MARCH 1, 1915 Single Copies 15 Cents

CANADIAN MINING JOURNAL

VOL. XXXVI TORONTO No. 5

Synopsis of Coal Mining Regulations

COAL mining rights of the Dominion, in Manitoba, Saskatchewan and Alberta, the Yukon Territory, the North-West Territories and in a portion of the Province of British Columbia, may be leased for a term of twenty-one years at an annual rental of $1 an acre. Not more than 2,560 acres will be leased to one applicant.

Application for a lease must be made by the applicant in person to the Agent or Sub-Agent of the district in which the rights applied for are situated.

In surveyed territory the land must be described by sections, or legal sub-divisions of sections, and in unsurveyed territory the tract applied for shall be staked out by the applicant himself.

Each application must be accompanied by a fee of $5 which will be refunded if the rights applied for are not available, but not otherwise. A royalty shall be paid on the merchantable output of the mine at the rate of five cents per ton.

The person operating the mine shall furnish the Agent with sworn returns accounting for the full quantity of merchantable coal mined and pay the royalty thereon. If the coal mining rights are not being operated, such returns should be furnished at least once a year.

The lease will include the coal mining rights only, but the lessee may be permitted to purchase whatever available surface rights may be considered necessary for the working of the mine at the rate of $10.00 an acre.

For full information application should be made to the Secretary of the Department of the Interior, Ottawa, or to any Agent or Sub-Agent of Dominion Lands.

W. W. CORY, Deputy Minister of the Interior.

N.B.—Unauthorized publication of this advertisement will not be paid for.—58782.

THE CANADIAN MINING JOURNAL

VOL. XXXVI. TORONTO, March 1, 1915. No. 5

The Canadian Mining Journal

With which is incorporated the

"CANADIAN MINING REVIEW"

Devoted to Mining, Metallurgy and Allied Industries in Canada.

Published fortnightly by the

MINES PUBLISHING CO., LIMITED

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

Editor
REGINALD E. HORE

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

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

CIRCULATION.

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

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CANADIAN MINING INSTITUTE ANNUAL MEETING

The seventeenth annual meeting of the Canadian Mining Institute will be held in Toronto March 3rd, 4th and 5th. The program is an interesting one, and the attendance should be large.

We wish to call the attention of our readers to the fact that the Canadian Mining Institute is not merely a technical society and that membership is open to mining men of all classes. One of the main objects of the Institute is to further the Mining Industry of Canada, and it is recognized that technical men are not the only ones interested in the success of the Industry. In addition to mining engineers, metallurgists, geologists, surveyors and chemists, the list of members includes many non-technical men, such as mine owners, directors of mining companies, holders of stock in mining companies and others. In short, the Institute represents the Mining Industry, and not merely the Mining Profession.

And we wish also to call the attention of our readers to the fact that the sessions to be held at the King Edward hotel this week are open to non-members. Visitors will be welcomed. If you are a reader of this Journal you are interested in mining. If you are interested in mining you will with profit to yourself attend the meetings of the Canadian Mining Institute.

And we wish also to call attention to the fact that the Toronto committee expects members to bring their ladies with them. The ladies will not be interested in the technical sessions; but they will be interested in the programme prepared for them by the ladies' committee.

We hear it stated occasionally that, owing to the war, attendance at this year's meeting will be smaller than usual. Possibly that is so; but it is probable that the effect of the war on the meeting will not be just what such persons expect. There is in the serious situation in which the Empire finds itself something that fosters the 'get-together' spirit. Canadian mining men will be glad of the opportunity to attend a banquet where there will be so much of meaning in the toast, "To the King."

COAL IMPORTS AND EXPORTS

The new war taxes seem to have been excellently well thought out, and should distribute the burden of raising additional money for Government purposes very equitably over the population, but, from the viewpoint of the producers of soft coal in Canada, the exemption of anthracite coal from the 7½ per cent. additional impost,

seems hardly necessary, at any rate, in that portion of Canada where anthracite coal is a strong competitor of Canadian mined soft coal. Very little attention has so far been paid by Canadian operators to the possibilities of the substitution of coke made from soft coal for anthracite. Generally speaking the use of coke has not been popularized in Canada, but for certain classes of heating, particularly office and domestic heating, coke, burnt in a slow combustion tubular stove, is an admirable fuel. It is lasting, smokeless, and produces a hot fire which needs very little attention, and is moreover economical.

The action of the Canadian Government in exempting anthracite coal from taxation is in marked relief to the attitude of one of the United States coal trade papers in connection with the importation of Nova Scotian coal into Boston. A very limited amount of business has been taken by Nova Scotian companies in competition with United States coal. The business was fairly obtained by actual tests, and it has, of course, only been possible for the Nova Scotian coal companies to obtain the business by quoting a very low figure. The incident has called forth very spiteful comment. A country which imports into Canada nineteen million tons of coal annually should be a little tolerant of so trifling competition as comes from Nova Scotian coal in the New England markets.

The imports of coal into Canada during the years 1909 to 1913 were as follows. Practically all this coal came from the United States.

	Tons.
1909	10,372,924
1910	11,096,936
1911	15,310,281
1912	15,223,984
1913	18,925,859

Canadian coal exports during the same period were as under:

	Tons.
1909	1,749,197
1910	2,377,049
1911	1,634,582
1912	2,173,839
1913	1,631,586

These figures show a very one-sided tendency, and when it is further remembered that the coal production of the United States approaches 600,000,000 tons per year, while that of Canada barely exceeds 15,000,000 tons, it seems very undignified for United States operators to squeal so loudly when a little Canadian coal is sold in Boston. It used to be remarked of the Dutch that in business they had the failing of giving too little and asking too much. There are others.

F. W. G.

THE REFINING OF NICKEL

The Ontario Government has announced that it will appoint a commission to enquire into the problem of refining nickel in Canada. Some of the newspapers would have us believe that there is no problem at all, that the Government should just prohibit the export of nickel matte, and that as a result the nickel companies would necessarily do the refining in Canada.

With this stand of some of the newspapers, that Canada should wholly disregard the interests of companies that have large sums of capital invested in the industry, we have no sympathy at all. Nor do we believe that the situation calls for the lack of confidence in the Governments at Ottawa and Toronto that is expressed in such demands.

Now that the announcement has been made that the question of nickel refining is to be investigated, we find these papers complaining that an investigation will take a long time, and that the war may be over before the report is ready. If the investigation is to be of any value it should take a long time. The problem will require careful study from many sides. As great speed as is possible, with due regard for the importance of the report, should be demanded of the commission. But to ask the commission to report in a few weeks would be equivalent to instructing the members to report without an adequate knowledge of the facts.

Some interesting comments on the nickel question by an outsider are contained in an editorial in our esteemed contemporary, the Mining Press, San Francisco. Mining Press, Feb. 13, 1915, says:

"Canada is populated with loyal sons of the British Empire, and it also produces a considerable part of the world's supply of nickel, which is used in making armor plate for war vessels, and to a minor degree in the manufacture of munitions of war, such as nickel-jacketed bullets. In the early days of the war the idea occurred to Canadians that possibly some of the nickel employed by the enemies of Great Britain was derived from Canada, and by reiteration the fear grew until it became an obsession. Not long ago a Montreal daily paper published a cartoon showing a British battleship being torpedoed by a German submarine, with the accompanying legend, 'Sunk by Canadian nickel.' That neither torpedoes nor submarines contain appreciable amounts of nickel is a mere detail; the underlying idea is a patriotic one, which must be regarded with respect.

"The two producers of nickel in Canada are the Mond Nickel Company, Ltd., and the International Nickel Company. The former is a British corporation which refines its nickel in Wales, and, being under the direct control of the British military authorities is, of course, beyond suspicion. The International Nickel Company is an American corporation which refines its nickel in New Jersey, and the weight of suspicion at once fell upon it. It was at first rumored that the American company was controlled, or at least in part owned, by Krupp interests, but the most cursory investigation was sufficient to prove conclusively that such an assertion had no basis of fact whatever. It was next charged that the International Nickel Company was selling its product to for-

eign buyers, some of whom would presumably attempt to take advantage of the high prices in Germany by forwarding nickel to that country. Since the International Nickel had taken precautions, soon after the war broke out, to clear itself of any such suspicion by placing all its foreign business in the hands of its English agents, it was equally easy to show that this was also not the case. That these facts are fully recognized in well informed circles in Canada is made clear by the editorial comment in the January 15 issue of our excellent contemporary, the Canadian Mining Journal. It is now proposed, however, to force the International Nickel Company, by appropriate legislation, to abandon its refining plant in New Jersey and carry on its refining in Canada, thus placing the industry wholly within Canadian control. The problem thus at once passes out of the domain of national patriotism into the more exact one of economics, and the factors which govern the situation are business relations into which it will be profitable to inquire more deeply before taking action.

"During 1913 there was imported into the United States approximately 47,500,000 pounds of nickel in the form of matte. Of this about 3,000,000 was derived from New Caledonian ores smelted into matte near Antwerp, and forwarded to this country for refining in order to avoid the 10 per cent. duty imposed on imports of metallic nickel. The remainder was derived from Canada, and of the total amount of refined nickel produced, a little less than one-half was consumed in the United States and the remainder exported. Very little of this nickel was returned to Canada, only about one-eighth of one per cent. of the total. The fundamental question is therefore whether it is better economy to make Canada the production centre from which to export its entire product to the rest of the world (in the case of the United States in the face of an import duty), or to retain New York as a refining centre, with one-half the product for domestic consumption and only the remainder for export. Two factors must be considered—the relative cost of refining in the two places, and the trade conditions to be met in marketing the product.

"In a letter published in the Canadian Mining Journal of January 8, Mr. R. W. Leonard argues that refining can be done as cheaply in Canada as in New Jersey. It is difficult to see how such a thesis can be supported. As is well known, the production of nickel from matte involves several successive smeltings with salt cake, whereby the copper-nickel matte is separated into copper containing a little nickel and nickel containing a little copper. Fuel costs at Sudbury almost twice as much as in New Jersey; salt cake costs more than twice as much. We have not at hand any record of the average rate of wages paid at Sudbury and Bayonne, but the average daily wage paid to unskilled laborers in the vicinity of New York is $1.75 to $2 per day, according to figures furnished by the Bureau of Municipal Research. It is evident, therefore, that the labor cost would also be higher in Canada. To abandon refining in New Jersey and take it up in Canada would involve abandoning the New Jersey plant and constructing another in Canada; the cost of the new construction would have to be charged to the cost of refining in Canada, and it is difficult for the outsider to see how costs at the two places could be made anywhere near equal.

"Refined nickel produced in Canada, on entering the United States, would be subject to a duty of 10 per cent., or approximately $80 per ton. In order to avoid this duty, one of the two French companies operating at New Caledonia, ships its ore to Holland, where nickel matte is produced that is shipped to New Brunswick, New Jersey, for refining; the refined nickel being sold in the United States in competition with the product of the International Nickel Company. To the unprejudiced outsider it would seem that if the International Nickel Company were obliged to remove its refinery to Canada, and attempt to reach the United States market in the face of a 10 per cent. duty, the French company would promptly increase its refinery capacity in this country and supply a larger part of the present demand. It is generally reported that the International Nickel Company has considerable holdings in the New Caledonian nickel region which it has not yet developed. If the French company can operate in the field of an old established company, it seems certain that the International Company would not abandon its New Jersey plant, but would instead supply it with enough ore or matte from its New Caledonia deposits to provide for the consumption of nickel in this country. In attempting to force the refining of Canadian nickel in Canada, it therefore appears as though our friends across the St. Lawrence would be doing something like killing the goose that laid the golden eggs; for it apparently means the abandoning of the United States as a market for Canadian nickel. Turning to the pages of history, we find that when a country has placed an embargo on any of its products, the net result almost invariably has been the ruining of home industry and the benefiting of foreign competitors. It seems probable that a similar result would ensue if the Canadian authorities should place an embargo on the export of nickel ore and matte."

While these remarks call attention to some of the factors not considered by those who have argued in favor of legislation against the outside companies, the remarks are open to criticism.

It is admitted that fuel and salt cake and labor would cost more at Sudbury, Ontario, than at Bayonne, New Jersey. But why choose such places for comparison? There are many places in Ontario where fuel and salt cake could be assembled at less cost and where labor is cheaper than at Sudbury.

And why should mention be made of the 10 per cent. duty on refined nickel without mentioning the 6 cents per pound bounty which the Ontario Government pays on nickel refined in Ontario. Surely the compensation is adequate. It is well to remember, however, that the bounty expires in 1917. The duty on refined nickel is one of the reasons why the bounty should be available for a longer period.

The method of refining nickel used by the International Nickel Co. at the New Jersey plant is more or less secret. From time to time there have appeared brief descriptions of the process used; but details are always lacking. Apparently the company avoids publicity for business reasons, and consequently no authoritative description of the plant has appeared.

However, some idea of the process may be obtained from a bulletin distributed by the Canadian Copper Co., in which Mr. Alex. Gray says:

"Briefly, the Orford process, as the court of last resort in the refining of nickel, is a chemical process conducted in a locality where there are sundry other scientific nuisances to which distance lends enchantment. The Orford works are close to chemical factories and oil refineries. The coke and coal used there would cost three

times as much if they were hauled to Sudbury or Copper Cliff, and then the assortment of unsavory flavors would doubtless suggest that the Orford Copper Co. should be bonused to return to Bayonne. In the smelting at the refinery the quantity of coke runs to about 40 per cent., and in the reverberatory work selected coal is necessary. In the final smelting of the nickel there must be a sulphur-free oil. Nickel cannot be smelted or heated for rolling with a sulphur-bearing oil.

"Refining consists, according to Orford practice, of several smeltings. First there is a smelting in a blast furnace with salt cake or sodium sulphate, the latter being reduced to a sulphide which forms, with the copper and iron sulphides, a fluid matte of lower specific gravity than the nickel sulphide. A crude separation is the result. The material is cast in pots. On cooling, the 'tops' or upper portion containing iron and copper sulphides with sodium sulphide and some nickel, and the 'bottoms' carrying most of the nickel with a small quantity of iron and copper, are easily separated by the blow of a hammer. Then the retreatment of the 'bottoms' begins. They are mixed with fresh salt cake and re-smelted, and the sulphide of soda liquates the copper from the nickel present, allowing the nickel to go to the bottom as nickel sulphide. Eventually, by means of careful adjustments, a pure sulphide of nickel is obtained. There are leachings with acids and Henderson roasts to eliminate the iron, copper and cobalt and a final reduction with charcoal in a reverberatory. The copper 'tops,' which contain 5 or 6 per cent. nickel, are re-melted in a cupola, and taken to a Bessemer converter, forming blister copper which is sent to the electric refinery. The copper slags go back to the matte cupolas. Altogether the metallurgy of the separation of nickel and copper is one of the most complicated problems in modern practice."

Further information concerning the process is contained in the following paragraphs from an application for a patent made by Mr. Ambrose Monell and published in the monograph on the Nickel Industry, written by Professor A. P. Coleman. The application says:

"In the reduction of ores containing nickel and copper where a matte is produced containing sulphides of nickel, copper, and iron, a process has been devised in which a separation of the nickel sulphides is effected by the use of sodium sulphide, advantage being taken of its power of dissolving the sulphide of copper and iron freely and forming a solution of less specific gravity than the nickel sulphide. The matte mixed with coke and sulphide of sodium has been charged into a cupola furnace. When this charge is smelted, the sodium sulphate is reduced by the coke to sodium sulphide and, forming a solution with part of the copper sulphide and iron sulphide, flows with the undissolved and melted sulphides of nickel, copper, etc., through the tap-hole, which is kept constantly open, into molds, where the molten constituents separate in accordance with their specific gravity, the sodium sulphide containing the dissolved copper and iron sulphides floating on the surface and the undissolved sulphides settling to the bottom. When the contents of the mold have solidified, the parts are separated by fracture and the tops containing the copper and iron are recharged into a smelting-furnace, where the sodium sulphide is fluxed off in an iron slag, being then lost. The bottoms contain most of the nickel sulphide of the original matte; but owing to the imperfection of the separation they also contain so much copper sulphide and iron sulphide that it is necessary to resmelt them with fresh additions of coke and sodium sulphate, and thus to repeat the smelting and separation to the fourth or fifth time before the bottoms are brought to sufficient degree of freedom from iron and copper to enable the resultant nickel sulphide to be economically subjected to the succeeding steps of the refining process. The process as thus carried on is slow and wasteful and because of the cost of materials and the amount of labor and handling required adds greatly to the expense of the nickel and nickel oxide, which is the final product. I have discovered that these difficulties can be overcome and the separation rendered quick and inexpensive by the following process.

"Instead of smelting the compound matte, as heretofore, in a cupola furnace and running the product continuously into molds I so smelt the matte that when melted it will remain in a molten state subject to the high temperature of a furnace for a considerable period of time, during which I find that the copper and iron sulphides will be thoroughly dissolved by the sodium sulphide, and in one melting a good separation can be effected, and by two such treatments results are obtained equal or superior to the results of the four or five meltings which have been employed heretofore. For this purpose I employ as the smelting-furnace an open-hearth reverberatory furnace lined with magnesite brick, as I find that silica-lined furnaces are quickly destroyed by fluxing with the sodium sulphide. Into such furnaces I introduce a charge of nickel-copper-iron matte, either solid or molten, together with coke and sodium suphate, the latter being preferably present in the proportion of sixty per cent. of the weight of the matte and the coke in the proportion of fifteen per cent. of the matte. The sulphate is preferably added in the form of commercial niter-cake. Where, for example, a fifty-ton charge of matte is treated, containing say forty-five per cent. of nickel sulphide and thirty-five per cent. of copper sulphide, it is melted in the furnace and retained subject to the heat for some time—say four to five hours after fusion has occurred—during which time it is preferably 'poled'—that is to say, treated by immersing beneath its surface poles of green wood, which evolve hydrocarbon gases and vapors, and thus aid in the reduction of the sulphate and produce an agitation of the material, which facilitates and renders more thorough the solution of the sulphides to be removed. Nearly complete solution of the copper and iron sulphides in the sodium sulphide reduced from the niter-cake is thus effected, and the molten charge may be tapped from the furnace and allowed to separate in molds; but to get the best results I tap the different strata from the furnace separately, tapping first the solution of copper and iron sulphides floating on the surface of the bath and finally tapping the undissolved nickel sulphide, or the order of tapping may be reversed, the lower stratum of nickel sulphide being removed first. The great proportion of the iron and copper is thus separated, the nickel sulphide obtained being nearly pure. Where greater purity is desired, the nickel sulphide may be recharged into the furnace and treated again in like manner."

From these brief statements it should be evident that the cost of supplies and labor in the process must be very high. Convenience to the source of necessary supplies and cheap labor are naturally considerations of first importance in locating a plant where such a process is to be used.

Up to March 12, 1915, according to the estimates of the Monetary Times, $78,831,500 of war materials and equipment have been ordered by various Governments in Canada, since August.

INCONGRUITIES IN THE YUKON PLACER MINING REGULATIONS AND SUGGESTED REMEDIES

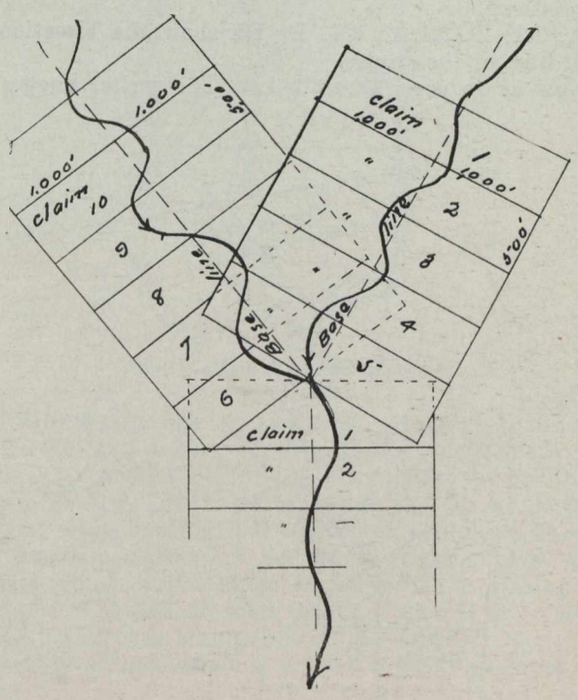
By J. A. MacDonald

The multiplicity of Placer Mining Acts and Regulations in the Yukon has given rise to much litigation and dissatisfaction among the miners. The difficulties met with by the surveyor of these claims in disentangling the various intermixed regulations cause profound irritation, from the fact that it is almost impossible to determine, *de jure* or *de facto,* the rights of ownership to many claims. It is said that in "every change of Federal representation a change in the mining regulations follows," *pari passu.*

Mining in the Yukon was of little consequence prior to 1897. At the time of the great rush in that year the old amended Act then obtaining was replaced by an entirely new one, known as Regulation Governing Placer Mining in the Yukon. This Act was in force, with some changes made in 1898, until three years later, when more changes were made. This 1901 Act did not meet with favor from the miners, and another new Act, entitled the "Yukon Placer Mining Act," was passed in 1906 and remains to the present day.

That these frequent and rapid changes in the mining regulations have caused endless litigation is not surprising.

