanic emanations and its presence in plutonic emanations has only been inferred. Gold has been found in the circulating waters of the earth's crust. There are a great number of valuable deposits of primary gold in geologically young conglomerates, several in geologically old conglomerates, and two known cases in metamorphic rocks, there is no gold in igneous rocks."

Lincoln suggests that "reef gold may be derived from older and very old buried places by circulating waters, put in circulation by the intrusion of igneous rocks." So far as has been observed by me, this hypothesis cannot yet be considered for discussion in connection with the gold fields of Dutch Guiana.

In regarding separately the two different quartz vein groups, mentioned already, it is remarkable that the bedded veins occur everywhere, but the veins lying discordant in the gneiss formation are not so prevalent. In the vicinity of the Saramacca placers they seem to have concentrated in a particular zone, which follows the great Guiana fault, gradually lose their importance as the upheaval decreases or becomes more remote. From the hills to the west of Brokolonka—a small mining settlement on the Saramacca river—down to the White Water reef—also on the Saramacca placer—gold-bearing quartz veins are numerous, but are thickest near creek "Rose"—the richest spot on the Saramacca placer, that is, in the vicinity of the fault.

In the flats, to the south of the concession, thus in the sunken and bruised wing of the fault, several quartz veins may be found, but they do not contain gold.

Along the little Saramacca river, a tributary of the main river Saramacca, upwards, volcanic rocks occurs to some extent, but the district is remarkable for its lack of well known placers and thus of important gold-bearing quartz gravel formations. The known little Saramacca placers lie much lower down the river.

In another part of Dutch Guiana, on the Gray's concession at Brokopondo, on the Suriname river, there are high hills similar to those on the Saramacca placers. The creeks have cut themselves deep valleys, but in the gold-bearing formation very little gravel is found, and compared with the enormous quantity of washed away, weather-beaten and disintegrated rock masses, there is very little gold indeed. The cause must therefore be ascribed to the absence of great faults, whereby very few gold-bearing quartz veins have arisen and the alluvial formations have remained unimportant.

In the Maroni, or Maronyne district, the government instituted gold researches and the land was exploited. A map of surveying was made on which geological remarks were recorded. Granite masses, diabases, diorites, etc., were found, but no gold. Shortly after these exploitations came to an end, some native prospectors found gold in large quantities, in a district immediately south and not far from the government exploitation operations.

In some placers in Dutch Guiana quartz veins have no connection with volcanic rocks of granite-like structure, nor with those of porphyritic structure, or with lead silver veins.

Some districts seem neither to contain volcanoes or volcanic rocks containing gold-silver veins, as is the case with the gold of Cripple Creek ores, which has risen along irregular channels. The ores in many cases can neither be compared with those of sedimentary or apparently sedimentary origin. Thus, the gold-bearing quartz in some places in the colony cannot be entirely compared with the primary gold ores that have so far been found.

So far I have come to the following conclusions:

The existence of gold ore in some districts must be ascribed to the quartz veins which lie discordantly in the gneiss formation. The quartz veins themselves may indirectly be connected, but it is evident that they are dependent from the great Guiana placer fault and the less visible faults of the bruised wings.

The gold deposits therefore are not the direct result of volcanic action, nor of the extreme weatherworn condition of the gneiss formation and its contents, but of the more or less important neighboring faults principally.

A few authors are of opinion that the gold gravel formation was the bearer of the primary gold ores, whilst they pronounced the gold quartz veins to be secondary gold infiltrations from the gravel banks.

I am inclined to accept the possibility of similar petty infiltrations, but I have no faith in the supposition that powerful gold quartz veins at a height of 300 or more feet are infiltered by the gold of gravel formations from the valleys.

PERSONAL AND GENERAL

Dr. S. J. Schofield has been appointed professor of mineralogy and geology at University of British Columbia.

Mr. Geo. Church of South Porcupine, formerly chief engineer at Dome mine, expects to leave shortly for Juneau, Alaska.

Mr. Kirby Thomas has been examining properties in the Elk Lake district, Ontario.

Mr. Geo. Mackenzie of the Mines Department has been appointed a member of a commission to enquire into the supply of raw material for munitions.

Mr. J. G. McMillan, formerly mine inspector in the Timiskaming district, Ontario, is in Toronto recruiting for the Tunneling company.

Mr. A. C. Bailey is mine superintendent at the Mercer mine, Cobalt.

Prof. H. E. T. Haultain was in Ottawa last week.

Mr. Geo. T. Holloway addressed the Royal Canadian Institute at Toronto on Nov. 20, on "The Relation of the Chemical and Metallurgical Industries."

Col. Thos. Cantley is chairman of the new commission on supply of raw materials for munition manufacture.

Mr. George G. Aitken, of Victoria, B.C., who since leaving the Geological Survey of Canada has done most efficient work as Chief Geographer for the Province of British Columbia, recently resigned the latter position and came East for the purpose of spending several months at the Royal Military College, Kingston, and afterwards proceeding to Europe on active service.