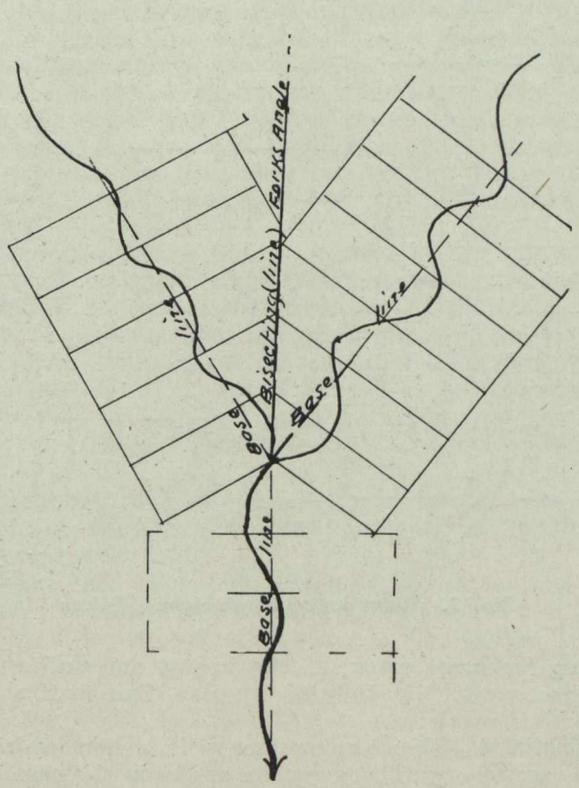
In the Yukon, under the present regulations, Act 1906, a placer claim is to be staked out in the form of a rectangle 500 ft. wide along the general course of the



No. 1. Creek Forks Claims, Yukon

creek and with side lines extending 1,000 ft. on either side of the creek or base line. A base line is generally run along the general direction of the creek, and this base line forms the centre of the claim, as will be seen by the illustrations accompanying this article. There are numerous cases in which the rights of ownership to claims have never been defined, hence, possibly, so much legislation. These may be called "incongruities," a few of which are presented here. In at least two cases a remedy is suggested:

Exhibit 1.—Here we have what is called Creek Fork Claims. Suppose a creek forks, a base line is run up



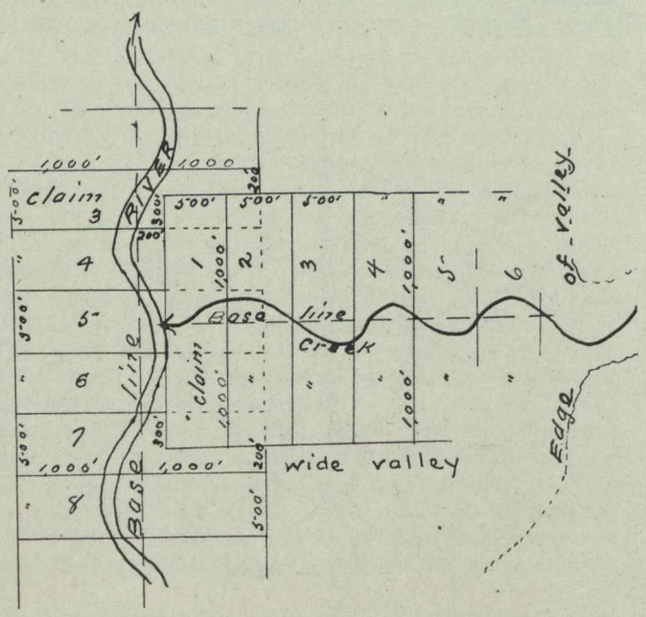
No. 1 A. Suggested method of laying out Creek Forks claims

each fork of the creek, a miner stakes a claim on one fork, being first on the ground, and his claim being as allowed by law, 1,000 ft. on each side of the base line, extends across the other fork, as shown in claims 5, 4 and 3, thus giving him two or more lengths of pay streak, each the length of a claim one on each creek. In the case shown Exhibit 1, the miner who staked out claim 5 possesses not only the full pay streak on his own creek base, but also two pay streaks on the other creek, rendering claims No. 6 and a good part of 7 almost worthless to their owners.

For, when No.'s 6 and 7 come along to stake out their claims, they find that Mr. No. 5 has run his stakes clean across the adjoining creek, and only a portion of a claim remains to be staked. No. 7 is very little better, for No. 5 on the adjoining fork has gobbled most of it up. No. 4, next him, has also a good part of two pay streaks, while the first three, 6, 7 and 8, are also unable to get a full claim, because 500 ft., along the base line, is the maximum length of a claim. The dotted lines of claims 6, 7 and 8 show the boundaries of their claims, as allowed by law. The illustration makes the case very plain in all its incongruity.

Exhibit 2.—Shows another incongruity. Here a small creek runs into a large one at right angles. The larger creek has a wide valley on the side upon which the smaller creek empties and its pay streak lies on that side. A miner stakes a claim along the smaller creek in the valley of the larger one (Claim 1), so that his claim of 1,000 ft. on each side of the base line along the smaller creek will include 2,000 ft. of pay streak of the larger creek, whereas the regulations are that such pay streak should be staked in claims of 500 ft. only.

It will be seen in this case that claim No. 1 takes up almost half of the pay streak of claims 3, 4, 5 and 6



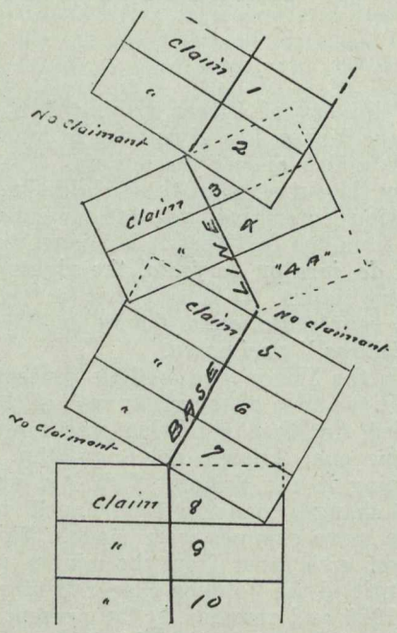
No. 2. Right angled creek claims, Yukon

along the large creek, a most unjust and unfair procedure, surely. A study of the plan, Exhibit 2, shows up this anomaly.

Exhibit 3.—Shows up another serious shortcoming in the regulations. There are the angles in the base line. The treatment of claims in the vicinity of such angles has given rise to many disputes. It is very difficult for the surveyor to adjust them in any way satisfactorily, for if the claims are staked according to the regulations, as they must be, there is necessarily overlapping at these angles, while there also remain parts not claimed by anyone.

Claims 1 and 2, which were first staked out or surveyed, have the full complement of area, while 3 and 4, notably 3, has but little more than half its size and area. The overlapping is shown by the dotted lines. The drawing makes this incongruity quite plain. There are other cases, but these three are sufficient for the present.

Suggested remedies.—Now, as to remedies: In the case of angles at the base line, Mr. Ogilvie, who spent many years in the Yukon, being the pioneer surveyor in that Northern region in the nineties and earlier, suggested, and in some few cases actually carried out, a remedy. Mr. Ogilvie simply split the angles at the base line corners, as shown in Exhibit 3 "A," and in this way utilized the corner vacancies shown in Fig. 3 "no claimant." This made irregular side lengths, but it gave the largest amount of fair play of any remedy yet suggested. By studying Fig. 4 "A" it will be seen that while the bases are equal the side lines are not as in Fig. 4. Take claims 1 and 2, in Fig. 4 they are rectangular with uniform boundary sides, while in Fig. 4 "A" the side lines are longer on one side than the other. Claim 3, as also claim 5, are gusset or jib shaped;

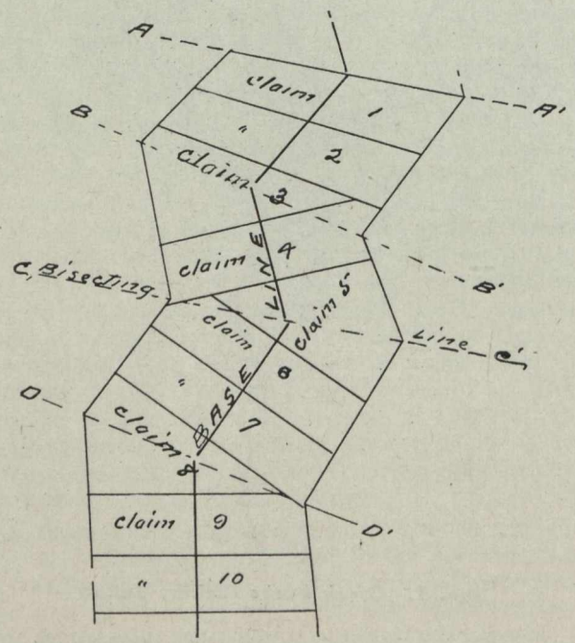


No. 3. Base angle claims

they have the complement of area, however, and there is no vacant ground at the angles. Strange to say, this remarkably overcoming-remedy, shown in 4 "A" as applied to 4, has not been incorporated into the Yukon regulations.

A, A1, B, B1, C, C1, D, D1 show the bisection, or split-line, of the angles.

Now as to case, Exhibit 1. The writer suggests a

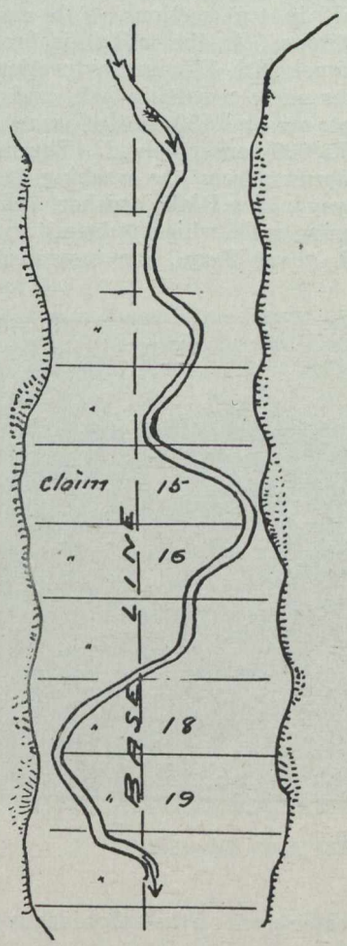


No. 3 A. Suggested remedy in case of base angle claims

simple remedy as shown in Exhibit 1 "A." This is simply split or bisect the angle at the forks by running a line in a direction which will divide the ground equally between the two creeks. In the case shown, 1 "A,"

this line need not be run more than 2,000 ft. In this each claim, on each fork, has fair play. The bisecting line forms the end boundaries of the adjacent claims, and there is no overlapping or no gobbling up of two pay streaks by greedy prospectors.

Fig. 5 shows another anomaly for which we do not see any remedy. The creek runs circuitously in the gulch, a base line is seen along its general course upon which the claims are staked. It is plain that those who have to take claims 18, 19, 15 and 16, where the creek runs to the sides of the gulch, are up against it. Mr. Thomas Fawcett, D.T.S., who spent several years in sur-



No. 4. Gulch claims, Yukon

vey work in the Yukon and who brought this anamoly to the writer's notice, could not offer any remedy.

Now, as to remedy for the incongruity in Exhibit 2. I have none, so far, to offer, though there is no doubt at all but some equitable arrangement could be made in the manner of staking out those right-angled creek claims which would make it worth while staking out claims 4, 5, 6 and, to some extent, 3 and 7, after claims 1 and 2 had been staked out on the smaller creek. That a remedy of some kind is urgent is quite apparent.

MINES BRANCH REPORTS.

The Mines Branch has issued recently the following bulletins: "The production of copper, gold, lead, nickel, silver, zinc and other metals in Canada during 1913," by Cosmo T. Cartwright, and "A general summary of the mineral production of Canada during 1913," by John McLeish.

U. S. MINE ACCIDENTS IN 1914.

It is gratifying to note that the fatalities in coal mines in the United States in 1914 were 334 less than during the preceding year, the total fatalities being 2,451, as compared with 2,785 for 1913.

According to Albert H. Fay, of the U. S. Bureau of Mines, the principal causes of accidents that show a material decrease were: Coal-dust explosions, 96 per cent.; haulage, 11 per cent.; and falls of roof and pillar coal, 10.6 per cent. The net decrease in underground fatalities was 365, or 14 per cent. This is equivalent to saving one life every day during the year.

There were 331 fatalities due to gas explosions as compared with 91 in 1913, making a net increase of 240. Of the total gas explosion fatalities, 261 were due to four serious explosions. There were slight increases in accidents due to explosions and electricity. There was also a net increase of 26 fatalities in shaft accidents, or 42 per cent., while on the surface, the net increase was five or about 3 per cent. The net decrease for the year for both underground and surface accidents at coal mines, as compared with 1913 was 12 per cent.

The exact figures for the number of men employed are not yet available, but taking the estimates as furnished by the inspectors for several of the States and using the same number of men as employed in 1913 for the other States, gives an estimated total number of employees for the year as 742,868 as compared with 747,644 in 1913. The fatality rate therefore becomes 3.30 per 1,000 men employed in 1914 as compared with 3.73 in 1913.

Excluding 1912, when the rate was 3.27 per 1,000 men employed, the 1914 rate of 3.30 per 1,000 is lower than any year since 1903.

While there was a reduction of 12 per cent. in the number of fatalities, there was also a reduction of 10.5 per cent. in the production of coal. The United States Geological Survey estimates the production for 1914 as 510,000,000 short tons, as compared with 570,048,125 tons for 1913. The fatality rate per 1,000,000 tons of coal produced in 1913 was 4.89 and in 1914 4.81. With the exception of 1912, when this rate was 4.41, the 1914 rate is the lowest yet recorded for the United States. The amount of coal produced per fatality in 1914 was 208,078 short tons, which with the exception of 1912 is the largest on record. The production per fatality in 1913 was 204,685 tons; 1912, 226,469; and in 1907, 144,325 tons.

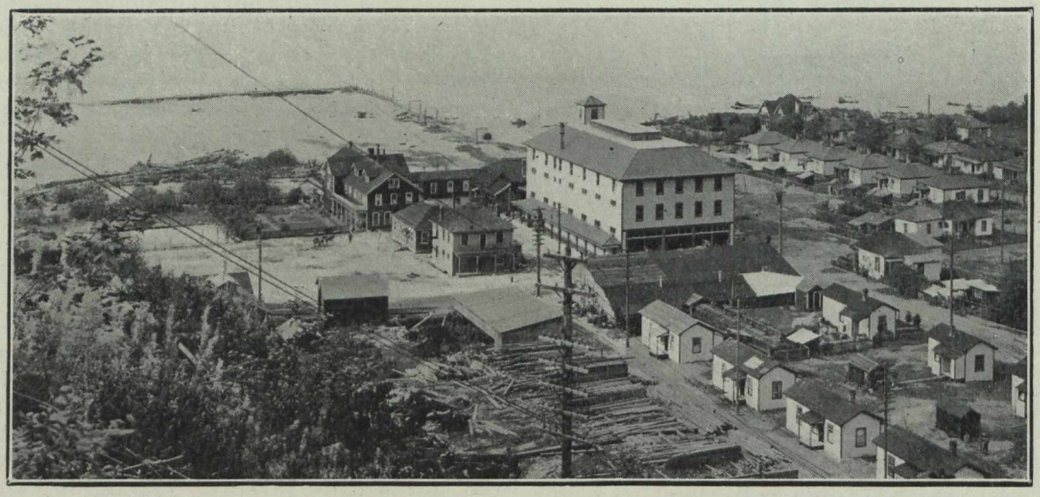
There were 316 lives lost in disasters in which more than five men were killed at one time, as compared with 464 in 1913, a net reduction of 148, or 32 per cent. in this class of accidents.

It is not possible to attribute these lower rates to any one particular influence. They may, however, be assigned in any part to any one of the following agencies or to a combination of all of them; closer and more careful inspection by the State inspectors; better enforcement of laws and regulations by the operators; a realization of the dangers attendant upon the miner in his daily work and his efforts to reduce accidents due to the educational campaign conducted in his behalf; the extended use of safety lamps in doubtful mines; the use of permissible explosives; humidifying dusty mines; first aid and rescue training which saves lives that might otherwise be lost by reason of injuries received; the enactment of industrial accident compensation laws; and last but not least the spirit of co-operation on the part of all concerned.

BRITANNIA MINING AND SMELTING CO., LIMITED

The Britannia Mining and Smelting Co. is operating a large copper property situated in Vancouver mining division, British Columbia. An account of this property, written in 1913 by Mr. R. G. McConnell, then on the field staff of the Geological Survey of Canada, was printed and issued as an appendix to the International Geological Congress Guide Book No. 8, published by the Geological Survey, and reprinted in the Annual Report of the Minister of Mines for British Columbia, 1913. Those interested in the description of the rocks and minerals occurring here can find the particulars given by Mr. McConnell in either of the publications mentioned. The general information follows:

Mr. McConnell wrote: "The group of mineral claims owned by the Britannia Mining and Smelting Co., and known as the Britannia mine, is situated in the Coast range east of Howe sound, about 20 miles directly north of the City of Vancouver, and 28 miles following the steamer route along the coast. Howe Sound is an irregular fiord, cutting well back into the Coast range, and is bordered along its whole length by rugged mountains and high ridges. The claims now being worked are situated on a steep ridge, about 4,300 ft. in height, separating Britannia creek from Furry creek. The principal workings are in the north slope of the ridge at a distance of three and a quarter miles from the coast and at an elevation of 3,275 to 3,775 ft. above sea level."



Part of Britannia Beach townsite, B.C.

Concerning the minerals occurring here Mr. McConnell said: "The metallic minerals in the Britannia orebodies consist of pyrite, chalcopyrite, considerable zinc blende in certain areas, and rarely some galena. Small quantities of black oxide of copper and bornite occur as alteration products, but are nowhere abundant. The gangue is principally the greenstone schists forming the country rock, more or less silicified. Small quartz veins, generally following closely the direction of the schistosity, but frequently cutting directly across it, are numerous. Calcite in very small quantities is occasionally present and some fluorspar has been found."

The development of the Fairview mine, which is the one now being worked, was thus briefly described: "The Fairview mineral zone has been opened by five levels at elevations of 1,050, 850, 700, 600 and 500 ft. below the summit of the ridge into which they are driven. The levels, with numerous crosscuts and raises following the orebodies, serve to explore the zone for a distance of 1,000 ft. along the strike and 500 ft. along the dip."

Of the treatment of ore, Mr. McConnell wrote: "The chalcopyrite in the Fairview orebodies occurs as a rule in fairly large aggregates, often separated by considerable waste, and the material mined is concentrated before shipment. The ore is crushed at the mine and transported to the mill at Britannia Beach by an aerial tramway built in two sections, with a daily capacity of about 600 tons. At the mill it is first washed in a 4x10 ft. trommel with 1½ in. perforations. The oversize discharges on to a sorting belt, and about 50 tons of 12 per cent. ore and 150 tons of waste are picked up daily from the 600 tons received. The milling ore, except the undersize from the washing trommel, passes from the conveyor to a Blake crusher, and then through a series of spring rolls, which reduce it gradually to the size required, about 2mm., for treatment in Hancock jigs. The greater part of the sulphides is separated out by these machines.

"The tailing and the undersize from 1½-mm. trommels, are ground in Hardinge pebble mills to a 40-mesh or smaller size, and subjected to the Minerals Separation Co.'s flotation process, the details of which are kept secret. The Hancock jigs used are of the Anaconda type and the separation of the sulphides by them, followed by the use of the Minerals Separation process on the finer material, has given excellent results, only a very small percentage of the sulphides escaping. The concentration is in the ratio of 4 to 1."

Britannia Mining Co. Operations in 1914.

The approximate production and the gross metal contents of the ore for 1914, together with the corresponding figures for 1913 for purposes of comparison, are shown in the following table:

	1914.	1913.
Ore mined, tons	239,174	215,589
Ore milled, tons	240,272	215,121
Crude ore and concentrate shipped, tons ...	38,750	45,000

Gross contents—

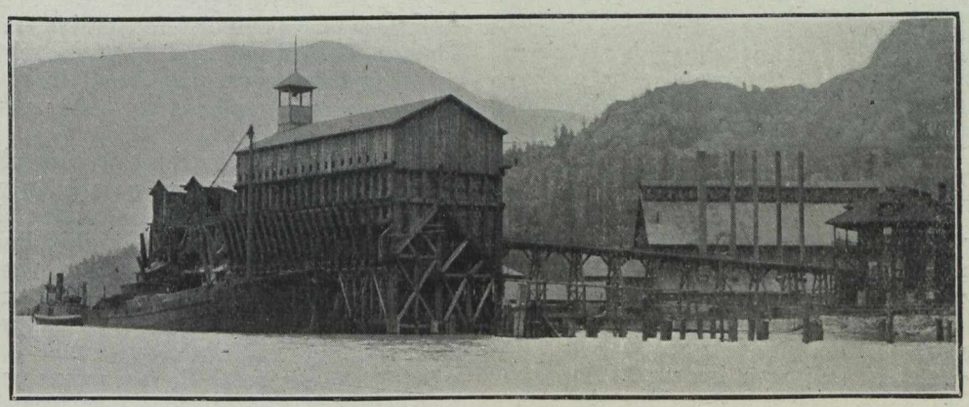
	1914.	1913.
Gold, oz.	250	89
Silver, oz.	70,000	72,300
Copper, lb.	12,000,000	13,167,000

The demoralization of the copper market last summer resulted in a curtailment of production by about 50 per cent. as from the middle of August, also in a practical suspension of important construction work previously in progress.

Much underground development work was done in 1914, chiefly in drifiting, crosscutting and raising.

The following is an outline of the progress made to the end of 1914 with the construction and other improvements the company is making with object of largely increasing its production of ore:

New Concentrating Mill.—The framing and roofing-in of the first 1,000-ton unit of the new concentrating mill, which is eventually to have a capacity of 2,000 tons a day, has been completed and the machinery (the larger part of which for the full plant is now on the ground) has been placed under cover. The grading and excavation for the second unit has also been completed. The storage and handling of the various products from the present 800-ton mill and the larger new mill have been greatly simplified by driving underneath the mill-site a tunnel from which three 6x10-ft. raises have been made down which to pass the concentrates, etc. An electric railway is operated through this tunnel and connection with the new bunkers on the shipping dock is made over a trestle.



Shipping dock and old concentrating plant, Britannia Beach, B.C.

Transportation System.—The Britannia crosscut adit, which is the 2,200 ft. level of the mine, has been driven at an elevation that is 1,196 ft. below the lowest (1,050 ft. level) workings in the company's Fairview mine; its dimensions are 9x12 ft. in the clear, and it has been driven a total distance of 4,336 ft. from its portal. A 3 ft. gauge track, with 45-lb. steel, has been constructed the full length of the adit, which will in the near future be the main outlet from the mine. The three and a half mile aerial tramway which has for years been the chief means of transportation between Britannia Beach and the upper mine camp, will be used as an auxiliary system.

The working shaft that is being driven vertically from the 2,200 ft. level, starting at a distance of 3,922 ft. from the portal, to connect with the present productive workings above, has outside measurements of 10 x 20 ft. and is divided into three compartments, of which two for hoisting purposes are each 6 x 7 ft. 6 in. and one, a manway, is 3 x 7 ft. 6 in. This shaft is now within 217 ft. of being completed; in addition, much work has been done in cutting stations at intermediate levels, and in crosscutting to connect with a rock-raise also put up from the 2,200 ft. level. The latter, which will be the chute and storage bin for the ore, is 8 x 12 ft. and 1,268 ft. in length; it was holed through to the 1,050 ft. level on October 24, when work in it was stopped pending completion of the main working shaft, after which installation of the machinery, already received, will be proceeded with. This plant includes a 20,000 lb. double-drum electric hoist, to be placed on the 1,050 ft. level for operation of cages, etc., in the shaft, and a Gates crusher, to be installed in the rock-raise at a height of 400 ft. above the 2,200 ft. level.

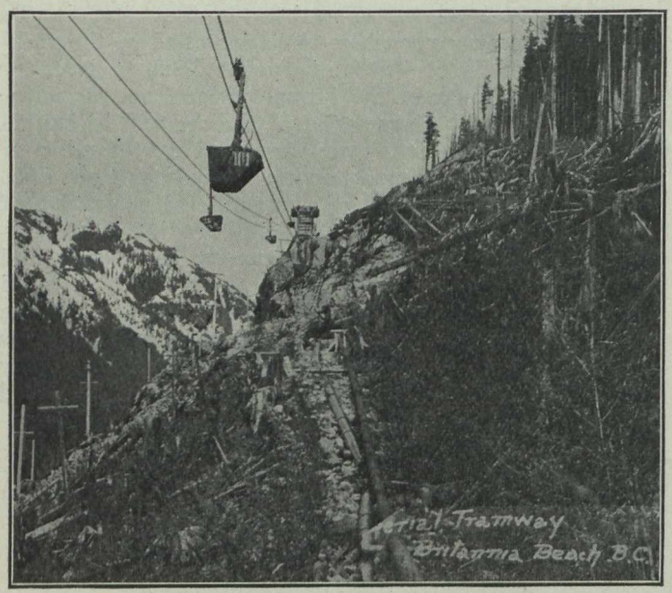
From the mouth of the tunnel outlet from the mine, which is 2,100 ft. above sea-level, the ore will be hauled by electric locomotives over three and a half miles of sidehill railway, having a maximum grade of 3 per cent. and leading to the head of an incline the elevation of which is 1,600 ft. During 1914 the grading and track-laying on the railway was practically completed, and the incline, which connects the railway with the mill bins at Britannia Beach, was graded through with the exception of a cut at the upper end. This incline, 5,500 ft. in length and of an average grade of approximately 30 per cent., will be standard-gauge and double-tracked with 56-lb. rails; it will be operated by a winding engine, and 20-ton skips which will convey the ore from the bins at its head to the concentrators at the Beach.

Power.—As the first step toward the provision of additional power for the larger operations, the company is supplementing its present 500-kw. auxiliary steam turbine with a 2,000-kw. unit of the Fraser & Chalmers type, the arrival of which at the Beach has been delayed until spring. Meantime, the remainder of the installation, consisting of two 500 h.p. Babcock & Wilcox high-pressure steam boilers, was completed in December, necessary arrangements having been made in the way of stack and breeching for the addition of a third similar boiler at an early date.

During last summer the company greatly increased the capacity of its Utopia storage dam at the head of Britannia creek, to which recourse is had for supplying the Tunnel and Beach hydro-electric plants during periods of shortage of water from ordinary sources of supply.

Other improvements.—Among the numerous other improvements made during the year are the undermentioned: There were constructed new concrete tanks for

slimes and Hancock jig and Minerals Separation flotation process concentrates from the old mill; addition to the old mill plant of Hardinge pebble mills, Allis-Chalmers tube mill, Butchart tables, slime pump, water-wheels, and other new equipment; more buildings were erected, including eleven dwellings for employees, some with five and others with four rooms; a large bunk-house was built at the Beach; all buildings on the property were painted; an up-to-date laundry, electrically operated, was completed, this to be run in connection with the Britannia stores; a new wagon bridge was



Aerial Tramway, Britannia Beach, B.C.

constructed over Britannia creek; provision was made for recreation and amusement of employees by adapting a large building for use as a roller skating rink and dance hall; modern fire-fighting apparatus was put in, and three pulmotors (for automatic resuscitation with oxygen) were purchased and men instructed in their use; and generally much else was done for the more efficient operation of the mine and concentrating mills and the accommodation and comfort of the company's many employees.

QUEBEC BUILDING AND ORNAMENTAL STONES

The third volume of a report on the building and ornamental stones by Dr. W. A. Parks has just been published. Volume I contains two parts, the first consisting of a general introduction to the subject and the second dealing with the building and ornamental stones of Ontario. The second volume contains a systematic description of the stones of the Maritime Provinces, and the present volume is devoted, in like manner, to a description of the building and ornamental stones of the Province of Quebec.

The Province of Quebec produces limestone of structural quality in large amount; it is rich in deposits of granite of various kinds; it is rapidly assuming a position of importance as a producer of marble, and it possesses the only important slate quarries in the Dominion. Sandstone is quarried in small amount and possibilities exist for the production of many of the rarer decorative substances.

Limestone of excellent quality is obtained on Montreal island, on Isle Jesus, and at various points north of the St. Lawrence river; it is largely quarried at Hull and at points in the Eastern Townships, such as St. Johns and St. Dominique.

Important granite quarries are located at Stanstead, in the little Megantic mountains, and at other points in the Eastern Townships. North of the St. Lawrence, producing quarries are found in Argenteuil and Ottawa counties, and to the nortward of the city of Quebec at Riviere a Pierre and Roberval. Dark basic rocks commonly called "black granites" are quarried at Mount Johnson, and opportunities for the production of this class of stone are afforded by many other localities.

Decorative and structural marbles are quarried on an extensive scale at Phillipsburg, in Missisquoi county, and in the township of South Stukely. The crystalline limestones of the great Pre-Cambrian area north of the St. Lawrence present many possibilities for the production of marble. A company has recently worked at Ste. Thecle, in Champlain county, and extensive operations are being planned for quarrying the white stone at Portage du Fort, in Pontiac county.

The production of sandstone is small and is practically limited at the present time to the hard whitish stone at Beauharnois. The Sillery sandstone near Quebec is still used in small amount, and a small quarry is operating in beds of Carboniferous sandstone on the north side of the Restigouche river. The Devonian sandstones of Gaspe present great possibilities, but they are not now being exploited.

Extensive deposits of serpentine are found in the Eastern Townships, and in the county of Grenville, but they have never produced decorative stone on a commercial scale and are not being worked at the present time.

Slate is quarried in the township of Melbourne and at Long Lake, in Temiscouata county. Many other slate belts are known, the commercial possibilities of which have never been thoroughly investigated.

The rarer decorative substances, particularly garnet-bearing rock, varieties of porphyry, and the iridescent feldspars, are known to occur in the province, and may prove a source of future supply.

Dr. Parks discusses the occurrence and properties of the several classes of stone in a very interesting manner. The report is splendidly illustrated with half tones, maps and colored plates.

MICHIGAN COPPER MINES BUSY AGAIN.

Houghton.—Every mine in the Lake Superior copper mining district, that is, every copper producing mine, is again working full time. The net increase in the output of refined mineral from this district is likely to show over 2,000,000 lb. in February and 2,500,000 in March. This additional copper will not of course reach the market before April, and will not have any appreciable effect on the market supply until late spring, if then.

Calumet and Hecla and its subsidiaries were the last mines to return to normal working time, following the slump at the beginning of the European war. Wolverine and Mohawk kept up full time all through the slump. Baltic, Champion and Tri-mountain went on half time, and just a few weeks ago resumed full time. Quincy has been working full time, but operating three shafts only. Other smaller mines worked full time.

DEPARTMENT OF MINES PUBLICATIONS.

The Department of Mines has published a new edition of "Economic Minerals, and Mining Industries of Canada" for the Panama-Pacific Exposition.

THE EVOLUTION OF STOPING METHODS DURING THE LAST DECADE*

By C. A. Macaulay.

In very sound rock, excavations of considerable size may be made without the necessity of immediately supporting the walls and roof; but even in such cases unprotected ground usually becomes dangerous in the course of time. In the case of weaker or more shattered rock supports are required for the roof and often also for the walls at an early stage in the excavation.

Drifts and shafts, being narrow work, naturally stand better than larger openings, but even they are usually protected—except in very sound rock—as their integrity is essential to the operations of mining. Shafts in particular are almost always substantially timbered or walled, not only for safety but also to carry the hoisting guides, ladders, etc.

Stopes are on the other hand, more or less temporary in their character, and when small they can often be excavated with little or no support. Large stopes almost always require protection of some sort or other, and it is proposed in this paper to discuss the methods most commonly in use for this purpose. The discussion will, however, be limited to workings in metalliferous ore bodies, and even iron ores will be included only incidentally. It should also be noted that the discussions will not include the modern caving methods such as top slicing, as these methods are radically different from ordinary stoping.

The methods of supporting the walls and, when necessary, the working face of stopes may be grouped under six general heads:—

(1) By timbering with setts.
(2) " filling with waste.
(3) " leaving pillars or ribs of ore.
(4) " filling with broken ore over dry walls.
(5) " the underground drifts method.
(6) " caving in descending slices.

The suitability of any one of these general methods for working any particular deposit, still more its detailed development, is dependent on a number of factors, of which the most important are: (a) The form of the deposit, (b) Its size and particularly the width, (c) The dip, (d) The character of the walls, (e) The character of the ore, (f) The extent to which the ore or the walls have been shattered by movements; penetrated by dykes, etc., and (g) The cost of labor and materials, and the grade of the ore, etc. This last consideration may almost be said to govern all the rest.

Many systems from a scientific point of view are very interesting to work out and scheme applications for; but in doing so one must not lose sight of the big factor, namely, costs. Of course, any methods or combinations of methods, no matter how suitably they may be applied to the problem in hand, can only be of passing interest to the operator, unless they show in addition to everything else a favorable cost sheet.

Timbering.—Some years ago sett timbering was almost the universal method of supporting stope excavation. Gradually other methods have crept in, replacing it, so that to-day, in a large majority of districts, framed timbering in stopes is a thing of the past.

We must not, however, in our rush to bring forward better and cheaper methods of stope support, lose sight of the fact that stoping with square setts has been very successful. There are some very important districts even now that still adhere to the method. For instance in the district around Buttte, Mont., where the ores are rich, relatively soft and the walls much shattered they know almost nothing else in actual practice. Butte trained men are very skeptical of other methods and often afraid to work under large backs without the immediate protection of timber. In other districts setts have been given up for the main stope; but are still used as a secondary device; that is, they are employed in small portions of a mine or stope where the ore is too soft and friable to permit of being removed without an immediate cover. In many of these cases, and in others which need not be named we must not condemn this use of timber because it really is an admirably convenient and safe method, and often justifies its cost.

In many places, however, timber setts are still used without any real reason except that the camps are in charge of miners of the old school, non-technical men who are, as a rule, very conservative when it comes to trying new schemes and methods. Such men are often excellent miners, but they allow themselves to be prejudiced in favor of older and more familiar customs. In general, however, stoping with timber should give place to later methods, not for one, but for a combination of many reasons, the chief of these being in most districts the increasing and often prohibitive price of timber. Then there is the danger of creep and crush, and in after years of subsidence. Added to all this there is the risk of fires. If we look back at the records of such mines as the Comstock or Broken Hill, or even Calumet and Hecla, we will see that crushes and fires have cost more than enough to have paid for filling systems many times over.

Filling with waste.—This method, which originated abroad even before we first used timber setts, is of comparatively recent use in this country, so far at least as it concerns replacing timber in stopes. The system necessarily calls for a large amount of waste rock, and although a certain amount of waste is ordinarily made in cutting the stopes themselves, there is never enough to fill the stope. Resort is made usually to waste rock from development work and to rock house waste, mill tailings, etc. The latter, in conjunction with dry walls of rock or waste, is largely used, since it is easily available and may be cheaply handled. It is quite common in Australia, where the tailings are dried out thoroughly, so as to free them as far as possible from cyanide of potassium, and are then sent into the mine. In South Africa, on the Rand, enormous quantities of tailings are now chemically treated to destroy the cyanide and are sluiced into the stopes, the water being drained off and pumped to the surface leaving the tailings in a compact mass.

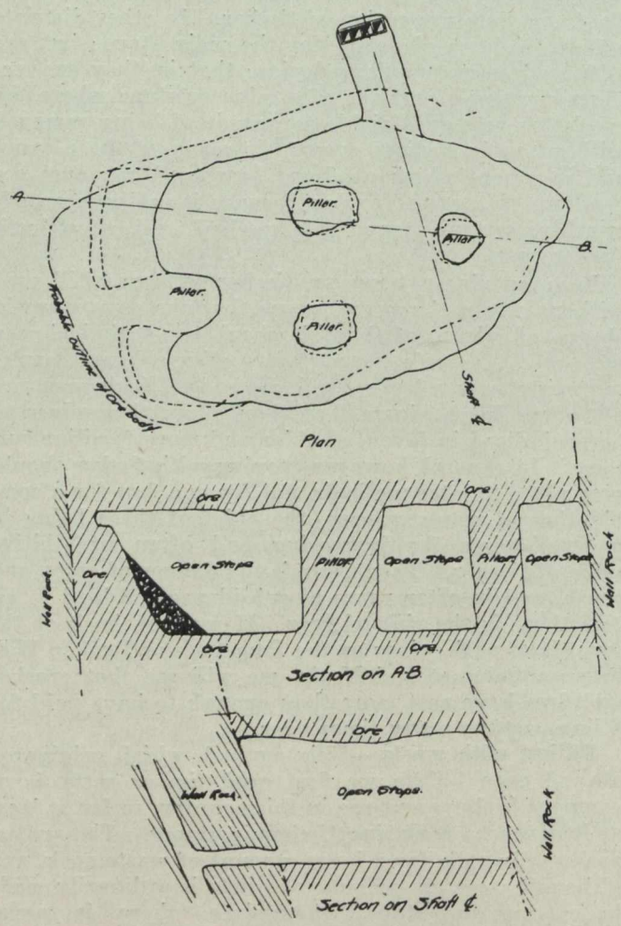
In cases where neither of these residues can be obtained for filling, inclined raises are sometimes driven into the walls and small amounts stoped from the wall rock to answer the purpose. This form of filling is

*A paper read before the Mining Section, Canadian Society of Civil Engineers, January 14, 1915.

somewhat more expensive, but raises may be driven in such a way that the fill is placed by gravity; as an example of this we have the Tramway Mine, Butte, Montana.

The main feature which requires care in this system is that winzes must be kept open. To work to the best advantage the winzes through the block of ore under attack should be kept in alignment with similar winzes from above, so that filling may be sent down from the surface or from any intermediate level. The logical place for these winzes is in the hanging wall of the stope as the waste will then reach the foot wall of the stope with a minimum of handling.

The disadvantage of this system is that a certain amount of timber must be used for chutes and in the dry-walls as binding matter. The building of dry walls for the tramways and the placing of timber



Plan and Sections Showing Method of Support by Pillars of Ore

and lagging required to cover them is a heavy expense, as is the first cost of timber necessary.

As an example of this type of mining we may look at the South Range Mines, Houghton County, Mich., such as the Baltic, Altantic and Champion mines and many others. In these mines the filling is kept just high enough for the machines to back stope from the fill floor. In most cases where the ore requires support, a few short stulls set on the fill are sufficient to hold the back; these are usually recovered when the next cut is taken down. When stulls are not heavy enough cribs or bulkheads are used. They are filled with waste and usually lost by being buried. Compared with all timber methods, such as square setts, the filling method has the advantage of more effective support to the mine, less danger of creep and much less danger of fire, and in most cases is by far the cheaper of the two.

It is stated that the cost of timbering by square setts in the LeRoi Mine is 21c. per ton of ore excavated. In the Ivanhoe Mine, West Australia, the cost of filling the stopes with waste is 22c. per ton of ore excavated. At the Le Roi, timber is said to be worth $10 per "M." At the Ivanhoe, it is worth $50 per "M", so that setting there would cost about 65c. per ton of ore excavated. From this we see that the location of the mine as affecting the cost of essential supplies is one of the big factors that has to do with selecting a method.

Pillars of Ore—As a method of supporting stopes in the type of mine under consideration, the use of ore pillars alone, strictly speaking, has no place. This method can be used only in mines where the walls are exceptionally strong, and where the backs show no tendency to cave at all.

Ore bodies of this character are rare, and even when they occur this method is only applicable to a moderate depth, as no ore pillar of reasonable size will stand the great pressures that are unavoidable at great depths. Another objection to this method is that a large amount of ore is locked up in the pillars, and only part of it can usually be recovered when the stopes are abandoned.

In shallow mines, however, the method works very well indeed. Pillars carry the back in a series of very high arches, and the ore is taken out by breast and bench stoping, a back of about 30 ft. being left to be broken down from the level above when the stope below has been worked out. This system has been largely used in the upper levels of the mines of the Sudbury Nickel District, and in some of the mines of the Tennessee Copper Company as well as elsewhere.

The disadvantages of this system in addition to the loss of ore in pillars are: the heavy expense of scaling necessary to keep the backs free from loose ground which would be liable to fall and thus endanger the miners below, and the expense of mucking, since all muck must be shoveled from the sill floor into cars for tramming. These disadvantages, however, are more or less completely offset by not requiring filling at all. So this system, if it may be so called, is excellent in so far as it goes; but its use is extremely limited. Ore pillars are often used in conjunction with other methods, but that will be discussed elsewhere.

Broken Ore Filling Over Dry Walls.—This method of support is generally known as "Shrinkage Stoping." It entails the construction of dry walls and ore-chutes, as in the filling with waste method; but it disposes with the winzes necessary for that method, and makes it possible to place nearly all of the filling by gravity.

The method is to stope out the sill floor and then to dry-wall along one or both sides of the proposed tram using ore with a timber binding and a timber lagging overhead; then to back stope the broken ore, filling the stope between and over the haulage ways. Chutes must be built up to keep pace with the filling, and as the broken ore occupies from 30 to 45 per cent. more space than the ore in place, the surplus ore must be drawn off. This is done continually through the chutes as the stope is broken towards the level above. The remaining 55 to 70 per cent. is left in the stope, affording a temporary support to the walls and a working floor to the miners. When the stope is com-

pletely broken through to the level above, it will be full of broken ore which may then be entirely drawn off. The dry-wall of the level above will come down with this also, as the last work in the stope will be the shooting out of the floor pillar between the working stope and the one above.

A stope that is to be mined by this method requires only by way of development, besides the haulage entry joining it to the shaft, to have preliminary winzes or raises at its extremities to provide a means of ventilation and an alternative method of entrance and exit.

When all of the broken ore in a worked out stope has been drawn off, the walls in most instances may be allowed to cave in. In cases where this is dangerous, or not convenient for any reason, some means of support must be afforded them such as rib pillars left in place, or waste filling which may be drawn down as the workings go deeper.

The advantages of this method are that practically no shoveling is necessary in the stopes, since the ore will come around the chutes, and when the angle of rest is exceeded, will roll into them. A greater distance between levels is possible than in the earlier method, and fewer raises and winzes are required. The cost of filling the stope is practically nothing since the ore has to be broken anyway.

The system has its disadvantages, however, the chief of these being that the ore must be broken fine enough in the stopes to prevent blocking in the chutes. It is not always possible to prevent some large pieces getting into the chutes and a little trouble is usually experienced from this, but the same may be said of the waste fill method in this respect. Then the breaking for some time of more than double the tonnage that the mine can ship results in the locking up of a considerable sum of money. In the long run, however, as the mine opens up new stopes and finishes old ones, this difficulty disappears. It also ensures a steady output.

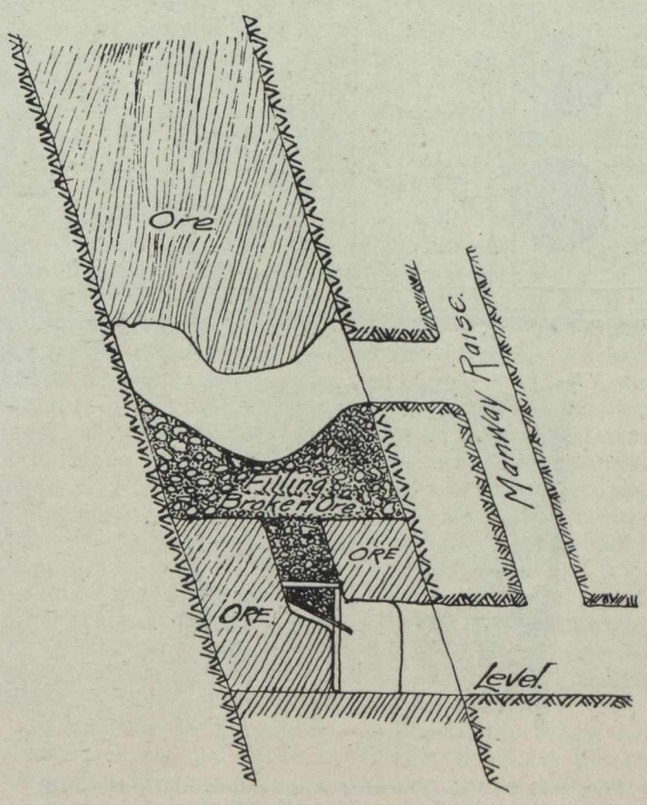
As typical examples of this method we have the King mine, the Coronado mine and others in Graham County, Arizona. There are also numerous mines in Canada where the method is carried out in its main features.

The Under-Drift Method.—We now come to a consideration of the last and most recent of the methods involving filling as distinguished from caving, namely, the under-drift method. By way of introduction we might say that this method, although it has been very successful in so far as it has been used, has not as yet really had sufficient application to varied problems to justify one in calling it a standard method. However, in as much as we believe that it will in the near future make good and become a standard method, we shall speak of it from now on as already being such.