Mr. Chas. A Banks, general manager for the Jewel-Denero Mines, Ltd., with a gold mine and 15-stamp mill in Greenwood mining division of British Columbia, has gone to England, to discuss future operations with the directors of the company. It is probable that he will make arrangements for service for some time in connection with the war in Europe.

Mr. W. J. Barker, of Nelson, B.C., after having for the greater part of the current year acted as superintendent of the Jewel gold mine, near Greenwood, B.C., during the illness of Mr. Wm. Rowe, is now in charge of development work at the Buck mining property, in the neighborhood of the Standard mine, Silverton camp, Slocan district of British Columbia.

Mr. Ed. E. Campbell has been placed in charge of mining operations at the Granby Consolidated Co.'s mines near Anyox, Observatory inlet, B.C. For some time previously Mr. Campbell had been the company's mining superintendent in the Valdez district, Alaska.

Mr. E. D. Conway, of Vancouver, B.C., one of the Granby Consolidated Co.'s field engineers, recently went to see a mining property near Nighthawk, northern Washington.

Lieutenant Graham Cruickshank, formerly in charge of the Consolidated Mining and Smelting Co.'s test concentrating plant at Rossland, left British Columbia about the middle of November with the 54th (Kootenay) Regiment for Eastern Canada to be in readiness to embark for England shortly.

Mr. Ensor R. Dunsford, Quarry, N.S., assistant superintendent for the Victoria Gypsum Mining and Manufacturing Co., Ltd., and Mr. Oliver Hall, Coniston, Ontario, mines superintendent for the Mond Nickel Co., have been proposed for membership in the American Institute of Mining Engineers. Several months ago Mr. Ben Gabriel Slaughter, Copper Cliff, chief engineer for the Canadian Copper Co., became a member of that institution.

Mr. F. W. Guernsey is again with the Consolidated Mining and Smelting Co., at Trail, having several months ago returned to British Columbia from Thompson, Nevada, where he was with the Mason Valley Co.

Mr. H. W. Heidman, of Vancouver, B.C., has been spending some time looking into mining conditions in the district about Princeton, Similkameen, B.C.

Capt. Harry Johns, of the firm of Keffer & Johns, Spokane, Wash., recently made a trip to San Francisco, California, where he visited the Panama-Pacific International Exposition. Mr. Frederic Keffer has been making an investigation into the situation at the British Columbia Portland Cement Co.'s properties in Similkameen district of British Columbia for the bondholders of the company, which is in liquidation.

Mr. Ernest Levy, manager of the Le Roi No. 2 company's mines at Rossland, was in Boundary district of British Columbia last month in company with Mr. W. Yolen Williams, who in earlier years was the Granby Consolidated Co.'s mine superintendent in that district. Since then Mr. Levy has been on a business visit to Spokane, Washington.

Mr. Anthony J. McMillan, under an arrangement with Government of British Columbia, is to deliver a series of addresses or lectures on that province before Old Country audiences. Sir Richard McBride has directed that a number of representative lantern slide views be sent to England for Mr. McMillan's use in that connection.

Mr. I. L. Merrill, president of the Hedley Gold Mining Co., reached Hedley, B.C., on November 11th on one of his periodical visits to the company's gold mine and 40-stamp mill in that camp. From Hedley he was to go to Victoria and thence to his home at Los Angeles, California.

Mr. J. F. Miller, superintendent of the Consolidated Mining and Smelting Co.'s electrolytic lead refinery, has returned to Trail from San Francisco, California. During his absence Mr. Miller was seriously ill for a while, but is now in better health.

Mr. Bruce R. Warden, for a number of years having his headquarters in Vancouver, B.C., is now on the engineering staff of the Consolidated Mining and Smelting Co. at Trail, where the company is making large and important additions to its already extensive metal-reduction plant.

Russell G. Belden, of Spokane, Washington, a mining company promoter who eighteen years ago was convicted for using the United States mails for purposes of fraud in connection with the promotion of some companies which he alleged would acquire and operate coal-mining property in the Crownsnest district, near the boundary between British Columbia and Alberta, was taken last month to the prison at McNeil's island to serve a 12-months' sentence after having unsuccessfully fought a long legal battle to obtain a reversal of the decision that sentenced him to imprisonment.

SPECIAL CORRESPONDENCE

COBALT, GOWGANDA and SOUTH LORRAIN

New Discoveries.—Since silver has passed the danger mark of 50 cents and there appears every likelihood that it will advance with comparative rapidity many mines have resumed development and exploration. The result is almost immediate. There have been several strikes of new orebodies on Cobalt properties and some of them are quite important. This applies most to the discovery on the Cobalt Comet property at Kerr Lake.