This method is probably one of the most simple and inexpensive systems for filling that has as yet been developed. The salient and new feature of this method is that it does away with timber practically entirely in the stope, and instead uses the ore or rock in place. In the method last discussed, we do away with, excepting the small amount used for binding the chutes, the timber while raising the stope from one level to the other, but we do not eliminate it on the sill floor in which place a considerable amount must be used. In the under-drift method we eliminate the sill floor timber entirely, in the sense in which the term is ordinarily used, and place the haulage roads in the floor pillar instead of on top of the floor as is usual.

The main idea of this system is to eliminate the timber on the sill floor. The method of doing this is as follows: When laying out a level the first 15 to 20 ft. of the ore-body above the floor level is left in place, instead of being stoped out as is usual; this ultimately forming part of the floor pillar or back of the stope which in due course will be cut below. This flat pillar is necessarily left until such time as the stopes above and below are worked out and are ready to have their broken ore drawn off.

The drifts and crosscuts which are to serve for haulage ways for the stopes are driven in this floor pillar. From these haulage ways raises or box holes are driven vertically upward, or at an incline, to the level of the bottom of the proposed stope which as stated above is from 15 to 20 feet above the floor of the crosscut, These box holes are usually about 25 ft. apart and are placed alternately on opposite sides of the haulage ways and are provided with chute gates. The lay-out of the haulage ways depends on the size and shape of the ore-body. In most cases they would be planned



Section Showing Application of Under-Drift Method to Narrow Stopes

and spaced in the same way as the dry-walls roads for ordinary shrinkage stopes. Entrance for men to the stopes is secured by means of manways which are generally placed in the pillars; but in the case of a narrow ore-body they may be placed in the walls a few feet back from the contact. In both cases the manways are usually connected to the stope about every 25 ft. (vertically). The stope is then opened out to connect with the top of the box holes, and this broken ore, or rather the surplus, is drawn off through the box hole gates into mine cars run just under the lip of the gate and are loaded by gravity so that practically all shoveling is done away with.

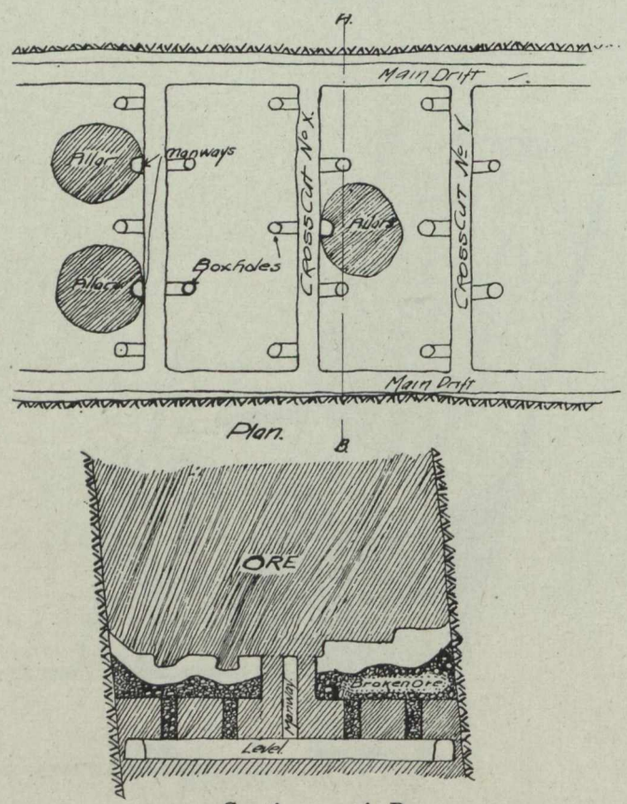
The actual stoping by this system, once the development is done, is the same as in any ordinary shrinkage stope. That is to say, back stoping proceeds in a series of rills, the broken ore supporting the walls and forming a working floor. A unique feature of this system is that the pillars, as they have raises in them serving as manways, may be drilled out as the work is driven up, the holes being plugged, and when the stope is worked out they may be shattered by blasting, and largely, if not totally, recovered. In the case of rib pillars the recovery would be less complete unless there were two or three raises; but even with a single raise a large part of the rib should be saved for, where the ground is weak enough to require rib pillars, it would probably be weak enough to break pretty completely when partly shattered and the support removed.

Taking everything into consideration we can see that this system has many advantages over the older practices. By far the most important of these is the elimination of the use of timber. Then, again, shoveling, which is always costly, is reduced more nearly than ever to a minimum. Also, there is practically no chance of a heavy crush ever closing up the haulage ways or the entrances to the stopes.

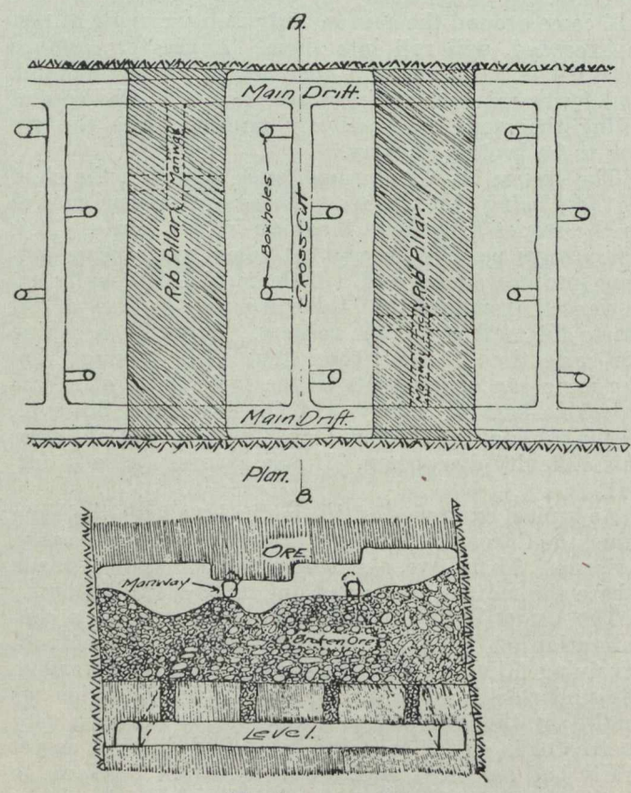
The development of a stope by this system probably requires more time than by the others if we count merely to the beginning of actual stoping operations, but when a stope is once started by this system the work should proceed without any subsequent check, whereas in the dry-wall system, for instance, although the sill floor is opened out more promptly, there is always a considerable delay while the dry-walls are being built and the chutes built in, and stoping proper cannot begin until this work is finished. On the whole, therefore, the system has all the advantages which ordinary shrinkage stoping possesses over dry-wall, with the added advantages that accrue from having no timber in the stopes.

An excellent example of this method of stoping is to be seen at the Dome mine, South Porcupine, Ont. It is also successfully used at the Frood mine, near Sudbury, Ont.

Caving.—As stated in the introductory paragraphs this system will not be considered here, as it is not strictly a stoping method, and is in general rarely suitable for as hard ores as those which have been considered above. Caving systems are, however, exceedingly cheap and satisfactory where practicable, and are very largely used not only in the soft iron ores on which they were first developed, but also in a number of the large, soft and medium copper ores in the south-western parts of the United States.



Plan and Section Showing Application of Under-Drift Method to Wide Ore Bodies



Plan and Section Showing Application of Under-Drift Method to Stopes with Rib Pillars

Comparison of the Various Systems.—In comparing the various systems of stope support that have been considered in this discussion we must remember that no two ore bodies are exactly alike in size, shape, character of walls and a dozen other features, and that, as mining is a matter of good practical engineering rather than pure science, there are therefore almost as many detailed methods of mining as there are miners. In view of this we must exclude all minor details from consideration, and we must draw out comparisons in as general a way as possible.

The rapid disappearance of the virgin forests of this continent, and the consequent advance in prices of timber has already greatly affected the mining industry, and the further inevitable rise in prices will

soon make "mining without timber" an essential feature of the economic operation of low-grade deposits.

It is probable that this matter of timber engrosses the attention of the most up-to-date mining operators more than any other single factor in their profession at the present time, and any system that can effect an economy in the use of timber, without loss of efficiency in other ways, must either now or in the comparatively near future, be given preference over the older systems that are so extravagant in their use of this once over-abundant material. In reality the whole question is one of dollars and cents; the systems that can give the greatest ultimate realization of profits are naturally the systems that will be used.

Greater temporary profits are often to be had from a wasteful or extravagant method; but they often mean lesser ultimate profits for the whole property owing to loss of ore, etc. Again, a given system, as applied to a particular mine may be very cheap to operate, but dangerous, and the cost of resulting accidents may greatly overbalance temporary gains. These are problems, however, which can only be solved by a thorough study of the individual property which one desires to develop and no more need be said of them here.

If we now compare, in a general way, the timbering and the shrinkage methods or waste filling methods, we can see that where the walls and ore are reasonably strong to resist caving, the latter methods have a decided advantage over the former in that they require so much less timber, and are practically on an equal with it in all other respects.

As to the ore pillar system, we can hardly compare it to the other systems since it requires such exceptional strength of walls and ore that it can never come into very general use.

Continuing our comparison, it is also obvious that the under-drift method is as far in advance of the shrinkage and waste filling methods as they are ahead of timbering methods, since it requires no timber at all.

The nearest approach to the under-drift method as described here that I know of in mining literature is that of the Alaska Treadwell mine, Douglas Island, Alaska. This system is very similar to the under-drift, in a general way, although it varies very considerably in detail. In comparison, we have the system that is in use at the Homestake mine, Black Hills, South Dakota. There they have done away practically altogether with timber; but without substituting the under-drift feature. Consequently they have to shovel all muck from the floor into cars. This, of course, would seem unnecessary and very undesirable.

In addition to the above consideration the elimination of timber in the mine is a big factor in preventing fires underground. Such fires have in the past proved very disastrous, but in a mine with up-to-date equipment such as reinforced concrete shaft walling and ore pockets, etc., and with steel or reinforced concrete wherever support is necessary, and virtually no timber in the stopes, there is practically no chance of fire.

Conclusion—In conclusion one may say that although Europe has for some years been forced to economize in the use of timber, we of America have not as yet seriously felt the shortage of timber supply. But that it is bound to come is a fact that cannot be questioned. Consequently it is, in the future to the timberless systems of mining that we must look as a means of recovery for low-grade ore bodies.

In conclusion the writer begs to acknowledge the assistance of Brinsmade's valuable book on "Mining Without Timber" for descriptions of the Homestake and Alaska Treadwell mines which he has not seen. He is also indebted to "Hoover's Principles of Mining" for certain ideas in his sketches and for some valuable ideas. This paper is, however, in most respects the outcome of several years personal experience of actual mining work, chiefly in central and northern Ontario.

TEXADA ISLAND, B.C.

The Geological Survey has just issued a report by Mr. R. G. McConnell on the geology and mineral and other resources of Texada Island, B.C.

The principal industries of the island are mining, lumbering and agriculture. Of these, mining at present is much the most important.

The mineral deposits of the island include important gold-copper sulphide ore bodies, numerous large masses of magnetic iron ore, and quartz veins carrying free gold. The copper deposits so far have yielded the best returns.

The Marble Bay mine, which has been continuously worked for over 14 years, and has now reached a depth of over 1,000 ft., produces about 1,200 tons a month, much of it high grade ore. The Cornell and Copper Queen have been worked by leaseholders and production has been intermittent. The known lenses have been practically exhausted, but the conditions at both mines warrant further explorations. Small shipments of copper ore have also been made from the Little Billy, Loyal Lease and from the Iron Range on the west coast.

The magnetite deposits are not being worked at present, but will probably play an important part in the future history of the island. The magnetite occurs in lenses varying in size from small bunches up to great masses several hundred feet across. The ore is high grade, the iron contents usually exceeding 60 per cent., but is seldom free from iron and copper sulphides, and much of it will require roasting before treatment. Shipments of iron ore from the iron range on the west coast were made regularly for some years to the Irondale smelter, Washington, and the product shipped to San Francisco. On the east coast a considerable quantity has been mined and used as a flux at the Vananda smelter.

Gold quartz veins are numerous, especially on the northern end of the island, and have led to a number of excitements. The veins are mostly small, and the gold contents have proved to be exceedingly pockety. Work on them is now practically abandoned.

In addition to the metallic minerals, the limestones, marbles, clays and sands of Texada island are important. The limestones at the northern end of the island, a bluish compact variety, are very pure and furnish an excellent lime. The supply is practically unlimited, and six kilns with a capacity of about 600 barrels a day have already been built. White, greyish and reddish marbleized limestone occur on various parts of the island, and marble quarries have been opened up on Sturt and Anderson bays. Work on both of these has been suspended for some years. The crystalline limestones, while usually strongly jointed and fissured on the surface, include small areas which judging from the surface exposures, are free or nearly so from these partings, and it is probable that a careful search for marble of a marketable quality would be rewarded with success. Clays and sands of glacial age occur at various points on the west coast, but so far have not been utilized or tested as to quality. A red clay bed at the base of the Cretaceous, evidently a residual deposit from the waste of the porphyrites in Pre-Cretaceous time, may possibly have some economic value.

ARISAIG-ANTIGONISH DISTRICT NOVA SCOTIA

The Geological Survey has published a memoir, No. 60, by M. Y. Williams, on the geology of a district in Nova Scotia, which is regarded as a key area for the stratigraphy of a considerable region.

The area has already been studied by many geologists.

The purposes in further examining the district and making the present report, were mainly two-fold, first, to work out in greater detail than had hitherto been done, the stratigraphic relations of the sedimentary formations to one another and by means of such relations and from palaeontologic evidence to determine more closely the age of the sediments; and second, to classify and work out the relations and ages of the intrusive and extrusive igneous rocks of the district.

The Arisaig-Antigonish district fronts on Northumberland strait and it situated about one-third of the way from Cape Breton to Pictou harbor. The area studied includes 10 miles of coast line, with Arisaig point at its centre, and extends inland southeast about 11½ miles to the Intercolonial Railway, including also the gypsum deposits south of that railway. The approximate area of the district is 115 square miles.

In many places green copper stains occur in the Mississippian formations in connection with plant remains, and some serious prospecting for copper has been done near Brierly brook. Ore is said to have been taken from one of the shafts sunk here, but only green stain of copper could be observed on the dump. So far as present indications go, there is no hope of finding workable deposits of copper in the Arisaig-Antigonish district.

An iron ore bed over 2 ft. thick on an average occurs in the Silurian strata south of Arisaig. It contains many distinctive fossils and is loose and friable at the surface, but when fresh is firm and finely oolitic. The attitude of the strata is nearly vertical. Some ore has been removed from this bed, but the prospects are now abandoned, presumably because of the low grade of the ore. The bed is in a badly faulted zone and could not be depended upon to continue unbroken for any great distance.

Near Browns Mountain post-office and in the locality of Doctors brook, oolitic hematite is apparently interbedded with the greywacke of the lower formation of the Browns mountain rocks. In the former locality the ore "beds," which are two or more in number, vary from about 5 to 20 ft. or more in thickness. The ore is evidently very siliceous. A part of the thicker "bed" is merely a grit impregnated with iron.

The ore "beds" of Doctors brook vicinity are three in number and vary from 2 to 8 ft. in average thickness. The thickest "bed" is very siliceous, but the thinner "beds" are freely oolitic, sparingly fossiliferous, and contain a fair percentage of iron (40-48 per cent). The iron ore horizon is found near the base of the upper formation of the Browns mountain group, which occupies a narrow belt to the south of the ore zone. The iron ore "leads" have been traced for about 3 miles, the ore "beds" being nearly vertical all the way. Numerous small faults intercept the ore and its thickness is variable.

From the evidence obtained, the ore is most probably sedimentary, is of lower Ordovician age, and may be directly correlated with the bedded hematites of Great Belle isle, Conception bay, Newfoundland. Small faults have been demonstrated as cutting the ore, but there appears to be no evidence of either extensive faulting or dislocation due to igneous intrusion between the East branch of Doctors brook and the west brook flowing out of the Little hollow. The ore beds are on the north side of a syncline and probably extend downwards without any serious change in attitude for several hundred feet. The faulting of the region appears to be mainly vertical, so horizontal displacements are not thought probable, but may exist. Much ore is already in sight and the main consideration is one of the grade of the ore, and expense in mining and transportation.

Oil shale has been discovered within the district in the vicinity of Pleasant valley and Marysvale. It is interbedded with the lower strata of the McAras brook formation. As the formation containing the shale lies at a low angle, the oil shale beds should not be buried to great depths. However, the thicker upper beds of shale found at Big marsh lie immediately below the basal limestone of the Ardness formation and probably have been removed entirely from the region about Pleasant valley and other localities in this district.

According to the breadth of karst, or sink-hole, topography and the general dip of the formation, the gypsum beds in the vicinity of Brierly Brook station are estimated to measure about 200 ft. in thickness. The gypsum stands as exposed cliffs 30 to 40 ft. high for more than one mile along the Intercolonial Railway near Brierly brook, and at other places similar exposures occur. The deposits are for the most part little mixed with foreign matter. However, water action has honeycombed the surface and doubtless much sand and gravel have fallen into the openings. Large quantities of gypsum are situated close to the railway inviting exploitation, and as soon as there is a sufficient demand for this material these deposits will be extensively worked.

Old lime kilns and lime quarries exist at a number of places along the limestone horizon north of the Intercolonial Railway. The quality of the lime formerly burned here is said to have been good. The workable limestone is probably not more than 20 feet thick, but the strata dip at low angles and much stone could be taken out by following along the strike of the bed.

Water worn gravel suitable for road metal and concrete work may be obtained from accumulations in the beds of the streams.

Although silver has been prospected for, none of any account has been obtained, and there are no indications of the presence of silver ores in the district.

Veins of calcite or quartz are not common and the chances are small for finding workable ores of any of the finer metals.

METALLURGICAL SMOKE

With the idea of bringing about a better understanding between the metallurgical industry and agriculture as to the troublesome smoke problem at smelting and ore-roasting plants, the United States Bureau of Mines has just issued Bulletin 84, "Metallurgical Smoke," by Charles H. Fulton, consulting metallurgist.

Metallurgical smoke causes considerable friction between the metallurgical industry and agriculture in certain districts. Owners of smelting plants are making every effort to devise ways and means to do away with possible damage and annoyance from smoke and are meeting with success. The problem is peculiarly difficult in the United States because of the large tonnages of material that must be handled. The solution

of the problem is not yet at hand and much work still remains to be done. As the mineral industry is one of the great basic industries of the country and of necessity is entitled to full consideration, it should be accorded freedom to work out the smoke problem to the benefit of all concerned. The effort is made in this paper to present the problem of metallurgical smoke as it actually exists, without bias of any kind.

The author says, "Sometimes, in discussions of the smelter-smoke question by interested parties, gross misstatements of fact are made. Thus, the agriculturist sees bad effects from smelter smoke which other people cannot find, and the metallurgist sometimes goes so far as to claim that smelter smoke is beneficial to vegetation, and even to assume that the damaging constituent of smelter smoke is sulphur trioxide only, giving rise to sulphuric acid, and to ignore entirely the sulphur dioxide content. It is evident that nothing is to be gained by a policy of this kind, and the solution of the problem lies in its study by disinterested commissions, such as the one recently appointed by an agreement between the Department of Justice and the attorneys of the Anaconda company to study the smoke question in Montana in its relation to the forest reserves.

"It is interesting to review the general situation in the United States. Much of the trouble is in the Western States, and chiefly in Montana, Utah and California. In those States very large tonnages of sulphide ores are smelted with the production of great volumes of smelter smoke, comparatively rich in sulphur dioxide and other injurious constituents. A number of the smelters have been in operation for many years and have experienced difficulties only comparatively recently.

"It is well known that mining and metallurgy are often the advance agents of civilization and the pioneers in establishing industrial centers. In many localities the mines and the smelters supplied by them were essentially the only locators within great stretches of territory. Around them grew communities and cities dependent upon them for a livelihood. Agriculture was of relatively small importance. But conditions changed with the increasing population of the country and the closer settlement of the West and coincident with this increase an agricultural industry has grown which, in the vicinity of the smelting plants, naturally suffers in some degree from smoke. Still, the area damaged is comparatively small and even this damage can be much lessened by the adoption of proper means. Since some plants have installed devices to remove sulphuric acid from the smelter smoke and have the smoke diluted with air, conditions have been much ameliorated in certain districts.

"The damage that smoke can do depends largely on climatic conditions, especially the relative humidity of the atmosphere. The damage is much greater in regions having a moist than in those having a dry climate. In this respect such States as Montana, Utah and Arizona are favorably located and smelters in those States can probably discharge gases richer in sulphur dioxide, without doing damage, than can those in regions having a moister climate. For the same reason, the damage done at different seasons of the year varies. The moist atmosphere and the rains of spring and early summer conduce to increased damage to vegetation, particularly as at that time of the year the early crops and young vegetation are susceptible to serious injury.

"It has been customary to discharge the smelter smoke by means of very tall chimneys, on the assumption that if the noxious gases are discharged at considerable height they will have opportunity to diffuse more thoroughly and thus become so diluted as to be comparatively harmless, but the efficiency of this method is now being questioned. There is reason to believe that the use of high stacks increases the area to damage, whereas low stacks may intensify the damage but concentrate it within a smaller area. Probably high chimneys do not serve their purpose as well as was anticipated, and at present the better method may be to dilute the smelter smoke and discharge it from a number of low stacks."

Copies of Bulletin 84 may be obtained by addressing the Director of the United States Bureau of Mines, Washington, D. C.

THE UNIVERSITY OF TORONTO AND THE WAR.

Though the military organizations of the Canadian Colleges were in a much more rudimentary condition than those of the British Universities, a large contribution has already been made to the army for the present war from their graduates and undergraduates.

The following is an account of what has been done by the University of Toronto:

First Contingent—Officers—Lt.-Col. C H. Mitchell, B.A.Sc., member of the Board of Governors; Lt.-Col. R. D. Rudolf, Professor of Therapeutics; Lt.-Col. W. A. Scott, Associate in Surgery; Major P. Goldsmith, Demonstrator in Oto-Laryngology; Captain G. R. Philp, Demonstrator in Anatomy; Captain P. K. Menzies, Assistant in Clinical Surgery; Captain G. A. Cline, Instructor in University Schools; Captain C. E. Cole, Demonstrator in Therapeutics; Dr. B. E. Clutterbuck, Assistant in Gynaecology; Dr. A. J. Mackenzie, Demonstrator in Medicine, and Mr. E. Owen, Lecturer in German.