The Cobalt Comet is one of the oldest mines in the district since the Drummond was the first mine to be worked in the Kerr Lake section of the silver camp. The Kerr Lake purchased 837,400 shares of Caribou Cobalt Mines stock in July, thus giving them a full control in this million share company. There is a knoll on this property which has always escaped exploration both on the surface and underground. This is most remarkable since it is of conglomerate, but most of the buildings were upon this hill and each succeeding management believed that it was quite useless to look in this direction. Since the Kerr Lake took hold of the property Mr. Livermore has been trenching this conglomerate section. Between the office and the manager's house there was discovered in a trench an eight-inch vein of niccolite and smaltite. The ore is massive and carries between three and four hundred ounces to the ton. It has now been opened up for several feet northeast of the discovery, upon which a shaft is being sunk. Several shoots of high grade ore have been discovered. This ore, which is three or four inches wide, is very rich indeed. Where the vein was discovered there was much cobalt bloom and in the decomposed matter above the solid vein there have been found indications of silver and the earth pans much leaf silver. The shaft is being sunk at the point where the vein is strongest. Ninety feet below and about forty feet away from the point where the vein was good there was a drift. This drift is being continued for the purpose of making connections with the new shaft. Although at this time of writing it is far too early to venture on any prophecy as to the real value of this discovery, even now it can be said with certainty that it will yield a considerable quantity of mill rock and it may produce a good deal of high grade ore. Exploration in other directions is being vigorously prosecuted from the Kerr Lake Mining Co. The mine is the Drummond, given up as played out by the original owners four or five years ago. Another manager recognized its possibilities in low grade ore and took from it a very large tonnage. It is quite possible that the Kerr Lake may extend the life of the mine for years. It is an admirable example of the tenacity to life shown by Cobalt mines.

Mercer.—Another discovery of less apparent importance is that made on the Mercer Silver mines within the past week. Here a two-inch vein of high grade ore has been discovered in a raise from the 200-ft. level. The Mercer Silver Mines is a company formed to take over the old Gould lease on Cart lake. They sunk a shaft on the east side of the lake in virgin territory. This is the first result from the work.

The Nipissing Mining Co. has decided to develop the ore deposit on the Cobalt Lake fault from a shaft on an adjoining property. This shaft will be sunk 250 ft. before any cross-cutting is attempted. It is a shaft belonging to the Cobalt Lake Mining Co. and from it the orebody can be cut with very little dead work. While it is known that the ore does dip on to the Nipissing nothing can be said yet as to the width or value of the ore on the Nipissing side of the line. It is anticipated, however, that it should be a valuable addition to Nipissing ore reserves.

The Timiskaming Mining Co. has declared an interim dividend of three per cent. This dividend will amount to $75,000 and it is certain that the company is quite well able to make it. The mine is in excellent shape and there is a large amount of ore broken and ready for stoping in the mine.

Foster.—From the Foster mine there has just been shipped three tons of high grade found near the Lawson line. It was sent to Campbell & Deyell's for sampling, and will probably be sold to a local reduction company.

The Silver Leaf has shipped four or five tons of high grade ore.

PORCUPINE, KIRKLAND LAKE and MUNRO

Buffalo.—There is going to be a very busy winter in Kirkland Lake. The Buffalo Mining Co. has completed the building to house their 100-ton mill. It will be roofed in before this is in print. The flow sheet has been completed and the machinery ordered. Work will probably be started underground within a very few days.

The Beaver Consolidated has definitely taken over the McKane claims from the Kirkland Gold Mines. There is no doubt that the Cobalt company will put forth a vigorous policy of development. There will be no delay due to construction of plant as there is a very complete prospecting plant adequate for operations on a small scale.

At Swastika Mr. F. L. Culver is running drills in the old Swastika mine to endeavor to discover further orebodies or extensions of old orebodies. This mine produced $60,000 in gold before it shut down. There is still a little ore left in the mine, but not very much.

In Goodfish Lake the La Belle Teck Mining Co. has almost completed the assembling of the small steam plant. On the surface exploration has been quite satisfactory which is demonstrated on length and value of the orebody on the fissure where the ore was deposited. It is also reported that good ore has been found in a drift on the Costello. This is on the other side of Goodfish lake.

At Kirkland Lake, the Lake Shore mine has resumed operations. Two drills are putting down the shaft to the 400-ft. level. From this shaft levels will be continued to the west where so far the orebodies have proved most valuable.

Hollinger.—During the past months most important developments have been made at the Hollinger mine. The long cross-cut from the 425-ft. level has cut three veins within a comparatively short distance of each other. These veins are four, six and ten feet wide and carry ten to eleven dollars a ton in gold content.

Millerton.—On the Millerton claim of the Hollinger the orebody cut there in the long crosscut has developed more satisfactorily than was anticipated by the management. The ore is averaging eleven dollars a ton, whereas on the surface it did not exceed six to eight dollars. It has been demonstrated to be at least seven feet wide and the area of enrichment was

not reached in the cross-cuts. Surface improvements are keeping pace with this development underground.

The new wing to the Hollinger mill is making satisfactory progress and Mr. Ames, the new superintendent, is effecting various economies which will bring costs down to considerably less than a dollar a ton as a milling charge.

The new office building is a very handsome one and the shell of it will soon be completed. Still quicker progress has been made with the directors' bungalow.

The masonry of the great new shaft on Hollinger hill has been completed and the contract for the head frame has been let to the Dominion Bridge Co. This contract calls for the completion of the head frame by the middle of December. The freight cars are now running right into the heart of the Hollinger property instead of all supplies being teamed from the town siding some half mile from the mine. All supplies are unloaded from the cars on to a track on a six-ton locomotive and lines have been laid to all centres of activity in the mine. A considerable saving in transportation will thus be effected. The transformer house was also found to be too small for the rapidly growing requirements of the property and the foundation of a new building has been laid between the old office and the mill.

Silver at Porcupine.—It has always been remarked that while silver is usually present in the auriferous ores of Kirkland Lake and Porcupine there is never enough to be considered as anything but a by-product of very minor importance. Several discoveries have recently been made which may alter the relative value of silver in areas where gold is the chief attraction. The claims of the Premier Langmuir were staked for silver in the early days of the Porcupine camp. Silver is now being found to pay the cost of freight on the barite ore which is being shipped to the States. On the surface there is native silver in this ore, but later it did not appear and the barite is now being mined as an adulterate of white lead. The other discovery is in the Kirkland Lake section about four and a half miles from the Tough-Oakes. It is as yet but a prospect of dubious value. The native silver is to be plainly seen in the ore, which is mainly galena. The vein is two feet wide. It is said to run fairly well in gold too.

Munro.—The development work upon properties in Munro township, other than the Croesus Gold Mines, has almost been stopped by the wet weather. The eleven miles of road between Matheson and Munro has been little better than mud. and it was not possible to get wagons loaded to full capacity, over them. The Croesus Gold Mines is the company name of the old Leyson-Dobie claims the Dominion Reduction Co. took over and found such remarkable ore in.

SUDBURY

Creighton.—Great activity has been shown at Creighton mine during the past four or five months, in which time not only have additions been made to the plant itself but also to the town. In the town there have been constructed two brick blocks. One is finished and another nearing completion. A brick school has been finished, also a theatre of brick construction and a church. In addition about forty or fifty dwellings have been moved from the Frood mine and many new houses have been built both by the company and individuals.

To the plant itself new shops, a new power house, rock house and head frame are all nearing completion. The shops embrace a warehouse 200 x 48, with a covered shed at each end and an unloading platform with spur connection to the railroad. Another building of the same size will be used as a machine and electrical shop. A third building will be the carpenter shop. All these buildings are of steel and brick construction and the warehouse has a concrete floor, while the others have wooden floors. These shops are very nearly completed.

Creighton Rock House.—The concrete work on the rock house is about finished and steel workers will soon take possession. This will be a tall building, being about 170 ft. high. Various tests have been made on sizing of the ore and the use of water for sorting purposes. Different types of lighting are also being experimented with and the rock house when completed will be one of the most modern in existence.

The shaft house in addition to the skip room and various offices, will have a room for the men to use while waiting for the cage. Thus it will not be necessary for them to remain exposed to the weather while waiting to descend into the mine, at which time they are clad very lightly.

Creighton Shaft.—These new head workings are in connection with a new five-compartment shaft that is being sunk. It is inclined at 55 degrees. There are two skipways, two cage compartments and a ladder and pipe way. Only a temporary hoist is in use now and the permanent machine will be one of the largest in the country. This will make the fifth hoist at Creighton. There is at present a two-drum hoist at No. 2 shaft, a single drum hoist at No. 1 shaft provided with two brakes for handling the man cage, a two-drum hoist for handling the two five-ton skips which are used in balance, and an auxiliary two-drum hoist in case of accident to the one in use.

A new powder magazine is also being constructed on the Creighton property. It will be located on a hill at some distance from the town and mine workings and a tunnel into the mountain will afford access to it. A track will connect the magazine by means of the tunnel with a siding.

Frood mine of the Canadian Copper Co. was closed down when the large new orebody at Creighton was found. Most of the machinery and practically all the dwellings have been taken to Creighton, but the camps with the heating plant still remain. The company has very generously offered the use of these buildings to the Government for the purpose of housing recruits for the winter. They will also provide a man to look after the heating apparatus. These buildings will make excellent barracks and the idea has gained great favor in Sudbury, as it will mean much increased business for the town in every way. It is thought quite probable that the Government will take advantage of the offer.

Moose Mountains, Ltd., located at Sellwood, has closed down. The method of treating the ore has proved unsuccessful and until further experiments have been made no more work will be done. All the men have left and things are closed up tight.