According to our most recent information there are, besides the members of the staff, 134 graduates and 86 undergraduates, and of these 137 are officers and 83 privates. The chief electrician and several of the laboratory assistants are also on service, and their places are being kept for them. Professor de Champ, and Messrs. Balbaud and Bibet of the Department of French in University College have been serving with the French army since the beginning of the war.

Second Contingent—Officers—Lt.-Col. Fotheringham, Associate-Professor of Clinical Medicine, is Chief Medical Officer. Other members of the staff who have been giving their time in preparing for its mobilization are: Captain J. A. Amyot, Professor of Hygiene; Lt.-Col. J. A. Roberts, Demonstrator in Clinical Surgery; Lt. G. B. Strathy, Demonstrator in Clinical Medicine; Lieut. Bruce Robertson, Assistant in Pathology.

At present our information is quite incomplete, but we have the names of 53 graduates and 63 undergraduates who have been accepted for service in the second contingent.

At the opening of the session the Caput, Senate and the Faculty Councils passed regulations to provide that standing should be granted to those who by reason of enlisting had been unable to take their September supplementals; also, that those who had enlisted or who would do so, should be shown the utmost consideration at the end of the session that the University's duty to the public in maintaining professional standards will allow.

It was further decided to discontinue all teaching and laboratory work after four o'clock in the afternoon in order to enable students to take the courses of drill

and instruction required by the regulations of the Officers' Training Corps.

In view of the probable establishment of an Officers' Training Corps in the University, a score of junior members of the staff began about September 15th to take drill and instruction to qualify themselves to become officers in the new corps. About October 20th authorization was received from the Militia Department. Dr. W. R. Lang, Professor of Chemistry, who with the concurrence of the Board of Governors had volunteered for active service but was appointed instructor for this Military Division, was made Colonel of the new corps. Messrs. C. S. McVicar, A. D. Le Pan, G. N. Bramfitt, C. H. C. Wright, R. H. Hopkins, G. H. Needler, F. C. A. Jeanneret, L. Gilchrist, M. W. Wallace, G. O. Smith, C. N. Cochrane, C. V. Massey, G. M. Smith, E. J. Kylie, G. S. Brett, E. S. Ryerson, A. F. Coventry, G. Gallie, W. F. McPhedran, R. G. Armour, D. Graham, C. R. Young, D. G. Hagarty, A. M. Thomas, A. W. McConnell, W. M. Treadgold, B. M. Morris, H. H. Madill, J. R. Cockburn, J. R. Mitchener, V. E. Henderson, H. R. Hopkins, A. R. Leggo, W. S. Wallace, H. G. Manning, all except three being members of the staff, have been appointed officers. The students enrolled enthusiastically, and though the strength authorized as yet is only 1,000, over 1,800 have been taking drill.

On Friday, January 22, 1,500 students with their officers were reviewed by His Royal Highness the Duke of Connaught. He addressed them in part as follows: "I wish to express to you my very great satisfaction with the splendid turnout you have given me this evening. When I looked at you and saw how you stood to attention and the admirable way in which you marched past, I saw that your work since you were formed, a very few months ago, has been performed with a will, and I can honestly say that I have never seen better results than you have shown me to-day.

"What pleases me still more is the splendid example you young gentlemen are showing to the whole of Canada. You have come forward at a moment when every man that is able to do anything to help the Empire in a time of stress is needed, and you have done so readily and in a most efficient manner.

"As an old soldier and as Governor-General of Canada, I wish to say that no parade that I have seen—and I have seen many lately—has given me more satisfaction than your parade this evening."

PHYSICAL PROPERTIES OF COBALT.

The Mines Branch has published the results of further researches on cobalt by Dr. H. T. Kalmus and assistants.

An extended investigation of the metal cobalt, and its alloys, for the purpose of increasing its industrial and economic importance, has been, and is being conducted at the School of Mining, Queen's University, Kingston, Ont., for the Mines Branch of the Department of Mines, Ottawa.

The bulletin just published, "Physical Properties of the Metal Cobalt," has been written by H. T. Kalmus and C. Harper, and is a report on a large number of measurements made at the University laboratories, of some of the important physical and mechanical properties of metallic cobalt. The properties which have been particularly studied are: Density, hardness, melting point, tensile breaking strength, tensile yield point, compressive breaking strength, compressive yield point, rolling and turning properties, electrical resistance, magnetic permeability and specific heat.

NEW YORK MEETING A. I. M. E.

A well attended meeting of the American Institute of Mining Engineers was held in New York at the Engineering Societies building, Feb. 15, 16 and 17. A large number of interesting papers were presented, and some of them provoked lively discussion.

The Monday morning session was chiefly devoted to questions of safety and sanitation. Papers were presented by F. H. Kneeland, H. N. Eavenson, S. Le Fevre and J. Parke Channing.

On Monday afternoon two sections met in separate rooms. One section heard and discussed papers on non-metallic minerals, while the other section devoted its attention to iron and steel.

At the Tuesday morning session a great variety of papers were presented. The subject arousing most interest at this session was the geology of the Butte mining district. The discussion arose from a very interesting account presented by Paul Billingsley of the structural relations at Butte. Owing to the author not being present an interesting paper on metallurgical practice at Porcupine was read by title only and not discussed. This paper is to be presented at the Toronto meeting of the Canadian Mining Institute this week, and will probably be discussed there.

The Tuesday afternoon session was devoted to fuels. Oils and oil well drilling were the chief subjects of discussion. A very interesting exhibition of oils converted into a substance closely resembling crude oils was given. By subjecting ordinary oils, such as kerosene, benzine, etc., to a high pressure in a vessel 3-11 full, a dark colored oil was obtained in every case.

The banquet was held Tuesday evening at the Hotel Astor, and was as usual well attended and a great success.

The Wednesday morning session was chiefly notable for the papers and discussion on the recent advances in copper smelting practice. The large part played in the development of reverberatory furnaces by David H. Browne, J. L. Agnew and others at Copper Cliff received due recognition. Mr. E. P. Mathewson presented L. V. Bender's paper on the practice at Anaconda and supplemented it by much useful information.

At the Wednesday afternoon session one of the most interesting papers was that presented by B. F. Tillson, of the New Jersey Zinc Co., on the "Testing and application of hammer drills." Two papers on mining methods were read by title only and there was consequently little discussion on them.

On Thursday there was an excursion to the Catskill aqueduct and new subway to inspect some of the construction work in progress.

A LARGE MASS OF COPPER.

Houghton.—During 24 hours Trimountain mine, Michigan, hoisted 18 pieces of mass copper averaging a ton each, and 30 tons of mass is now on surface for shipment. All of this has been cut from the large mass discovered early in 1913 at the 25th level.

This mass has been followed from above the 25th level to the 27th, and Superintendent Richard Bowden says the end is not yet in sight. He is certain operations will continue to uncover it for the succeeding year. The immense sheet of solid copper is in the foot wall and not considered as truly a part of the vein matter, but the operation of mining it is comparatively simple. The mass is cut into sections, each weighing about a ton. It is continuous, and varies in thickness from less than an inch to eight inches.

THE TESTING AND APPLICATION OF HAMMER DRILLS*

By Benjamin F. Tillson.

(Continued from Last Issue.)

Perhaps the consideration of the physical phenomena relating to the process of drilling may prove of interest and value.

When rock is excavated by a drill bit three applications of forces seem to be involved—by abrasion, by crushing and by severing or chipping. Although all of these must take place to a certain degree, the greatest amount of useful work is performed when the percentage of force applied to chip reaches a maximum. But in rock it appears that chips can be produced in radically different ways, first, by the severing of molecules, and second, by the reflex forces produced in an elastic medium. To illustrate this, consider the chipping of a comparatively inelastic substance such as lead. With a hammer and chisel, whose axis is inclined considerably from the normal to the surface of a lead block, it is possible to sever the lead and roll up chips, but if the chisel is normal to the surface of a thick block only an indentation can be made and there probably will be a raised area about the indentation to accommodate a certain percentage of the displaced metal. On the other hand, with a highly elastic material, such as glass, the forces impressed by a normally positioned chisel will cause a compression of the molecules, whose elasticity will cause their expansion toward a free, unresisted surface. Since the greatest forces are developed at the surface, since the penetration of the chisel carries some forces to a depth below the surface; and since the chisel surface itself applies some forces at an angle to its axis and impedes the re-expansion of molecules to the space it occupies, therefore, the reflex forces produce more or less cone-shaped chips or flakes and leave a corresponding crater in the block of glass. Now, if the chisel is placed near the edge of a block of glass, the blow upon it will induce stresses to another free face and a correspondingly larger chip will be produced because of the tendency of the forces to seek relief in the shortest direction as well as because of the severing effect. The method of cutting of a drill bit is commonly shown as taking place in this last way with the progressive chipping of a series of benches or steps, but it is doubtful whether such a procedure exists, except in rare instances, for the speed and latitude of rotation between consecutive blows of the drill piston or hammer cannot be controlled with sufficient precision nor adjusted to the various rocks; and an inspection of the cuttings from a drill hole shows them to be flakes, or a crushed and abraded powder.

In the formation of these flaky chips there may be a limiting force of blow for each velocity of impression in order to gain the most useful work (i.e., in the production of flakes), for it appears that beyond certain limits the blows increase the percentage of crushed material and the drilling speed does not vary with the force applied, so that some heavy hitting drills accomplish more in medium-soft ground when a portion of their blows are absorbed by a tappet at the shank end of the steel or by a cushion of water intervening between the bit and the rock. If the force of the blows was lessened by a reduction in air pressure the speed of the piston would be slowed up, and the drilling would suffer from the fewer number of blows per minute.

The transmission of the kinetic energy of the piston to the rock is also influenced by many factors. The blow may be delivered against the rock by the free drill steel which is driven forward through the intervening air or water by the impact of the piston and the velocity of the steel will depend upon the relative masses of the drill steel and piston, the velocity of the piston, and the coefficient of elasticity of the steel, in accordance with the well-known laws of mechanics which deal with elastic or partly elastic bodies and their impact. The drill steel in this way assumes the functions of a "jumper" drill which is driven against and rebounds from the rock at a high frequency, and its action is well seen in most all screw-feed hammer drills with the ringing or jingling of the steel in a drill hole. Another mode of force transmission is by compressional waves, traveling through the drill steel from the shank to the bit. This latter condition brings a cutting effect only when one end of the steel is tight against the rock, but then proves very efficient. Although the air-feed hammer drills usually chatter the steel against the rock, like a projectile shot from the chuck bushing by impacts of the piston, yet it seems possible to approximate the other working condition by designing the air feed so that the pressure is lowered as the piston is traveling on its back stroke (possibly by taking the supply air, for the back stroke, from the air feed) and so that the air feed pressure builds up and forces the drill against the rock just before it is struck by the piston. The reversed air feed may sometimes approximate these conditions and then assist the machine to a higher drilling speed. If hammer drills were made so that the drill steels were always held firmly against the rock, when the piston strikes them, it seems unquestionable that the greatest efficiency of the blows of the piston would result, providing they were properly timed, for no energy would be lost by reason of the inertia of the drill steel, but only that due to heating, resulting from the imperfect elasticity of the metal. The question of the proper timing of the piston blows opens another phase of the matter, namely, the reaction of the rock upon the drill steel; and this effect is the more pronounced with harder rock. It tends to speed up the piston and is so noticeable in running a machine against a metal block as to invalidate, as too high, all air-consumption tests so conducted. The effect of these reactive vibrations upon the drill steel may prove very marked and serious. Where the reactive vibrations interfere with oncoming compressional waves, considerable energy is dissipated, and at times one may be so fortunate as to detect points of increased temperature (probable nodes) upon a drill steel which is cutting ground; and it is no uncommon thing to see a drill steel, in service, break at two points (into three pieces) simultaneously, probably from fatigue because of those vibratory stresses. On the other hand, if these vibrations synchronize at the bit it is quite possible that the chipping forces are greatly augmented, and such an explanation may readily answer those puzzling drill tests in which a dull or broken bit exceeds a finely formed bit in drilling speed. For a long time at Franklin a tally was kept of the different individual drill steels which entered into the testing, with the hope of determining that some particular piece of steel produced the greatest cutting speed, but no con-

*Extract from a paper presented at the New York meeting of the American Institute of Mining Engineers, March, 1915.

clusion could be drawn from the records, except that the changes in length due to resharpening probably masked any possibility of determining the suitable lengths for maximum efficiency. And it seems quite plausible that such a result should be expected if the possible wave lengths of the compressional vibrations in the drill steels are considered. Probably these reactive vibrations occur to a great extent, as well, in the process of drilling, where the steel dances in the chuck and against the rock, for steel breakage appears equally as high, if not higher, with such a type of machine as with the pneumatic feed, and tests comparing these two types for such effects might prove very interesting as well as instructive.

But still other factors influence the force delivered at the rock. If the anvil block or tappet is not in contact with the drill when the piston strikes, a considerable energy loss occurs through the transference of momentum to several pieces. If the steel is bound in the chuck bushing, a great amount of the energy is absorbed by the friction. If the steel is not straight, it loses energy because of the flexure. If the chuck is badly worn, the axis of the steel does not coincide with that of the drill and there is a loss due to the oblique, eccentric impact. If the steel is tight in the drill hole, or if the friction against the side of the hole is great because of its depth, the velocity of the steel, as a projected body, is lessened and the drilling speed is reduced.

The length of the drill steel is an item generally credited as an important influence, and common opinion supports the idea that the cutting speed falls as the length of the steel increases, although some people, on the contrary, feel sure that the long steels drill the fastest. The tests conducted at Franklin do not lend an unqualified support to either view, for the peculiarities of different types of machines play so important a part. For example, if the air feed is very strong in a stoping drill the additional counteracting weight of a long and heavy steel may so improve the working conditions as to indicate a superiority for the long steel, and if the air feed is weak, the reverse may be true; if the drill steel cuts by virtue of a dancing or "jumper" action, the mass added with length may so reduce its velocity against the rock as to bring it below the amount required for efficient chipping; if the piston normally delivers too heavy a blow for the rock, the drilling speed may be improved by the added inertia of the long steel; and if the steel is always against the rock when a blow is delivered, it is doubtful whether the length of the steel plays an important part unless the permitted decrease in the gauge of the drill bits aids the cutting speeds. It is, of course, to be understood that the above considerations of drill steel lengths refer to the performances with bit gauges of the same diameter.

The use of an anvil block is considered by some drill designers to necessitate a loss of from 20 to 30 per cent. of the power of a drill; but actual tests do not always indicate such a condition when the identical steel is tested in the same drill with and without a tappet. The results probably depend upon how frequently the tappet is struck when away from the shank of the steel, and also upon the suitability of the machine to the rock, for if its blows are too heavy the intervention of a loose tappet might reduce their force, with a benefit in drilling speed. The use of water at the bottom of the hole ordinarily consumes about 10 per cent. of the cutting speed if there is no tendency for the drill bits to lose their temper, and compressed air for cleaning the holes encourages a greater drilling speed, providing the cushion of water in the bottom of the hole does not have a benign influence in reducing too powerful a blow upon the rock.

The manner in which a drill is rotated has a bearing upon the amount of work accomplished, and with hand rotated tools, a vigorous rotation with a rapid and wide arc of swing produces the best results; with power-rotated drills it is possible to reach such a speed as to abrade and dull the drill bits, and consequently lessen the drilling speed. It seemed that, with a positive and constant rotation, the axial planes of the cutting edges of the drill bits should be at the same angle with the cut surface as the resultant velocity vector, as estimated for the rotative and striking velocities; and such a bit was tried at Franklin without showing a change in cutting speed, probably because with either bit the chips came out in flakes, as previously described.

Kinetic energy of a blow.—In view of the fact that the subject of hammer drills is more or less in its infancy and literature in regard to them is rather limited, it seems desirable to correct at the earliest opportunity any typographical or other errors which, if accepted without investigation, might work to the detriment of the art of drilling. In this connection it seems that some statements should be corrected in the 1910 edition of Eustace M. Weston's book, Rock Drills, in the chapter Philosophy of Process of Drilling rock, under the sub-heading of hammer drills. In considering the kinetic energy of a blow he states, on p. 139:

"In other words, to double the energy of a blow it would be necessary to double the mass, or weight, if the velocity is the same; but to double the energy, keeping the mass the same, the velocity must be increased four times. The weight of the piston hammer of the largest type of drill is 15 lb. The weight of piston, steel, etc., of a piston drill varies from 60 to 125 lb., so that a blow of equal force can be delivered by a hammer drill only by increasing the velocity of the hammer very greatly. This is acknowledged, for as one hammer-drill maker states, the weight of the piston is one-fourth that of a piston drill; but the velocity is four times as great. To give a blow equal in power it should be sixteen times as great."

A mathemetical error appears to have been made in the premises of Mr. Weston's argument and his consequent deductions as to the practical impossibility of hammer drills being able to compete with piston drills are quite logical, but probably at fault.

If the kinetic energy of a body, such as a drill piston, is designated by K, its velocity by V, and its mass by M, then,

$$K = \tfrac{1}{2}MV^2 \text{ and } K_1 = \tfrac{1}{2}M_1V_1^2.$$

Now if M_1^2 equals M and K_1 is, say, twice the value K, then

$$V_1^2 = 2V^2 \text{ and } V_1 = V\sqrt{2}$$

therefore,

$$V_1 = 1.414V$$

So the velocity of the piston in a hammer drill need be only 1.4 times as great as that when the kinetic energy of the piston is cut in half.

Piston weights.—Again, in the example comparing the piston weights of piston and hammer drills, Mr. Weston appears in error in stating that the velocity should be 16 times as great, for if the piston of a hammer drill is one-fourth the weight of that of the piston drill the velocity of the hammer drill piston need be only twice as great as that of the piston drill in order to deliver blows of the same energy; and the hammer drill will also surpass the piston drill since it will strike twice as many of such blows per minute. The necessity of using high air pressures in hammer drills is only incident to the peculiarity of certain drill designs and is not dependent upon the divorcing of the piston from the steel. If we are to consider the shock upon the parts of two drills of equal

capacity it is evident that with the shorter piston strokes in hammer drills, with the increased number of blows, whose final striking velocity is equal to that of a piston drill under comparison, the weight of the hammer drill piston may be less and the energy in each individual blow may be less in order that the same amount of energy per minute be developed. Therefore, the shocks upon hammer-drill parts are more frequent but not as heavy as the shocks upon piston drills of equal capacity.

Maintenance of drills.—It is extremely difficult to get adequate figures as to the maintenance of drills unless some special forms are kept, which become to all intents a ledger account of each individual drill, for questions naturally arise as to the cost per foot of hole drilled, the length of time the machine has been in service and has been running, the number of holes drilled, the kind of rock encountered and the supply of steel used, as well as the drill parts replaced. The New Jersey Zinc Co. uses a system of punched slips for shift bosses' reports and "drill record" slips are a part of the scheme. These are punched in duplicate by the shift boss and filed at the mine office and main office, where the information is transferred to large sheets, of which each one accommodates the record of one machine for a month, and the footings are carried forward so as to indicate the total work accomplished and maintenance of any machine "to date." The repair parts are designated as to whether they are new or old (second-hand) ones, and original and subsequent drilling-test records are noted on the same summary sheet.

On the record slip and sheet, the location of drills are by top-slice co-ordinates, the class of work (whether raising, drifting, stoping, block-holing or drilling chutes) is indicated, the kind of rock (ore, limestone, gneiss, pegmatite, garnet or feldspar) is punched, and if the machine is idle, broken or being cleaned those points are recorded.

Improvements in drilling methods.—The compressed air rock drill made revolutionary changes in mining methods and in the reduction of mining costs in units of labor per ton of ore, and at Franklin even more marked savings have been made through the development of hammer drills. There, in the days of hand drilling, a total of 8 ft. in three drill holes with varying diameters of 1¾ to 1¼ in. was considered a fair 10 hour shift's work, and possibly 8 tons of ore would be broken per drill shift or 4 tons per man shift. With 3 in. reciprocating rock drills from 20 to 40 ft. of drill holes, ranging in diameter from 2½ to 1½ in., would be the average work for a 10 hour shift, although on rare occasions some men might drill as much as 80 or 90 ft. of holes in a shift, and possibly 20 tons of ore would be broken per shift, or 10 tons per man shift, since two men were needed on a drill. It seems that as a rule a greater tonnage per foot of hole was obtained with hand drilling because of the fact that, rather than dismount and reset heavy drill columns, machine men would tend to place as many holes as possible from one set-up, therefore many holes were placed disadvantageously for breaking efficiency. Another cause, which would contribute to the same results, would be the difficulty of starting holes with piston drills on uneven sloping faces, so that holes were frequently deflected from the direction in which they were supposed to be placed. These figures would lead to the rough estimate that 2½ times as much tonnage per drilling man shift was accomplished by piston drills as by hand drilling.

With hammer drills 80 to 100 ft. of 1¾ to 1¼ in. drill holes are placed by one man in a 10 hour shift, about 150 to 200 tons of ore will be broken per drill shift and the same amount per drilling man shift, or 15 to 20 times the amount broken per man with reciprocating drills. Of course the entire credit for such increase in tonnage cannot be given to the type of drill, for improved organization, system of working, and supervision have undoubtedly played an important part; but the greater mobility and flexibility of the light hammer drills have permitted and encouraged a more efficient placing of drill holes; have cut in half the labor necessary to run a drill; and permitted a more effective supervision and mining scheme. The actual tonnage broken per man working in a stope will not be so high, comparatively, since it has been found worth while to place additional men in stopes to sledge and block-hole large chunks of ore, which were formerly often allowed to become buried and proved obstacles to high trimming efficiency by blocking chutes through which the shrinkage stopes were drawn into tram cars.

Table II. shows the gains which have been made with the adoption of hammer drills by the New Jersey Zinc Co. It is to be regretted that no records of tonnage and labor were available for earlier years, so as to cover the average efficiencies before the advent of hammer drills and back to the days of hand drilling. The different divisions of mining work are classified in this table as drifting, raising, stoping and open cut or quarry, and it may be interesting to summarize the important features, reducing the labor to an hourly basis, inasmuch as a change was made from a 10 hour to an 8 hour shift basis in July, 1913.