A novelty in tank construction is to be seen at Creighton mines, where an iron tank has been circumscribed with a brick wall. Between the tank proper and the wall an air space has been left in which electric heaters will be placed, so as to protect the tank against the wintry weather and insure a winter supply of water. The tank is on a high hill, insuring a great pressure. It is 40 by 25 ft.

Shining Tree.—The Canadian Copper Co.'s option on a Shining Tree copper property is reported to have been given up. The property is supposed to have run about 1½ per cent. copper and to have a gold content. The difficulty of access to the property and the expenditure necessary to start the work is the big argument against the prospect. Another company now has the option under consideration.

BRITISH COLUMBIA

Whether warranted by actual achievements of the year now drawing to a close or not, there certainly is a better feeling in connection with the mining industry of the Province than existed early in the year, and most assuredly a transformation from the doubts and fears that a year ago were general in mining districts affected by the practical closing of the market for the metals constituting the larger part of the metalliferous mineral production of British Columbia. In the autumn of 1914 many of the mines were inoperative, especially in Ainsworth, Slocan and Boundary districts; now there are few of those idle that were then for the time being adversely affected by the outbreak of war in Europe. This much improved situation causes optimism and fosters confidence, with the result that money is again available for the development of mining properties, and the mining industry is benefited accordingly.

West Kootenay.

Of all the mining camps in this district, Rossland camp, in Trail Creek mining division, gives the most evidence of substantial progress. Last month figures were supplied indicating an expected increase in total quantity of ore shipped this year to the smeltery at Trail of about 52,000 tons. The most gratifying feature of the situation at Rossland is that there is good reason to look for permanence in mining operations, at least for a generation, since the known ore reserves are large and the average value of the ore is sufficiently high to make its mining and smelting profitable.

At Trail, the smelting centre for Kootenay ores, important progress is more manifest, since there it is on the surface, while in Rossland camp it is chiefly underground. Of course the greatest activity is at the Consolidated Co.'s smelting and refining works, where many improvements and additions have been made during several recent years. In fact, there has been an almost entire transformation of the ore-reduction side of the works, old buildings and plant having been gradually replaced by larger modern structures and equipment, thus providing for a considerably increased ore-treatment capacity and this at reduced cost. These comments apply to both lead and copper-smelting departments. Larger storage bins for ores with ample provision for bedding so as to secure generally uniform charges for the blast furnaces, enlarged and improved sample mills, better transportation arrangements between ore beds and furnaces, bigger blast furnaces for both copper and lead, an overhead electrically-operated crane for handling matte pots, the substitution of Wedge roasters for the old Huntington-Heberlein roasters long in use in the lead department, belt-conveyors for handling materials in and from the roasters, several treaters of the Cottrell system for precipitating metals carried from the furnaces in the fumes and smoke, and many other provisions for more expeditious and economical treatment of ores and furnace products and, as well, for improving working conditions for the men employed in the smeltery. Methods at the company's electrolytic lead refinery are also up to date. Excellent progress has been made toward the completion of installation of copper-converting plant and it is generally understood (though not so stated by the local officials) that it will not be long before copper refining by the electrolytic process will be undertaken here. Meanwhile the buildings and machinery for zinc reduction works being erected and installed by the company are an earnest of the intentions to also make spelter at Trail, though no information is being given out relative to this further extension of the company's activities.

Similkameen.

The production of lode gold is being maintained at about the usual rate at the Hedley Gold Mining Co.'s mine and stamp mill in Camp Hedley. The additions made during the current year to the company's gold milling appliances, following the completion of its hydro-electric power system, allow of a somewhat larger percentage of the gold in the ore being saved, and with ore reserves known to be large, the outlook for continued profitable operation of the property is regarded as most satisfactory.

At Princeton, the coal mining situation shows improvement, largely the result of the opening of more markets now that there has been established a railway train service southeast to the Okanagan district and northwest to the C.P.R., thus giving a much shorter connection with Vancouver and other places on the Pacific coast than is afforded by the Great Northern system southeast to Spokane, Washington, and thence by a long and roundabout route to Vancouver. The saving in freight charges is evident when a comparison of railway mileage between Princeton and Vancouver is made. Prom Princeton to Vancouver via Spokane and Everett, Washington, by Great Northern railway, is 735 miles; by the Kettle Valley and Canadian Pacific railways it is 285 miles. Princeton coal, therefore, can now be sent to Vancouver by a route 450 miles shorter than it had to travel to reach that city before the opening of the Kettle Valley railway to connect with the Canadian Pacific system. Then, too, the railway connection with Okanagan and Boundary district towns not previously accessible by railway, except in some cases by most circuitous routes, is another advantage. Together these additional railway facilities are providing outlets for Princeton coal that are admitting of the gradual building up of a regular coal trade and the consequent working of the Princeton Coal and Land Co.'s coal mine without the interruptions that have heretofore necessitated its operations being intermittent.