Drifting.—There have been no radical changes in the placing of the drill holes in drifts since the adoption of the air feed hammer drill for this work, but one

Date	Drifting											
Year	Footage Advance	Drill Shifts per Foot Advance	Type of Drills, Per Cent.		Per Cent. Size of Powder, 50 Per Cent. Strength		No. Caps per Foot	Powder in Sticks per		Explos. Cost per Ft. Advance	Runners and Helpers per Foot Advance
			H. D.	P.	1¼ in.	1 in.		Foot Advance	Drill Shifts		
1908[a]	494	1.45	.....	....	.....	.....	.....	36.4	25.2	.....	.....
1909	4,890	1.31	.....	....	.....	.....	.....	32.7	25.0	.....	.....
1910	4,909	0.74	.....	99.2	73	27	5.43	31.1	42.5	$1.84	1.84
1911	2,814	0.63	.....	99.2	96	4	4.95	26.5	41.9	$1.59	1.71
1912	374	0.44	100	....	11	89	7.40	36.4	89.6	$1.61	0.84
1913	905	0.33	100	....	.....	100	5.56	34.6	106.0	$1.40	0.59

[a] Last 4 months.

Date	Raising										
Year	Footage Advance	Drill Shifts per Foot Advance	Type of Drills, Per Cent.		Per Cent. Size of Powder, 50 Per Cent. Strength		No. Caps per Foot	Powder in Sticks per		Explos. Cost per Ft. Advance	Runners and Helpers per Foot Advance
			H. D.	P.	1¼ in.	1 in.		Foot Advance	Drill Shifts		
1908	715	1.18	.....	...	.....	.....	.....	27.7	23.4	.....	.....
1909	5,446	0.90	.....	...	.....	.....	.....	29.3	32.4	.....	.....
1910	4,257	0.44	97.0	...	16	84	5.11	27.4	62.7	$1.54	0.78
1911	1,865	0.23	98.5	...	8	92	4.38	21.5	92.5	$1.04	0.65
1912	1,311	0.17	100.0	...	2	98	3.46	20.1	115.0	$0.93	0.48
1913	2,306	0.20	100.0	...	1	99	3.94	21.4	106.2	$1.03	0.58

Date	Stoping (active)												
Year	Net Tons Ore Broken	Type of Drills, Per Cent.			Net Tons Broken, Excl. Idle Drills, per Drill Shift	Per Cent. Size of Powder, 50 Per Cent. Strength		No. Caps per Foot	Powder in Sticks per		Explos. Cost per Net Ton Broken	Net Tons Broken per Man in Stope	Remarks
		B. H.	H. D.	P.		1¼ in.	1 in.		Net Ton	Drill Excl. B. H. Shift			
1908	57,000[b]	....	.....	....	23.4	....	.....	.....	0.76	17.7 19.3	.....	....	
1909	361,000	7.0	24.5	68.5	20.5	....	.....	.....	1.01	20.7	.....	.....	
1910	337,000	12.7	62.3	25.0	38.1	16	84	0.310	1.025	39.0	$0.055	13.2	
1911	386,000	30.1	55.8	14.1	121.0	11	89	0.356	0.77	95.8	$0.041	20.3	
1912	427,000	35.5	62.0	2.5	195.0	6	94	0.415	0.86	108.3	$0.045	25.6	
1913	494,330	30.3	69.7	....	170.0	2	98	0.420	0.89	233.0	$0.049	26.7	

[b] Two months, estimated.

Table II.—Annual Comparisons of Mining Efficiencies with Piston and Hammer Drills.

man with a single machine is now placed in a heading; he is instructed to "pull" a "round" each 8 hour shift, stopping overtime if necessary, and to accomplish an advance of 3½ to 4 ft. per round. Two men operating a reciprocating rock drill formerly made an advance of a 5 to 6 ft. round in five 10 hour shifts. So the drilling labor (runners and helpers) per ft. of advance averages 18.4 hours for the entire mine during the year 1910, when reciprocating rock drills were solely in use. As shown by the average for 1913, hammer drills have reduced this figure to 5.7 hours per ft. of advance, or about one-third the former labor of drilling and blasting. The explosive costs have also been reduced by the use of hammer drills from the figure of $1.84 per foot of drift during 1910 to $1.40 per ft. in 1913, for two probable reasons.

First, hammer drills permit the placing of the drill holes smaller in diameter than those bored by reciprocating drills, so that an unnecessary amount of explosive is not required merely to fill the holes sufficiently to distribute the force of the explosion.

Second, the flexibility and ease of rigging the light hammer drills permit and encourage a more efficient placing of drill holes. The almost exclusive use of 1 by 8 in. explosive cartridges now, as contrasted with the 1⅛ by 8 in. cartridges formerly used, demonstrates the first contention, for in terms of 1 in. powder, the equivalent of 36.8 sticks per ft. of drift was used in 1910, and 34.6 sticks per ft. in 1913. The drill shifts per ft. of advance have been lowered from 0.44 in 1910 to 0.20 in 1913, and the corresponding drill hours from 4.4 to 1.8.

The different drifts may vary in size from 6 by 7 ft. to 8 by 11 ft. in section, and perhaps 7 by 8 ft. is an average section. Because of the compact, tough nature of the ground, it requires from 20 to 30 drill holes in a round, and 24 would be a fair average, so the drilling operation is an important factor of the drifting costs. The following comparison of the average drifting costs for each year shows the saving which has been possible because of hammer drills; but only the cost of drilling labor and explosives is considered. The record drift in 1913 was driven for $2.06 per ft.

	1910.	1911.	1912.	1913.
Drifting cost per ft.	$5.33	$4.92	$3.35	$2.70

Raising.—In 1908, using 2¼ in. piston reciprocating rock drills, 0.7 ft. of 6 by 6 ft. raise per 10 hour drill shift was made with a labor expense of 28.5 man hours per ft. of raise. About 27 ft. of drill holes were placed per shift, 24 holes were placed in a round, and 16 lb. of explosives were used per foot of raise advance, at a cost of $2.70 per ft. for supplies. Since labor was then paid $2 and $1.55 per 10 hour shift, the total cost of raising was approximately $7.50 per ft. of advance.

During the same year, 1908, hammer drills were introduced, and an advance of about 1.5 ft. per drill shift was made with a labor expense of 13.3 man hours per ft. of advance. About 50 ft. of drill holes were placed per shift, 24 holes per 5 ft. round, and 10 lb. of explosives were used per ft. of advance, at a cost of $1.75 per ft. for supplies and a total cost of $4.10 per ft. of raise, or only 55 per cent. of the cost with the reciprocating rock drills.

The development of hammer drills with increased drilling speed permitted the reduction of the drilling labor to 7.8 hours per ft. of raise advance, and the explosives cost to $1.54 per ft. of raising done in the year 1910; and a further reduction to 4.8 hours of drilling labor during 1912, and an explosive cost of $0.93 per ft., although the wages were $2.20 and $1.70 per 10 hour shift. These costs rose slightly in 1913, since wages rose to $2.25 and $1.85 for 10 hour shifts, and in July of the same year the working hours were lessened from 10 to 8 and the hourly wage was increased to $0.281 and $0.231. However, the cost per foot was then only 5.2 hours of drilling labor and $1.03 per ft. for explosives. About 18 drill holes are now placed to pull a 5 ft. round and two men are expected to blast a round each 8 hour shift and are each paid 11 hours' time for performing the task.

The average raising costs for operating labor and explosives have been as follows:

	1910.	1911.	1912.	1913.
Raising cost per ft.	$2.95	$2.31	$1.88	$2.22

The record raise (of about 50 ft. in length) for 1913 had a cost of $1.65 per ft., and the record long raise (about 100 ft. long) had a cost of $2.09 per ft., with explosive costs, respectively, of $0.77 and $0.99 per ft. of raise.

Stoping.—In 1909, when about 74 per cent. of those drills placing holes in the solid orebody were of the reciprocating type of 3-in. piston diameter, the ore production averaged about 20 net tons of ore broken from the solid per 10 hour drill shift, with an equivalent of 1.1 sticks of 1 by 8 in. of 50 per cent. dynamite per ton of ore.

In 1910, when about 72 per cent. of the producing drills were air feed stoping (hammer) drills, the tonnage per drill shift rose to 38 net tons with about the same amount of explosive (which cost $0.055 per net ton of ore broken), and 13.2 tons were broken per 10 hour shift of men working in stopes, or 1.32 tons per hour. Although there is no record of the breaking labor prior to this year, the fact remains that in the actual running of the drills only one man was used with a hammer drill while two men were employed with each reciprocating drill.

In 1911, when the hammer drills were about 80 per cent. of the total, the stoping efficiency profited by the improvements in the drilling speed of the hammer drills, and 121 net tons were broken from the solid per drill shift with about 0.8 stick of 50 per cent. 1 by 8 in. dynamite per ton (at an explosive cost of $0.041 per ton), and 2.03 net tons were broken per man hour of men working in stopes.

In 1912, when about 98 per cent. of the stoping drills were hammer drills, 195 net tons were broken per drill shift with about 0.87 stick of 50 per cent. 1 by 8 in. dynamite per ton (at an explosive cost of $0.045 per ton), and at the rate of 2.56 net tons per man hour in the stopes.

In 1913, when all the stoping drills were hammer drills, the length of the working shift was reduced from 10 to 8 hours in the middle of the year and the tonnage broken per drill shift fell proportionately to 170 net tons, but remained at approximately the same hourly rating as for the year 1912. However, the tonnage broken per man shift in the stopes increased slightly to 26.7 net tons, at an explosive cost of $0.049 per ton, with the consumption of 0.89 stick of 50 per cent. 1 by 8 in. dynamite per ton. The tonnage broken per man hour was 2.97, which showed a steady gain over previous years.

It should be noted that the explosives charged against stoping include those used by the trammers in blasting ore in the chutes, and thus represent all the dynamite necessary to reduce the ore to the proper size for being handled through chutes and in the mill.

Opencut.—In order to provide broken rock for filling material to fill empty stopes to support the remaining orebody, "mill-holes" are developed in limestone

country rock at the surface. For some years it was the practice to use 30 ft. bench-holes in the opencut for quarrying the rock, both 3 in. and 3½ in. reciprocating rock drills being used. It took steady work for two men to sink one 30 ft. hole in a 10 hour shift, and their work was hazardous because of the inconvenient localities where set-ups were made, and because of the clumsy weight of their machines and the long, heavy drill steels which were handled. After the success of hammer drills in the underground mining operations, they were tried in the opencut work in 1912. Small holes were drilled to an average depth of 16 ft., and were given lighter burdens than had previously been the practice, for the object was to distribute the dynamite more evenly in the rock, as contrasted to churn drill or mammoth blasts. In the tough, crystalline Franklin limestone this application of hammer drills to quarrying has proved superior to the heavy or mammoth blasts, for the same tonnage can be produced from a bench with a saving of labor and powder, since a great amount of expensive blockholing is avoided. A machine will drill about 100 ft. of holes in a shift with a heavy hammer drill and two men can drill only 30 ft. with a rock drill.

TAR SANDS OF ALBERTA

The existence of deposits of bituminous sands in the McMurray district of Nothern Alberta has been known for many years. The absence of transportation facilities has, however, prevented the utilization and even the prospecting of these deposits.

Anticipating the building of the Alberta and Great Waterways Railway into Northern Alberta, a preliminary examination of the deposits was undertaken by the Dominion Mines Branch in 1913 and continued in 1914. Meanwhile, the construction of the railway, which will open up and render these deposits available, is being rushed, and its completion is expected in 1916.

The investigation revealed the fact that the tonnage of bituminous sands in the McMurray area is very large, and, although much of the material is low grade and in some cases the overburden so heavy that mining by open-cut is impracticable, it is found that some 20 per cent. of the material, representing many millions of tons, may be considered as of commercial value.

Bituminous sands have for a number of years been used in the construction of various classes of pavements in the United States. The extent to which the material has been used appears to have been largely determined by the freight rates. The greater portion of the bituminous sand used at the present time in California for paving purposes comes from the Santa Cruz quarries, and is, in many respects, similar to the Alberta material. The bitumen contained in the McMurray rock is, however, much softer. It is believed that, with proper manipulation, such as heating, and the addition of hardening flux, the penetration of the bitumen can be reduced to meet the requirements of standard specifications for its successful employment in the laying of pavements in substitution of imported asphalt.

In view of the fact that the bitumen contained in the tar sands of Alberta is softer than the bitumen of the California material, arrangements have been made by the Mines Branch for the laying of an experimental pavement in the city of Edmonton with the Alberta material, the city government having agreed to construct the concrete foundation. Upward of sixty tons of suitable material has been assembled for transportation to Edmonton, and it is expected that the pavement will be laid next summer.

The City Commissioner states that: "If this work is successfully carried out it will be of greater value to the city of Edmonton and Alberta generally than the bringing in of half a dozen industries. . . . at the present time, we are absolutely suffering for the lack of cheap pavement and for the lack of good road material, whereby the farmers may haul their products to the city on well built roads. The solution of this problem will be worth millions of dollars. . . . ."

At present, all asphaltic paving materials used in Canada are imported from foreign countries. In 1913-1914 the value of these imports reached a total of nearly $900,000 and the consumption is rapidly increasing. The value of a cheap and satisfactory paving material in Western Canada would be very great.

The bituminous sands may also serve as a source of pure bitumen, which may be extracted either by disulphide of carbon, the lighter petroleum distillates, or by the use of hot water and steam. Among the many uses to which this extracted bitumen may be applied may be mentioned floorings for many classes of buildings—such as mills, hospitals, schools, skating rinks—for foundations which require to absorb vibration and jars, as in electric power plants, for lining and damp courses for cellars, reservoirs, etc., for insulation of pipes, and as a source of asphaltic oils.

Attempts in this direction have been made for the past twenty years in the United States. No industry however, has been established and no extracting plant is now in operation. The cause for the failures is not far to seek. In California extracted bitumen, at $12 per ton, cannot compete with petroleum residuum at $6.50 to $9.00 per ton. In Alberta, however, bitumen extracted at $12 would compete with imported refined asphalt, costing $27 to $34 per ton, delivered.

Before such an industry, however, is attempted, all available information of the results of many years' serious and often costly experimentation in the United States should be consulted.—Dr. Haanel, at the Annual Meeting of the Commission of Conservation.

GRANBY.

According to reports from Boston two more furnaces of the Grand Forks smelter have been blown in by Granby Consolidated, making six sections of that plant now in operation. Within another month the two idle furnaces will also have been blown in, thereby placing the entire battery of eight in commission.

The Hidden Creek smelter continues to operate two of its three furnaces; but the capacity of that plant will be increased fully 25 per cent. by the erection of a fourth furnace, orders for which have already been placed. This will permit of the steady operation of three furnaces at Anyox, leaving a fourth furnace in reserve.

Through lack of sufficient water at Hidden Creek, Granby has lately been shipping matte from that property to the Grand Forks smelter for conversion into blister copper. As the company secured an "in transit" rate of but 25 cents a ton for the transportation of this material it was considered a good step to take.

By July next Granby should be in position to treat 2,500 tons of ore daily at Hidden Creek, in addition to a normal quota of ore at the Grand Forks plant. From current operations the company is understood to be earning in excess of $100,000 a month.

SHIPMENTS FROM COBALT.

According to the Cobalt Nugget shipments of ore and bullion for the week ending Feb. 19 were far below the average, only one small bullion shipment and three cars of ore appearing on the weekly list.

Chambers-Ferland made its first appearance of the year with a car of concentrates shipped to Newark, N.J. The concentrates ran about 700 oz. to the ton and was the first shipment made since early November of last year. The concentrates for the low grade treated at the Northern Customs mill has been stored owing to conditions, but it is likely that more shipments will be made shortly. The Temiskaming sent out a car of high grade, containing ore mined from the new discovery made from the 530 ft. level of the Beaver workings. A car of high grade from the Townsite-City completed the week's list.

The bullion shipments have been lower during the past few weeks, due principally to the annual clean-up at the Nipissing high grade mill. The big mine has not made a bullion shipment in three weeks, but the mill is now in readiness to be in operation within a few days. The shortage of power also assisted to keep the bullion shipments below normal. O'Brien's 23 bar consignment was the only bullion to leave the camp in the week.

The ore shipments, in lbs., were:

Chambers-Ferland	79,980
Temiskaming	87,345
Mining Corp. of Canada—	
Townsite City	77,044

PULVERIZERS.

The Jeffrey Manufacturing Company, of Columbus, Ohio, have recently issued a new 48 page bulletin, No. 147, illustrating and describing the prominent features of their complete line of swing hammer pulverizers, giving full information regarding capacities, speeds, horse power, general dimensions, etc. More than 1,000 of these machines are now in daily operation reducing limestone, shale, gypsum, clay, coal, coke, ores, tankage, bark, oyster shells, rock for road top dressing and many other materials. A free copy of this bulletin may be obtained by writing to their home office.

ANTIMONY DEPOSITS AT LAKE GEORGE, YORK COUNTY, NEW BRUNSWICK.

According to the Fredericton Board of Trade a valuable and extensive deposit of sulphide of antimony was discovered in 1863 in York County, N.B., 24 miles from Fredericton. Between 1870 and 1885 at least three companies operated, and for the most part very successfully. From 1909 to 1910 a company operated one of these mines, and expended a considerable sum in modern equipment, buildings and machinery, which are kept in good condition. This company was obliged to close down owing to the price then prevailing for antimony in its marketable condition, and the long distance haul to the then nearest railway shipping point, 13 miles. Since then the St. John and Quebec Railway has been built, and is now regularly operated by the Intercolonial Railway as a part of that system. The distance to the latter railway is now only three miles, with a down grade all the way.

This metal is used as an alloy for making babbitt metal, Britannia metal, music plates, machinery bearings (for high speed), bells, projectiles, enamelling, manufacture of glass, paints, vulcanizing rubber, and for hardening bullets and shot.

At the present time the price is more than double what it was when the work closed down in 1910. With the greatly improved shipping facilities, the opportunity for reviving this industry is most favorable.

As this metal is comparatively rare, there would be in ordinary times a market for all that could be produced.

M. C. M. MEN IN NEW YORK.

During the recent meeting of the American Institute of Mining Engineers in New York, Michigan College of Mines men gathered at the Engineers' Club for luncheon, and swaped stories and experiences. There were present: Wm. Kelly, Dr. F. W. McNair, Dr. A. C. Lane, W. E. Parnell, F. F. Sharpless, Louis Wright, C. V. Drew, W. L. Cumings, Ed. Russell, C. B. Dunster, F. W. O'Neil, B. B. Hood, A. E. May, J. S. Dunstan, Clarence Boyle, F. J. Hollis, J. M. Longyear, Jr., F. B. Burrall, Wm. G. Schneidler, Leo F. Arnold, M. S. Walker, W. E. Segsworth, W. Judson, Scott Turner, G. Rizo Patron, W. Baggaley, R. M. White, Ernest Klepetko and R. E. Hore.

Mr. Scott Turner, who is general manager of the Arctic Coal Co., gave an interesting account of the development of the company's coal mines in Spitzbergen. Under very severe conditions Mr. J. M. Longyear and his associates have developed, in what was formerly a desolate region and uninhabited even by Eskimos, a successful enterprise.

Mr. W. L. Cumings, of the Bethlehem Steel Co., gave an account of visits to mines in South American countries, from which he has recently returned.

It was decided to form an eastern Alumni Club and arrange to hold luncheons regularly in New York.

GERMANY'S INVASIONS.

The Wall Street Journal says:

That seventh and latest threatened invasion of England, directly or through her maritime commerce, by submarine attack, must now be put into execution or classed with the six preceding threats.

It is worth while to recall what those threats were, particularly in view of their virtually negligible military value:

First—The British Empire, being held together by imperial power, must break up as a result of war with united and homogeneous Germany. India, South Africa, Egypt and Ireland were to fight England for their freedom at this heaven-sent opportunity; while Canada was to annex herself to the United States, and Australia would seize the chance to declare her independence.

Second—England's commerce would be invaded, and largely destroyed, by the roving warships of Germany.

Third—The English navy would be worn down by piecemeal destruction, called "attrition," until the German fleet could safely give battle to what was left of it.

Fourth—A fleet of Zeppelins would invade England, attacking her coast defences, and laying waste her greatest cities.

Fifth—On the taking of Dunkirk and Calais, new Krupp guns, mounted on the Continental coast, would shell the opposite English shore, making a special Krupp invasion of England.

Sixth—A fleet of transports was forming for the land invasion of England by the German army.

The war has now progressed more than six months without any material development from these threats. Is it to be taken that the threat department of the German general staff in the Wilhelm Strasse is a specimen of the wonderful efficiency of the great war machine?

HANDING DOWN

By Harold Begbie, in London Chronicle.

Soldier what are you writing
By the side of your cooling gun?
Sir, since I'm stopped from fighting,
A word to my little son.

Tell me the thing you've written,
For I love the writer's art;
Sir, that to be a Briton
Is worth a broken heart.

Show me so fine a letter
That you write in trench's mud;
Sir, you could read it better
Were it not for the stain of blood.

Soldier, tell me your story—
Your eyes grow bright and wide;
Sir, it's a taste of glory
To think of the young one's pride!

Would you like to be a soldier, little Tommy-all-my-own,
Would you like to tip the Kaiser off his high and mighty throne,
Would you like to be with father in a well-dug trench,
Knocking spots off German generals and saluting General French?

Would I like to be with Tommy, little Tommy-all-my-own,
Would I give a month of Sundays just to see how he has grown?
Yes! I'd like to be a dustman in the poorest London streets
For the chance of seeing Tommy with a gumboil made of sweets.

If you want to be where I am, then I want to be with you,
But I'm here to show a tyrant that a Briton's word is true;
We must stand by little Belgium, we must fight till fighting ends,
We must show the foes of Britain that we don't desert our friends.

Don't you go and think my Tommy, little Tommy-all-my-own,
That we're squabbling here for nothing, that we're growling for a bone;
We are here for Britain's honor, for our freedom, for our peace,
And we're also here, my Tommy, that these wicked wars may cease.