The placer-mining season ended for 1915 with the coming of sharp frost during the first half of the month of November. The most activity in placer mining in this district this year has been along the Tulameen river above the town of Tulameen, which is situated at what has long been known as Otter Flat. A number of tributaries of Tulameen river join the main stream, flowing in from one side or the other along a distance of ten or twelve miles. These are Slate, Bear, Eagle, Champion and other creeks. The greater part of the platinum recovered in British Columbia to date has come from the Tulameen along the stretch of the river above indicated together with that from Granite creek, another tributary which flows into the river below Otter Flat, and about eleven miles above Princeton, which last mentioned town is situated at the confln-

ence of the Tulameen and Similkameen rivers. It is stated that there has been more placer mining done on the Tulameen this year than for a number of years past, the high price of platinum having proved an incentive to miners to work their placer leases this year. While the total value of the placer gold and platinum recovered this year is not large, so far as known it is higher than the total of any two or three-year period as recorded, probably during the present century. On Granite creek, too, placer mining has been carried on this year, and a fair amount of gold has been recovered, though not so much as was expected, several unforeseen difficulties having prevented the washing of the much larger quantity of gravel that it was estimated earlier would be run through the sluices this year. However, it is the intention of those who have done the most work to do what they shall find practicable throughout the winter to prepare for washing a larger quantity of gravel next year.

General Notes.

In connection with published figures purporting to show the amounts paid as dividends this year by metalliferous mining companies operating in British Columbia—a total given for the Le Roi No. 2, Ltd., is entirely erroneous. It has been made to appear that this company this year has paid two dividends, each totaling $150,000; as a matter of fact, when that misstatement was given publicity the company had paid only one dividend in 1915, and that of one shilling a share on its 120,000 shares, the total for that profit-distribution having been less than $30,000. It was expected that a second similar dividend would be paid before the close of the current year, but at the time the misinformation was given to the public by one unreliable writer, and copied by others equally ill-informed, the stated total payment this year of $300,000 was more than ten times the amount of that actually distributed.

A report has been received of a find of ore in the district lying between the Nicola Valley region and the northern part of the Similkameen country. Specimens shown are of solid copper-bearing ore that looks promising for a fairly high copper yield, but no authentic particulars are available as to the extent of the ore deposit, so far as opened, nor as to its assay value. It is known, though, that copper ore occurs in considerable quantity in the neighborhood of the locality in which the new find has been made, but, owing to lack of transportation facilities, it has not been developed.

A Vancouver newspaper lately published an account of progress reported to have been made on the Surf Inlet Gold Mines property, on Princess Royal island, in the Coast district north of Vancouver. For several years development work had been done on this property by a Vancouver syndicate or company until about two years ago it was brought to the attention of the Tonopah-Belmont company, operating in Nevada, and since bonding the property the latter company has done much work on it. The statement now made is to the effect that a fine shoot of gold-bearing ore has been encountered at a depth of approximately 1,000 ft. below the outcrop at the surface. Whatever the facts of the case—and published reports should not for the present without verification be taken as accurate statements of the actual position, since it is not the policy of the Tonopah-Belmont Co. to give out much information—there is no doubt that good reason has long existed, for the belief that eventually the Surf Inlet property would be found fully equal to expectations founded on the excellent reports made by mining engineers of good standing and on the results of the limited amount of development work its Vancouver owners had found it practicable to do.

Little information has been made public this year relative to the Iron Mask mine, situated a few miles from Kamloops, but it is evident that progress is being made at it, since the total quantity of ore received at the Consolidated Mining and Smelting Co.'s smelting works at Trail from the Iron Mask group between July 1st and November 4th of the current half year was 1,019 tons, which quantity compared with 289 tons for the whole of the year 1914. The Gold Commissioner for Kamloops mining division was quoted in the 1914 Annual Report of the Minister of Mines for British Columbia, as follows: "There has been little mining activity in the Kamloops division, but faith in the future has been shown by the keeping-up of assessment work generally, and by the owners of the Iron Mask mine in the expenditure of a considerable amount of money in preparing for future development. . . . E. C. Wallinder (managing director) reports that the shaft on the Erin claim was sunk to a depth of 330 ft. The Iron Mask shaft was sunk 150 ft. to the 750-ft. level, where drifting and cross-cutting are now in progress. The mill has been enlarged to 750 tons capacity; machine and carpenter shop erected; 500,000-gal. tank for water storage and fire protection constructed; and a 750-h.p. electrical equipment completed." The property was visited by Mr. W. M. Brewer, on behalf of the Provincial Department of Mines, and his account of it was published, probably in the 1913 Annual Report, but as these notes are being written on train in another part of the country, no additional particulars of the Iron Mask property can be given here at this time.

NEWFOUNDLAND

Iron Ore.—As the season advances, and winter draws nigh, the shipments of iron ore from the iron mines of Bell Island are more frequent and the cargoes if anything larger than those shipped in the summer months. The cause for this is that by the end of the present months, the boats chartered by the Dominion Iron & Steel Co. and the Nova Scotia Steel & Coal Co. finish their charters for this year, in connection with the iron ore trade of Newfoundland, and take up work in southern waters during the winter months. The shipping season, now about closing, was the most successful in the history of these mines. Work will be carried on during the winter months with renewed activity, employing in the neighborhood of 3,000 men working full time day and night, so that by the time navigation opens in early spring large stores of ore will be all ready for shipping.

In addition to the large army of men these companies will employ during the winter season at Bell Island workings, they are also sending forward by every available opportunity large numbers of men to their operations at Sydney, C.B. These will be employed at various works, some around the smelting works; but the greater number, it is understood, will be employed at the coal mines.

Since the outbreak of the war in August, 1914, the importation of coal from Sydney and Wales to this country, has nearly doubled that of preceding years. This was brought about by the increase of steamship cargoes going from here, and because of several ships coaling here during the past year. In addition to this some forty steamers took cargoes of pit-wood from dif-

ferent ports of Newfoundland to England the past season and many of these ships took on supplies of coal from St. John's.

Copper.—Work on the copper mines of Tilt Cove and Baie Verte are progressing favorably with the usual shipments to the English and American markets. Both mines will carry on operations all through the winter months and the copper will be piled ready for shipping in the spring. Cargoes will be sent forward as long as navigation will permit this year.

Few Accidents.—All the mines in operation the past year have been most successful in the matter of any serious accidents. Not a person wounded or killed in the copper mines. One miner was killed and another wounded by a fall of ore in one of the workings at Bell Island at the beginning of this month. That this was the only serious mishap speaks well for the efficiency of our miners and for the careful supervision of the work carried on.

Porte-de-Grave.—A meeting of the directors of the Porte-de-Grave Mining Syndicate, Limited, was held last week at its offices on Water street. The syndicate intends to carry on work until next spring, when it is said the property changes ownership, being sold to one of the largest steel companies in the United States, for a very handsome figure.

Oil Shale.—Development of the great oil shale deposits owned by the Colonial Oil, Shale and Chemical Company has been considerably delayed owing to financial matters arising out of the war. The property was thoroughly tested and the engineers report very large deposits of shale, some of which gave as high as 47 gallons of oil to the ton, with very valuable by-products. But for the outbreak of the war it is not unlikely that ere this the company owning the property would have established a plant. Some men are kept working on the property and the company still continues to make tests of the shale from different parts of the deposit. All samples are being shipped to London and are tested in a miniature plant which has been erected solely for this purpose.

Limestone Quarries.—Work on the limestone quarries at Port-au-Port, owned by the Dominion Iron & Steel Company, which were not in operation the past season, will be reopened on the return of spring. The limestone from these quarries is used in large quantities as a flux in connection with the smelting works at Sydney, C.B.

Newfoundland Products Co.—The survey of the Humber River Valley, and other different sections of the properties acquired by the Newfoundland Products Company is progressing favorably under a large and competent staff of engineers. It is thought the company will make a start next season to do some mining work on its marble quarries, pyrites deposit, and coal areas, although it must take all of three years to build, equip and establish such a mammoth plant as this company contemplates, which will cost in the aggregate eighteen million dollars.

A New Smelter.—At a meeting of the municipal board, held last week, Mr. W. A. MacKay was present, and gave full explanation of the nature of the proposed smelter he intends to erect on the Reid Newfoundland Company's land west of the dry dock. The plans were submitted and approved, and Mr. MacKay assured the board erection of the building and installing of plant would be undertaken at once and finished with all possible speed. The plant will run full blast during the winter, and Mr. MacKay is very optimistic as to the future. The Reid Newfoundland Company will supply the necessary electric power for all smelting purposes.

DEPARTMENT OF MINES PUBLICATIONS.

Electrothermic Smelting of Iron Ores in Sweden—By Alfred Stansfield—Published by Mines Branch, Ottawa.

Mr. Stansfield visited Sweden during June and July, 1914, and inspected the principal smelting plants, to obtain information with regard to the operation of the electrothermic iron-smelting furnaces. The results of his investigation are given in this report, a copy of which can be procured by application to the Mines Branch.

Arisaig-Antigonish District, Nova Scotia—By M. Y. Williams—Memoir 60—Published by the Geological Survey, Ottawa.

The purposes of further examining this district were mainly to work out in greater detail the age relations of the rocks. The geology of the district was remapped. The economic mineral resources of the Arisaig-Antigonish district are neither of great variety nor have they proven so far of great commercial value. Most important are the iron-ore deposits which were first prospected many years ago. Next in importance are the gypsum deposits which as white cliffs form a noticeable landscape feature along the Intercolonial railway. Oil-shales have been found in limited quantities and signs of copper occur at a number of localities. Indications of silver have been previously reported, but no evidence of its presence has been recently found. Limestone, formerly quarried to some extent for the manufacture of quicklime, is present in considerable quantity, and stream gravels suitable for concrete work form local deposits along the streams.