Don't you say that I am funky, don't you say that I am sick,
Boy, I'm half afraid to tell you, but I love it when it's thick—
When the shells come screaming, bursting and whistling bullets wail;
God forgive me, but I love it, and I fight with tooth and nail.

But it's after—looking round us, missing friends, and finding dead,
It is then the British soldier gets a fancy in his head;
And he swears by God in heaven that the man who starts a war
Should go swimming into judgment down a cataract of gore.

That's what makes us such great fighters, and I'd have you be the same;
Love your country like a good 'un, hold your head up, play the game.
Be a straight and pleasant neighbor, be a cool, unruffled man,
But when bullies want a thrashing, why you thrash 'em all you can.

While you say your prayers, my Tommy, little Tommy-all-my-own,
Asking God to save your daddy, I send this one to His Throne:—
Save my little lad from slaughter, guard his heart and mind from wrong,
Keep him sweet and kind and gentle, yes, but make him awful strong.

Good night, my little Tommy, here's your daddy's good-bye kiss,
Don't forget what I have told you, and remember also this—
If I don't come back to see you I shall die without a groan,
For it's great to fall for freedom, little Tommy-all-my-own.

CORRESPONDENCE

INDUSTRIAL ACCIDENTS.

To the Editor of the Canadian Mining Journal:

Sir,—A contributor, "D," to your February issue, page 75, referring to the matter of accident prevention, remarks: "While no statistics of the accidents occurring throughout Canada are avaiable," etc. In some senses, no doubt, there is ground for the view expressed by your contributor, who may not have been, however, aware of the extent to which information on this subject is gathered and compiled by the Department of Labor for publication monthly in the Labor Gazette and annually in a carefully compiled statement printed in the annual departmental report, as well as in the Labor Gazette. The facilities and authorities of the department do not perhaps permit the record to be exhaustive, but the report furnished contains a large amount of what is believed to be pertinent and valuable information on industrial accidents. The department receives regularly from the various branches of the different Provincial Governments, also from different Dominion authorities collecting statistics of a particular class, reports based on returns collected by these officials, and, by extensive correspondence and a careful and comprehensive clipping system, collects particulars also of a large number of accidents in occupations not under official regulation. In this way information was gathered during the calendar year 1913 concerning 1,500 fatal and 7,195 non-fatal accidents.

Yours, etc.,

F. A. ACLAND,
Deputy Minister of Labor.

Ottawa, Feb. 11, 1915.

PERSONAL AND GENERAL

Mr. F. H. Shepherd, M.P. for Nanaimo, Vancouver Island, B.C., has been appointed chairman of the Mining Committee of the House of Commons, Ottawa.

Mr. Frederic Keffer, of Greenwood, Boundary district of British Columbia, is now practising as a consulting mining engineer on his own account after having been with the British Columbia Copper Co. ever since its inception in the spring of 1898.

Mr. Robert Johnston, for eight years chief electrician for the Crow's Nest Pass Coal Co. at its Coal Creek colliery, and who also has had charge of the company's mine-rescue apparatus at Coal Creek, near Fernie, has gone to England on an extended trip.

Mr. O. E. S. Whiteside, of Coleman, Alberta, general manager for the International Coal and Coke Co., was in Nelson, B.C., on February 9 on his way to Spokane, Washington.

Mr. Lorne A. Campbell, general manager for the West Kootenay Power and Light Co., who represents Rossland constituency in the Legislative Assembly of British Columbia, has been appointed chairman of the mining standing committee of that body.

Mr. T. J. Vaughan-Rhys, for several years connected with mining in the Portland Canal district of British Columbia, is now developing a mine situated near Rocher Deboule mountain, a few miles from New Hazelton, in the Skeena district of that province.

Mr. C. P. Hill, of Montreal, Quebec, vice-president of the Pacific Coast Coal Mines, Ltd., operating coal mines on Vancouver Island, B.C., is at Victoria, looking into the situation brought about by the recent disastrous flooding of the company's South Wellington coal mine, situated four or five miles from Nanaimo, V.I.

Mr. John L. Retallack, of Kaslo, B.C., for many years actively associated with mining in Ainsworth and Slocan divisions, has been appointed quartermaster of the British Columbia division of the Third Canadian Contingent, and is now with the troops in training at Victoria, B.C.

Mr. George O'Brien, instructor in training at the Provincial Government mine-rescue station at Fernie, Crow's Nest Pass, B.C., has been gazetted a district inspector of mines in British Columbia, a vacancy in the inspection staff having been caused by the death of the late Mr. Evan Evans at the Coal Creek mines on January 2.

Mr. A. Gordon French, metallurgical chemist, who in 1911 claimed to have found platinum in commercial quantities in dikes on mineral claims near Nelson, B.C., and who also about that time was engaged in conducting a series of experiments in Nelson with the object of separating and saving zinc occurring in conjunction with silver-lead and iron in ores from Slocan district of British Columbia, left Kootenay on Feb. 11 for Boston en route to Glasgow, Scotland.

Mr. Howard W. DuBois, of Philadelphia, Pa., managing director of the Quesnelle Hydraulic Gold Mining Co., which in recent years expended about $1,000,000 on an important water supply system to provide for extensive hydraulicking operations on its placer-gold leases in Quesnel mining division of Cariboo district, British Columbia, spent a week or two in Victoria last month on business connected with the mining interests he represents. Last year Mr. DuBois was occupied in Alaska, where his principals have other mining interests.

The second Canadian and International Good Roads Convention and Exhibition will be held at Convocation Hall, University of Toronto, March 22 to 26, 1915.

Of the Toronto members of the American Institute of Mining Engineers there were present at the New York meeting last week, J. B. Tyrrell, W. E. Segsworth, J. M. Clark and R. E. Hore.

Mr. Wakely A. Williams, of Anyox, Observatory Inlet, B.C., smeltery superintendent for the Granby Consolidated M. S. and P. Co., went to New York last month to there meet the directors of the company with the general manager, Mr. F. M. Sylvester, of Vancouver, B.C.

The Provincial Mineralogist for British Columbia has prepared the customary "Preliminary Review and Estimate of Mineral Production," for 1914, which the Bureau of Mines of that Province issues early in each year, giving brief information of the progress and production of the mining industry several months in advance of publication of the larger "Annual Report of the Minister of Mines for British Columbia."

Prof. Arthur Lakes, of Denver, Colorado, who for some months has been living with his son, Mr. Arthur Lakes, Jr., manager of the Ymir-Wilcox gold mine, near Ymir, Nelson mining division of British Columbia, has arranged to give a series of at least four lectures at Nelson under the auspices of the local Y. M. C. A. His subject will be, says the Daily News, "The Discovery of Fossil Monsters in Western America." The date of the first lecture was fixed for February 4.

Several weeks ago Mr. J. W. D. Moodie, vice-president and general manager of the Britannia Mining and Smelting Co., Ltd., operating the Britannia copper mine and concentrating plant near Howe sound, Vancouver mining division, British Columbia, sustained a severe loss in the death of his wife, after only a brief illness. Mrs. Moodie's body was taken to southern California, where her immediate relations reside, for interment there. It was accompanied by the bereaved husband and family of young children. Afterward Mr. Moodie went to New York City, where the Howe Sound Copper Co., which controls the Britannia Co., has its headquarters. He was expected to return to Britannia Beach, B.C., early in February.

Mr. S. S. Fowler, general manager for the New Canadian Metal Co., operating the Bluebell lead mine and concentrating mill at Riondel, Kootenay lake, B.C., was in Vancouver recently; he left that city on Feb. 17 for Ontario with the object of attending the annual meeting of the Canadian Branch of the St. John Ambulance Association as one of two delegates from British Columbia, and the seventeenth annual meeting of the Canadian Mining Institute at Toronto as the official representative of the Western Branch of the Institute, of which branch he is chairman for the year.

Two more western mining men have lately been bereaved by the death of their respective wives. These are Mr. Melbourne Bailey, manager of the John Hopp placer gold mines near Barkerville, Cariboo district of British Columbia, and Mr. J. H. McMillan, manager of Nos. 5 and 6 mines, Comox colliery, Cumberland, Vancouver Island, B.C. Mrs. McMillan was the granddaughter of the first white settler in Comox valley—Mr. Adam McKelvie—who went there in August, 1862.

Mr. D. G. Small, of Porcupine, was in Toronto last week.

The Council of the Canadian Mining Institute has recommended that Sir Richard McBride, Premier and Minister of Mines of British Columbia; Hon. G. Howard Ferguson, Minister of Mines of Ontario; and Hon. H. Mercier, Minister of Mines of Quebec, be elected honorary members of the Institute.

Mr. J. B. Tyrrell has returned to Toronto from New York, where he presented a paper on the Beauce gold deposits, Quebec, at the annual meeting of the American Institute of Mining Engineers.

Mr. R. E. Hore has returned to Toronto from New York.

On January 30, the Rossland Miner published a paragraph stating that "Mr. James Cronin, the well-known mining man of the early Kootenays, is reported to have suffered a paralytic stroke at Spokane." Happily the report was incorrect, for late in January Mr. Cronin reached Victoria fit and well, having just returned south after a field season spent developing lode-mining property in the Babine region of Omineca mining division, and on February 2 he was still in the capital city of British Columbia as hearty and energetic as ever.

Mr. A. Fournier, as he was known during the several years he was managing a mining company for French shareholders having a silver-lead mine and concentrating mill on the South Fork of Kaslo creek, in Ainsworth mining division, British Columbia, but Captain Fournier when he rejoined his regiment in France after the outbreak of the war, has been taken prisoner by the Germans. After his return to France he was made a commandant and was soon at the front. Madame Fournier, who also returned to France, was informed by the French military authorities that her husband had been killed in action; but just after she had arranged for masses to be said for the repose of his soul, she received a telegram from him informing her that he and his son were prisoners and that their captors were treating them kindly.

The Jeffrey Manufacturing Company has issued a bulletin illustrating and describing belt conveyor equipments, and another bulletin describing malleable and steel elevator buckets.

HILLCREST CO.'S COMPENSATION LIABILITY.

A press despatch from Lethbridge, Alberta, is as follows: "Under the Alberta Workmen's Compensation Act the Hillcrest Collieries will pay over to the dependents of the miners who lost their lives in the Hillcrest coal mine, in southwest Alberta, on June 19 last, approximately $250,000.

"The agreement between the company and the representatives of the United Mine Workers of America provides for payment of the full amount of compensation, namely, $1.800, to the dependents of 57 deceased miners, and it is the opinion of the officials of the union that the number will be brought up to 90.

"Thirty-two of the deceased men were Austrians. Their rights have been acknowledged by the company, but no compensation will be paid their dependents who reside in Austria until peace has been declared between Austria and Great Britain."

It may be pointed out that there is a discrepancy in the figures above quoted, for even if payment be made in the larger number estimated, namely 90, a total of only $162,000 will thus be accounted for.

COAL MINE DISASTER IN BRITISH COLUMBIA.

A serious and fatal disaster occurred at the South Wellington colliery of the Pacific Coast Coal Mines, Ltd., situated within five miles of Nanaimo, Vancouver Island, British Columbia, on the morning of Feb. 9, when the company's Fiddick mine was flooded, it is thought, by breaking into old mine workings of an adjacent property that had not been worked for twenty years or more. So far as known 19 men were drowned, including Joseph Foy, the mine manager, who was overwhelmed by a cave caused by the incoming water when he was endeavoring to rescue some of those known to be farther in the mine.

Until the mine shall have been unwatered so that an examination may be made, the exact cause of the disaster can only be surmised. What is known, however, is that after a blast had been fired there was a sudden rush of water, which in a short time filled the lower workings of the Fiddick mine. Mr. John H. Tonkin, of Victoria, president and general manager of the company, has been quoted in district newspapers as having stated that the company's mine maps made it appear that the Fiddick workings were not within hundreds of feet of the old Alexandra mine workings, abandoned years ago, after the mine had been operated by the Vancouver Coal Co., which also owned the No. 1 Shaft and other mines about Nanaimo prior to sale to the Western Fuel Co. He said, further, that every precaution had been taken to allow plenty of barrier space between the Fiddick workings and the parts shown on a registered map to have been worked when the Alexandra mine was in operation. According to the Fiddick mine map, there had been left a solid wall of 100 ft. of coal between the part where the flooding occurred and the boundary of the Alexandra property. The Provincial Government district mine inspector promptly took charge of the mine, and several big electrically operated pumps are now being used to free the mine from water, but it may take a couple of months to do this.

The official report for 1914 on this property is not yet available, but the published report of the district inspector for 1913 showed that in that year there were 302 men and 15 boys employed underground during the six months of that year the Fiddick colliery was operated. These figures do not take into account the months May to October, inclusive, when the miners were on strike.

The company has a newly opened mine, known as the Morden Shaft, situated about a mile away from the Fiddick mine, so that its output operations will not be entirely stopped, but there are not enough coal faces open in the new mine to allow of so many men being worked in it as have been employed in the older property.

LALLY GOLD MINES.

At the annual meeting of the shareholders of the Lally Gold Mines Company at the Windsor hotel, Montreal, the board and officers were elected as follows: President, G. H. Benson; vice-president, H. M. Levine; directors, W. L. Murray, R. H. Brand, W. Snow, J. Thurston Smith, M. L. Rose; secretary, John W. Evans; treasurer, M. Donnelly.

CALUMET AND HECLA.

The directors of Calumet and Hecla have declared a dividend of $5 per share. With the payment of this dividend stockholders will have received $124,750,000 in dividends since the formation of the company.

SPECIAL CORRESPONDENCE

PORCUPINE, SWASTIKA AND KIRKLAND LAKE

Power at Porcupine.—The scanty rainfall which has proved so serious a factor in entailing shortage of power and the closing down of mines in the Cobalt section has not caused any inconvenience in the Porcupine camp yet. As a matter of fact there was much more rainfall in the Mattagami basin above the height of land than to the south, and the two plants of the Northern Canada Power Company at Sandy Falls and Waiwaiten have not been so adversely affected. At the same time the power company thought the situation sufficiently serious to notify many of the mines that they might be obliged to cut off half the power at the beginning of March, and many mines have been storing coal for the possible emergency. The mild weather has made a slight change for the better; but while it thaws in the daytime it freezes at night, and very little moisture finds its way to the watercourses. It is quite possible that many companies may have to have recourse to their boilers before the spring thaw finally comes. As there was power trouble in Porcupine last year most of the companies are quite prepared for the change; but it will raise costs, necessarily.

McIntyre.—Very satisfactory to the management of the McIntyre is the underground development at the mine within the past month. The No. 5 vein across Pearl lake is showing up splendidly. At the 400 ft. level a diamond drill hole had already indicated that there was a good grade of ore and the management was therefore able to find the vein easily. When first discovered it showed 3 ft. of ore much above the average grade of the McIntyre. Now it has widened right across the face of the drift and drill holes put into the walls show that there is enrichment for 15 ft. of an average grade of $9. At the same time the level has been cut at No. 4 shaft at the 600 ft. level. Here there was a surprise in cutting a good body of ore in the station. It is 4½ ft. wide of a lower grade. It is the policy of the management to open up new levels with all possible speed. The shaft on No. 5 vein will be continued down to the 500 ft. level, and No. 4 will be put down again directly the drift is well under way at the 600 ft. Operating costs are showing a satisfactory falling off. Last month they were $4.77 a ton on a 150 ton basis, charging all costs against actual production. The milling costs are now below a dollar. The nature of the orebodies at the McIntyre makes a lot of dead work necessary and the mining costs are therefore still a very large proportion of the whole.

Vipond.—An addition is to be made to the Vipond mill whereby the capacity will be increased materially. The plant is now running very smoothly and a good extraction is being made.

Underground at the 300 and the 200 ft. levels the developments on the Davidson vein have been far better than could have been anticipated. The grade at the 300 ft. level is far higher than at the 200 ft. and the width is well maintained at the 200 ft. level, some very good ore is being stoped. This is all the more satisfactory, owing to the fact that when work was resumed the drift on the Davidson vein showed results not at all pleasing to the company. But this lean spot has now been traversed and the ore is quite spectacular.

Hollinger.—At the 800 ft. level of the Hollinger the lean patch in the main vein, which has always to be drilled through before the average grade is reached, has been traversed. The Hollinger always sinks a winze before making connection with the main shaft, and this winze is always in lean ore. But the drift at the 800 ft. level now shows in the face 4 ft. of ore of a character which could not be distinguished from that on the first level. As the tonnage of the mill is increased more and more, ore from minor veins can be included as profitable ore. These smaller veins are of lower grade than those that have furnished the bulk of the ore to date. It is this inclusion of smaller and less valuable orebodies that is gradually lowering the Hollinger average grade, rather than any falling off in gold values in the veins originally worked.

It is considered probable that the Hollinger and Acme will have 100 stamps falling early in March. Sixty of these will be dropping on Hollinger ore and 40 on Acme. It was at first intended that 80 should be on Hollinger and the 20 on Acme; but the demands of the Acme have so grown on development that it was deemed advisable to increase the earning from that privately owned property at once. The Hollinger mill can be speeded up to 900 tons a day without much difficulty, and for the immediate present this is considered enough.

Dome.—Measurement of ore reserves at the Dome mine by means of diamond drilling has been definitely abandoned, owing to the difficulty in obtaining vertical holes. Instead drill holes are being bored at intervals of 15 ft. from crosscuts that are being opened up from the main levels and a revaluation of the mine being made by this means. Costs are still showing a satisfactory decrease and tonnage a good increase. There is no immediate likelihood of a further extension of the mill.

Dome Lake.—An average of 90 tons a day is being milled at the Dome Lake, and an extraction of about 80 per cent. obtained. Good results have been obtained by handpicking on the bumping table, and on the belt in reducing the percentage of waste milled.

A rich shoot of ore has been opened up on the No. 3 vein at the 400 ft. level in the east drift. Across 16 in. the gold contents are very satisfactory. But veins are erratic in width and exceedingly difficult to follow, so that a large amount of exploration work is necessitated.

At the annual meeting of the company it was shown that the Dome Lake Mining Company owed the Hudson Bay company $79,000.

There has been some discussion as to the advisability of cyaniding the ore; but it was finally decided to endeavor to increase the capacity of the present mill rather than to raise the extraction by resorting to the chemical process of treatment.

Jupiter.—The Jupiter shaft has been allowed to fill up. It will be remembered that for some time after the McKinley-Darragh relinquished its option the old company kept the mine pumped out. But the cost was material and the mine has been allowed to fill up for the present.

COBALT AND SOUTH LORRAIN

Milling difficulties.—The mills are closing down in rotation, but not quite as to schedule. The soft weather has made no material difference to the situation, for although it thaws in the day it freezes at night.

The Northern customs mill and the Dominion Reduction have resumed operations, and as they are treating La Rose, Chambers-Ferland, Kerr Lake, Crown Reserve, Drummond Fraction and Caribou Cobalt ore there is activity in these properties as usual. The Cobalt Lake mill has also resumed after a two weeks' shut down. The Cobalt Reduction mill, serving the Townsite and the City of Cobalt, was closed down for a week. The high grade mill at the Nipissing has been closed down for the annual clean up, but the low grade mill has not ceased operations at all as yet. Water is so low in Sasaginaga lake that there is danger to the Buffalo, Coniagas and Northern Customs mill from this quarter.

The Trethewey mine has been closed down after running continuously for almost ten years. The immediate cause is the shortage of power. It was required that the mill should be closed down for a month, and the company has been running along on so narrow a margin of profit for the past four or five months that it was decided to cut down overhead expenses while the property was idle by discharging the staff and not reopening until the price of silver improved. There is still a considerable quantity of low grade ore in sight in the mine.

Right of Way.—It is reported that the Right of Way Mining Company will reopen the mine at Cobalt shortly if air can be obtained. The same holds good of the Shamrock, Mr. A. M. Bilsky being successful in raising money for the purpose of further exploration of the old prospect.

It is remarkable that since the Workmen's Compensation Act came into force there has not been one serious or fatal accident in the Northern Ontario mines. Some minor accidents have occurred and already the commission has been set some difficult problems to solve.

Prospecting.—As a preliminary to the discussion on the problem of keeping the prospector in the country, Mr. B. Neilly, president of the Cobalt branch of the Canadian Mining Institute, appeared before the Cobalt Board of Trade recently. He stated that whereas there were three thousand prospectors in the bush two or three years ago, he had it on the best authority that there were not more than 300 now. He appealed to the Cobalt Board of Trade to co-operate with the Canadian Mining Institute to get the law changed so that there would be more inducement for the prospector to stay in the bush and hunt for the precious metals.

Nipissing.—Nipissing has stopped work at the No. 64 shaft until such time as there is more power available. Before stopping work the company cut the station at the 1,000 ft. level.

BRITISH COLUMBIA

Renewed activity.—With the approach of spring preparations are being made for extending mining activity in several of the lode mining districts of the province. While no considerable enlargement of operations is being arranged for at any individual mine, a resumption of work at a number of properties indicates general endeavor toward progress. It is yet too early for much preliminary work to be done in the placer-gold fields. Where, though it is practicable to work to advantage even before the melting of the winter's snow, as in the case where underground work in lode mines can be effectively undertaken without much additional cost, some men are being employed on various properties that had been idle during a longer or shorter previous period. Among the parts thus affording evidence of renewing activity are Ainsworth, Slocan, Rossland, Boundary and Ashcroft division of Yale district. It may be that in each individual instance the number of additional men given employment is small, but taken together an appreciably large number is the encouraging result.

East Kootenay.

Metalliferous mines.—The only mine in Fort Steele division that during January and the early part of February shipped ore to the smeltery at Trail was the Consolidated Co.'s Sullivan property neary Marysville. For six weeks ended February 11, the average quantity received at the smelting works from this mine was 607 tons a week. At the St. Eugene, also owned by the Consolidated Co., ore shipment was suspended early in September; it is expected, though, that the prospecting work done latterly in this mine will result in other ore shoots being found.