Rainy River District, Ontario, Surficial Geology and Soils—By W. A. Johnston—Memoir 68—Published by Geological Survey, Ottawa.

The object of this report is to present the results of an investigation to determine the distribution and character of the different soils of the region and the geology of the various unconsolidated rocks of drift deposits upon which the different soils have been developed.

Map of Upper White River District, Yukon Geology—By D. D. Cairnes—Topography by W. E. Lawson—Map 123A—Published by Geological Survey, Ottawa.

This is a geologically colored map of an area west of White River up from Beaver Creek to the vicinity of Canyon City.

Notes on the Geology and Palaeontology of the Lower Saskatchewan River Valley—By E. M. Kindle—Museum Bulletin No. 21—Published by Geological Survey, Ottawa.

The observations recorded here are the result of field work undertaken during 1913 for the purpose of extending northward and westward previous stratigraphic and formal studies.

MARKETS

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Toronto.)

Nov. 26, 1915.

New York Curb.

	Bid.	Asked.
Braden Copper	16.62½	16.87½
Chino Copper	55.00	55.25
Goldfield Cons.	1.18¾	1.31¼
Granby	83.00	84.00
Inspiration Copper	46.00	46.25
Miami Copper	34.50	34.75
Ray Cons. Copper	25.75	26.00
Tonopah Mining	6.75	7.00
Tonopah Merger	.40	.45
Yukon Gold	2.75	3.00

Porcupine Stocks.

	Bid.	Asked.
Apex	.03	.03½
Dome Extension	.27	.27¾
Dome Consolidated	.20	.20½
Dome Lake	.20	.22
Dome Mines	28.00	28.25
Foley O'Brien	.50	.60
Hollinger	26.00	27.50
Jupiter	.13¾	.14½
McIntyre	.83	.84
McIntyre Extension	.30	.31
Moneta	.07½	.08
Plenaurum	.75	.90
Porcupine Vipond	.72	.73
Porcupine Imperial	.04¼	.04½
Porcupine Crown	.83	.85
Preston East Dome	.04½	.05
West Dome	.08⅝	.09

Cobalt Stock.

	Bid.	Asked.
Adanas	.25	.26
Beaver	.39	.40
Buffalo	.65	.80
Chambers Ferland	.30¾	.21
Coniagas	4.50	4.60
Crown Reserve	.65½	.66
Foster	.05	.06
Gifford	.02¾	.03
Great Northern	.03	.03½
Hargraves	.02	.03
Hudson Bay	20.00	22.00
Kerr Lake	4.20	4.40
La Rose	.75	.80
McKinley	.43	.45
Nipissing	7.45	7.60
Peterson Lake	.37½	.38
Right of Way	.05	.06
Rochester	.03½	.04
Teck Hughes	.11	.12
Temiskaming	.59	.60
Trethewey	.18	.19
Wettlaufer	.09	.10
Seneca Superior	.89	.90
York Ontario	.01½	.01¾

SILVER PRICES.

	New York. cents.	London. pence.
November—		
9	50⅛	24 7/16
10	50	24⅜
11	50¼	24 7/16
12	50¼	24 7/16
13	50¼	24 7/16
15	50⅜	24½
16	50⅝	24⅝
17	51	24¾
18	51⅜	24 13/16
19	51⅞	25
20	51½	24⅞
22	52⅛	25⅛
23	52¾	25⅜
24	54½	26¼

TORONTO MARKETS.

Nov. 26, 1915—(Quotations from Canada Metal Co., Toronto)

Spelter, 21 cents per lb.
Lead, 7 cents per lb.
Tin, 43 cents per lb.
Antimony, 48 cents per lb.
Copper casting, 20¾ cents per lb.
Electrolytic, 20¾ cents per lb.
Ignot brass, yellow 13c.; red, 15 cents per lb.

Nov. 26, 1915—(Quotations from Elias Rogers Co., Toronto)

Coal, anthracite, $7.75 per ton.
Coal, bituminous, $5.25 per ton.

NEW YORK MARKETS.

Nov. 24, 1915—Connellsville coke (f.o.b. ovens)—

Furnace coke, prompt, $2.15 to $2.25 per ton.
Foundry coke, prompt, $3.00 to $3.25 per ton.

Nov. 24, 1915—Tin, straits, 39.25 cents.
Copper, Prime Lake, 19.75 to 20.00 cents.
Electrolytic Copper, 19.62½ to 19.87½ cents.
Copper wire, 20.87½ to 21.12½ cents.
Lead, 5.25 cents.
Copper wire, 20.87½ to 21.12½ cents.
Sheet zinc (f.o.b. smelter), 22.00 cents.
Aluminum, 56.00 to 58.00 cents.
Nickel, 45.00 to 50.00 cents.
Platinum, soft, per ounce, $68.00.
Platinum, hard, per ounce, $72.00.
Quicksilver, per 75-lb. flask, $105.00.
Cobalt (metallic), $1.25.