Coal mines.—There is little that is new to chronicle relative to coal mining in the Crowsnest district. The demand for coke is being favorably affected by the increasing requirements of the Granby Consolidated Co., which has blown in more copper furnaces at Grand Forks, and railway coal requirements are stated to be larger, so these have also in a measure improved the local situation. The Crow's Nest Pass Coal Co. is operating mines at two of its collieries, namely, Coal Creek and Michel, and coke ovens at Fernie and Michel, but is not working full time at either colliery. The Corbin Coal and Coke Co. is also sending out coal and is looking for an improvement in the demand for this fuel.

West Kootenay.

Ainsworth.—Small shipments of ore have been made to Trail recently by four mines in this division, namely, the Charleston, J. L. Retallack & Co.'s Whitewater group and Utica, all in the western part of the division, and the Early Bird, on the western shore of Kootenay lake. A few men have been put to work at the No. 1 mine, at which operations had been suspended for a while; other properties within a few miles of the town of Ainsworth, on which development has been continued, are the Silver Hoard, Florence Silver Mining Co.'s Hope group, Olive A. group, and Gallagher. It is probable that the Consolidated Co., which also owns the No. 1, will shortly resume operations at its Banker-Maestro and Highland properties, all of which are within easy reach of a shipping wharf at Ainsworth.

Slocan.—Production has not yet been resumed to any considerable extent from mines in Slocan division, mine owners generally thinking it better to wait for the restoration of terms and conditions that will leave them more profit than they would be likely to receive under those in force last Autumn. Negotiations have been in progress with the object of securing the removal of a charge additional to rates previously paid, to which several of the silver-lead ore shippers have objected. It is stated that there is a probability of a satisfactory understanding being arrived at shortly. Meanwhile the higher price now obtainable for spelter is influencing mine owners having concentrating mills

available for operation in connection with their mines, and it is expected that if the advance in market price of that metal be maintained, the mining and milling of lead-zinc ore will be again undertaken at full capacity.

Slocan mines that have made shipments this year are comparatively few. Receipts of ore and concentrate at Trail from this division to February 12 were as follows: From Rambler-Cariboo 378 tons, Hewitt (Silverton Mines, Ltd.),, 64 tons, Idaho-Alamo 58 tons, Reco 32 tons, Mercury 17 tons; total 489 tons.

Shipments of zinc concentrates from Slocan mines to United States smelting works in January were, according to the Nelson Daily News, as follows: Surprise 600 tons, Rambler-Cariboo 88 tons and Hewitt (Silverton Mines, Ltd.) 119 tons. The Utica shipped 42 tons of zinc ore. The Slocan Record, New Denver, reports that 23 cars of concentrates from Surprise ore have been shipped from the Ivanhoe mill at Sandon to Newark, New Jersey.

Around Sandon development is being continued at a number of mines, among them the Payne, Ruth-Hope, Slocan Star, Noble Five group, and several others. Of the numerous properties tributary to Slocan lake towns the Standard, near Silverton, is the most notable; while no production is being made pending an adjustment of smeltery charges, development work of considerable importance is being done in this mine, and the quantity of ore available for extraction is now large, other shoots than those from which ore was being stoped when production was discontinued having been opened as progress has been made toward their development.

Nelson.—There is little change to note in mining conditions in the parts of Nelson division to which access is obtained from the west arm of Kootenay lake. To the southward, though, within a few miles of Salmo and in Sheep Creek camp, operations are being continued at a number of properties, four or five of which are productive. Lead ore has this year been shipped to Trail from Salmo from three neighboring mines, as follows: From the H.B. 326 tons, Emerald 270 tons, and Leadville 63 tons; the Queen mine has shipped 109 tons of gold concentrate and the Hope 40 tons of ore. Three other gold mines, namely, the Relief in Erie camp, the Dundee at Ymir and the Granite near Nelson, have each shipped a carload. Total receipts at Trail of ore and concentrate from Nelson division to February 12 is 863 tons.

Granite is being shipped from Three-mile Point, near the town of Nelson, to Cardston, south-western Alberta, for use in the erection of a temple for a Mormon community resident in that district. It is stated that between 350 and 400 railway carloads will be required for the structure, and it is expected that this will all be supplied from the neighborhood of Nelson.

Rossland.—Production is being continued on a comparatively large scale from Rossland mines, the output of which has exceeded an average of 7,000 tons a week during the six expired weeks for which figures are available. The total of 42,189 tons received at Trail does not include milling ore put through the Le Roi No. 2 Co.'s concentrator. The proportions of the several mines are as follows: Centre Star group 23,804 tons, Le Roi 16,834 tons, Josie group (Le Roi No. 2 Ltd.) 1,546 tons, Phoenix 5 tons. Both the Centre Star and Le Roi groups are owned and operated by the Consolidated Mining and Smelting Co. of Canada, Ltd. The Phoenix is a small mine situated in the South Belt of Rossland camp, on which lessees recently commenced work; another property to which attention is again being turned is the Blue Bird, of which the Rosalia Mining Co. lately granted a lease to a Spokane man, who is expected to shortly ship ore from it to Trail.

The report of the Le Roi No. 2 Co.'s Josie mine for December, sent by the company's managers at Rossland to London, has been received from England. It gives the following information: "Shipped to Trail 823 tons of ore and 68 tons of concentrate. The receipts from the smeltery were $9,648, being payment for 903 tons of ore, and $642, for 41 tons of concentrate; sundry receipts were $639; total receipts, $10,929. Estimated working costs for the corresponding period were as follows: Ore production, $5,000; milling, $500; development, $1,500; total $7,000."

Trail.—On January 30 a fire occurred in the roaster department of the Consolidated Mining and Smelting Co.'s smeltery. In a brief published account of the damage done the loss was placed at about $2,000.

The total quantity of ore and concentrate received at the smeltery during six weeks ended February 11 was 50,019 tons. Of this, 44,279 tons came from the company's own mines, namely, from the Sullivan group in East Kootenay 3,641 tons, and from Rossland 40,638 tons, of which 23,804 tons was from the Centre Star group and 16,834 tons from the Le Roi. Custom ores received totalled 5,740 tons, this quantity including 101 tons from mines in Ainsworth mining division, 549 tons from Slocan, 863 tons from Nelson division, 1,551 tons from Rossland, 152 tons from Boundary district, 17 tons from Lardeau, 8 tons from Yale district and 2,499 tons from the State of Washington.

Boundary.—In the early part of February two more blast furnaces were blown in at the Granby Consolidated Co.'s smeltery at Grand Forks, these bringing the total in blast up to six. It is thought probable the remaining two will also be in operation soon. The Grand Forks Gazette says: "Somewhat of an experiment is now being tried in the shipment of matte from the Granby Co.'s smeltery at Anyox, Observatory inlet, to the company's reduction works at Grand Forks, to be reduced to blister copper. By this system work will be facilitated at Anyox, while the matte will serve as a flux at the Grand Forks works. During the latter part of January a shipment of 1,300 tons of matte reached Grand Forks from Anyox, a shipment of 1,500 tons, will come about February 15, and a further shipment of 1,500 three weeks later."

Reports from Franklin camp, north fork of Kettle river, tell of much activity in that part of the Grand Forks mining division. While the Union is the only producing mine at the present time, ore is being developed on other properties. There are numbers of prospectors at work, and the outlook is more promising than for years past.

The statement is made in district newspapers that the British Columbia Portland Cement Co.'s manufacturing works and plant at East Princeton, Similkameen, will shortly be offered for sale, as the company is being wound up. It is stated further that the Inland Development Co., of which Mr. J. J. Warren is head, is regarded as a probable purchaser.

General Notes.

One of the resolutions passed at the annual meeting of the Nelson Conservative Association, held on Feb. 9, was as follows: "Resolved, that this association desires to urge upon the Dominion Government the great importance of immediate financial assistance toward the zinc smelting development and further experiments in Nelson B.C."

It has been announced from Spokane, Washington, that an ore testing department for the purpose of determining the constituents, value, and uses of ores, rocks and chemical deposits submitted from any part of the North-West has been organized as a new feature of the annual North-West Mining Convention arranged to be held in Spokane February 22 to 27.

NOVA SCOTIA

Coal Outputs.—Outputs have been very restricted since the opening of the year, and production for January was the lowest for many years past. The Glace Bay mines of the Dominion Coal Company produced 256,000 tons, compared with 348,000 in January, 1914, and this reduction may be taken as typical of the other operating companies.

The Cape Breton Coal, Iron and Railway Company closed down its Broughton colliery during January. This mine was yielding about two hundred tons per day. It has had a very chequered career, and it is not expected that the colliery will re-open until the financial situation improves.

The Dominion Coal Company temporarily discontinued work at No. 2 colliery, placing the men in No. 22 mine, the output of which has been increased about 50 per cent. No. 21 colliery will resume operations towards the opening of navigation.

The Acadia Coal Company is considering the method of recovering the Allan shaft after the recent explosion. The shafts have been sealed since about the middle of December, and analyses of the mine air seem to indicate that the fire, if one existed, is practically extinguished. If it is decided to recover the area presumably affected by the fire, the operations will probably be guided by the principle successfully followed in similar cases of bringing forward the ventilation in a series of air locks, thereby avoiding the access of oxygen to the fire area. In view of the possible necessity for exploration of the unventilated area and the use of oxygen apparatus in this connection, the Acadia Company is training men in the use of apparatus daily, and has brought the equipment to a very efficient state. The fact that the management is going about the recovery of the Allan shaft in such a methodical manner, and is preparing so thoroughly, should lead to successful operations when the time comes to carry them out.

THE EXPORT OF NICKEL MATTE.

Ottawa, Feb. 11.

Correspondence between the Canadian Government and the Acting High Commissioner in London regarding the measures taken to prevent Canadian nickel going to Germany, was brought down to-day by the Prime Minister.

Sir Robert wrote on November 20, forwarding a copy of the report of Mr. Graham Bell, financial comptroller of the Railway Department, who had acted for the Dominion Government in their arrangement with the International Nickel Company. On December 11, Sir George Perley cabled that the arrangement was considered by Sir Francis Hopwood, chairman of the sub-committee appointed for the purpose of curtailing the enemy's supplies, as perfectly satisfactory. In a subsequent letter Sir George spoke of the arrangement being submitted to Mr. Churchill. Mr. Bell's report was considered quite satisfactory. On December 23 Premier Borden cabled for confirmation of the opinion of the Imperial Government, as there had been complaints in the press of nickel reaching the enemy. Sir George Perley replied by cable that Sir Francis Hopwood assured him the British Government were quite satisfied with the arrangements made "and appreciate the steps you have taken to assist them in this important matter."

The correspondence closes with the following letter to Mr. Graham Bell from W. A. Bostwick, assistant to the president of the International Nickel Company, New York:

"The statement that the Krupps are interested in the International Nickel Company has again been shown in attached article from the Journal of Commerce. To our positive knowledge, the Krupps have absolutely no influence in the affairs of the International Nickel Company. Our list of stockholders of record show that only 158 shares of common and 263 shares of preferred stock are owned by stockholders residing in Germany and Austria. An examination of the list of stockholders of record is open to any one of our Canadian stockholders, and we should be glad to extend the opportunity of extending the same to you should you so desire. This constantly recurring statement of Krupps' ownership and influence in this company is becoming exceedingly annoying, and we trust that some means can be speedily found by which it can be definitely refuted."

The annual general meeting of the shareholders of the Intercolonial Coal Mining Company, Ltd., will be held at the office of the company, Room 413 Dominion Express building, Montreal, on Wednesday, the 3rd day of March, 1915, at noon.

Officials of steel companies are concerned over sudden advance of 50 per cent. in price of manganese following Germany's blockade against England, which it is feared may interrupt the shipping of that alloy to United States. A lot of 200 tons for Pittsburg steel makers a few days ago was sold at $100 a ton, delivered. Prior to this, manganese could be purchased in Baltimore at $68 a ton.

BOOK REVIEWS.

THE CYANIDE HANDBOOK—By J. E. Clennel, Second Edition, Revised and Enlarged—McGraw-Hill Book Co., 1915—Price $5.00—For sale by Book Department Canadian Mining Journal.

In this new edition of Mr. Clennel's authoritative work every effort has been made to bring the information on all important sections of the subject up to date. New sections deal with improved methods of crushing and grinding, hydraulic classification, filter-pressing, vacuum filtration, agitating and aerating devices, zinc and aluminum devices, etc.

MINING COSTS OF THE WORLD—By Edmond Norton Skinner and H. Robinson Plate—McGraw-Hill Book Co.—Price $5.00—For sale by Book Department Canadian Mining Journal.

This is a compilation of cost and other important data on the world's principal mines. It is a compilation of results obtained at the various properties. The figures are taken mainly from the companies' annual reports and financial statements and from the authors' personal notebooks. Accompanying the data are brief descriptions of the mines and methods. These descriptions are too brief to allow of intelligent comparisons of costs at several properties. However, to those who know the conditions the book will prove very useful.

ASBESTOS CORPORATION OF CANADA.

According to the third annual statement of the Asbestos Corporation of Canada the operating profit for 1914 was $343,236, showing a gain of $77,304. After increased expenditure on renewals and betterment and the creation of a special reserve of $40,000 for possible loss the year's surplus of $68,183 shows a gain of $13,418. This brings the total surplus up to $191,031.

The balance sheet shows that the company has strengthened its position materially. The current assets increased by $71,332, while current liabilities fell off to the extent of $36,609.

The profit and loss account offers the following comparisons:

	1913.	1914.
Operating profit	$270,932	$343,236
Renewals, etc.	67,416	85,052
Special reserve	.....	40,000
Bond interest	148,750	150,000
Total deduction	216,166	275,052
Surplus for year	54,765	68,183
Previous surplus	68,082	122,847
Total surplus	122,847	191,031

The chief features of the balance sheet afford the following comparisons:

Assets.

	1913.	1914.
Property account	$9,065,703	$9,062,122
Cash under trust deed..	40,140	41,261
Bonds in treasury	25,000	25,000
Inventories of asbestos, etc.	344,163	366,642
Accounts and bills receivable.	207,128	326,992
Cash.	524,390	453,379
	$10,216,502	$10,288.077

Liabilities.

	1913.	1914.
Preferred shares	$4,000,000	$4,000,000
Common shares	3,000,000	3,000,000
Bonds issued	3,000,000	3,000,000
Accounts payable	72,437	52,130
Accrued liabilities	5,010	3,101
Liabilities in suspense..	16,207	1,814
Special reserve	.....	40,000
Surplus.	122,847	191,031
	$10,216,502	$10,288,077

The president, W. G. Ross, in reporting on behalf of the board to the shareholders says:

"The statement of profit and loss for the year shows a gross profit before providing for interest on the bonds and provision for renewals and betterments, etc., of $343,236.11, as compared with $270,932.37 for the previous year.

"The amount expended on additions and betterments to the property during the year amounted to $85,052.70 as compared with $67,416.78 expended during the previous year; and there has been provided in a special reserve account an amount of $40,000 for doubtful accounts.

"The properties of the company were operated throughout the year with the exception of the British Canadian property at Black Lake, which was closed down during the winter months. As mentioned in the last annual report, the production of this property has not been satisfactory owing to the small percentage of yield of asbestos, and while the reopening of the Standard pit has slightly improved the yield during the past summer, the mill results from this property are disappointing. In order to further explore the properties at this place your directors decided to tunnel from the present pits towards and under the old Manhattan pit; the driving of this tunnel will take at least one year, but when completed will not only have the object of prospecting your Black Lake property, but will prove the value of the Manhattan pit and if successful will allow of economical handling of the rock from this pit.

"The change in the hoisting and handling facilities at Kings pit have been further considered and studied, and your directors have decided to carry out the improvements during the summer of 1915 in order that the new plant may be put in operation early in the spring of 1916. The cost of this change involves an expenditure of approximately $200,000.

"In this connection before deciding to proceed with the new equipment your directors deemed it advisable to prospect the property immediately adjacent to the pit by diamond core drilling. This work was proceeded with throughout the year, the results of same being highly satisfactory. Two holes were drilled in the pit to a depth of 400 ft. below the present bottom, which showed equally as good material as that which had been extracted. Based on this depth, the territory prospected, which is only a comparatively small part of the company's property, showed a tonnage sufficient for over 40 years' operation.

"The machinery and plant of the company has been maintained and improved, owing to the disturbed conditions the development of the properties was curtailed during the latter half of the year.

"The company's office at Hamburg was perforce closed at the outbreak of hostilities and unsettled the business of the company, over one half of which was done in Germany and Austria, the effect of which will be felt more during the coming year. Your directors, however, hope for increased demand from England, and with the orders on hand from the United States that the results of the coming year, in spite of the unsettled conditions, should be fairly good under the circumstances.

"Your directors would call your attention to the strong financial position of the company, the advantage of which cannot be overestimated during such unusual and disturbing conditions. The tonnage produced was the same as last year. The unfilled orders on hand amount to $666,214.50.

C. M. I. WESTERN BRANCH MEETING.

The nineteenth general meeting of members of the Western Branch of the Canadian Mining Institute will be opened at Victoria, B.C., March 11, 1915, at 11 a.m.

At this meeting routine business will be transacted and several papers having particular reference to coal mining on the Coast, mine-rescue apparatus, first aid to the injured, and on other matters relating to the mining industry, will be read and discussed.

All members of the Canadian Mining Institute in good standing residing in British Columbia or the neighboring parts of the United States are, by virtue of such membership, also members of the Western Branch. Members are earnestly requested to make an effort to attend the ensuing meeting, and are cordially invited to contribute papers on matters relating to mining for reading at it; also to kindly notify the secretary that they will do so, if such be their intention.

Non-members will also be heartily welcome to attend, and to take part in the discussion of the papers submitted to the meeting.

MARKETS

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Standard Bank Bldg., Toronto, Ont.)

February 23, 1915.

New York Curb.

	Bid.	Ask.
Alaska Gold	.27⅝	.28
British Copper	.00½	.01
Braden Copper	.06⅝	.06¾
California Oil	276.00	279.00
Chino Copper	.34	.35
Giroux Copper	.00½	.01
Green Can.	.24⅛	.25
Granby.	.66½	.67
Miami Copper	.18¼	.18½
Nevada Copper	.11⅞	.12⅛
Ohio Oil	131.00	133.00
Ray Cons. Copper	.16	.16¼
Standard Oil of N. Y.	189.00	191.00
Standard Oil of N. J.	386.00	389.00
Standard Oil (old)	1200.00	.....
Standard Oil (subs)	800.00	.....
Tonopah Mining	.06⅝	.06⅞
Tonopah Belmont	.03⅝	.03⅞
Tonopah Merger	.39	.41
Inspiration Copper	.18⅛	.18⅜
Goldfield Cons.	.01½	.01 3/16
Yukon Gold	.02⅜	.02⅝

Porcupine Stocks.

	Bid.	Ask
Apex.	.02	.02¾
Dome Extension	.06¾	.07¼
Dome Lake	.24½	.25½
Dome Mines	5.80	6.00
Foley O'Brien	.16	.20
Hollinger.	22.00	22.40
Jupiter.	.09¾	.10½
McIntyre.	.33½	.34
Moneta.	.02	...
Pearl Lake	.02	.02⅝
Porcupine Gold	.00¼	.00½
Imperial.	.01¾	.02
Preston East Dome	.01½	.02
Rea.	.12	.17
West Dome	.06	.09
Porcupine Crown	...	.83
Porcupine Vipond	.37½	.38

Cobalt Stocks.

	Bid.	Ask.
Bailey.	.02¼	.02⅜
Beaver.	.27	.27½
Buffalo.	.70	1.00
Chambers Ferland	.12	.15
Coniagas.	4.75	5.00
Crown Reserve	.72	.77
Foster.	.02	...
Gifford.	.01	...
Gould.	.00⅜	.00½
Great Northern	.03¼	.04
Hargraves.	.01	.01¼
Hudson Bay	.20	.30
Kerr Lake	4.50	4.80
La Rose	.67	.73
McKinley.	.40	.43
Nipissing.	5.40	5.60
Peterson Lake	.22¾	.23
Right of Way	.03½	.03¾
Leaf.	.02½	.02¾
Silver Queen	.02	...
Temiskaming.	.17½	.17¾
Trethewey.	.10	.14
Wettlaufer.	.05	.06
Seneca Superior	1.00	1.50

TORONTO MARKETS.

Feb. 23—(Quotations from Canada Metal Co., Toronto.)
Spelter, 11 cents per lb.
Lead, 5¼ cents per lb.
Tin, 44 cents per lb.
Antimony, 21 cents per lb.
Copper, casting, 17 cents per lb.
Electrolytic, 17 cents per lb.
Ingot brass, yellow, 10; red, 12 cents per lb.

Feb. 23—(Quotations from Elias Rogers Co., Toronto.)
Coal, anthracite, $8.00 per ton.
Coal, bituminous, $5.25 per ton.

GENERAL MARKETS.

Feb. 19—Connellsville coke, (f.o.b. ovens).
Furnace coke, prompt, $1.55 per ton.
Foundry coke, prompt, $2.00 to $2.50 per ton.
Feb. 19—Tin, straits, 39.50 cents.
Copper, Prime Lake, 14.62 to 14.87½ cents.
Electrolytic copper, 14.55 to 14.65 cents.
Copper wire, 15.87½ cents.
Lead, 3.85 to 3.90 cents.
Spelter, 9.50 cents.
Sheet zinc, (f.o.b. smelter), 12.00 cents.
Antimony, Cookson's, 21.00 cents.
Aluminum, 19.00 to 19.50 cents.
Nickel, 40.00 to 45.00 cents.
Platinum, soft, $43.00 to $44.00 per ounce.
Platinum, hard, 10 p.c., $47.00 per ounce.
Bismuth, $2.75 to $3.00 per ounce.
Quicksilver, $60.00 per 75-lb. flask.

SILVER PRICES.

	New York cents.	London pence.
February—		
9.	48⅛	22 3/16
10.	48¼	22⅝
11.	48⅜	22 11/16
12.	....	22⅝
13.	48¼	22 11/16
15.	48½	22¾
16.	48⅜	22¾
17.	48⅝	22⅞
18.	48⅞	22 15/16
19.	48⅞	22⅞

PROFESSIONAL DIRECTORY.

The very best advice that the publishers of the Canadian Mining Journal can give to intending purchasers of mining stock is to consult a responsible Mining Engineer BEFORE accepting the prospectus of the mining company that is offered them. We would also strongly advise those who possess properties that show signs of minerals not to hesitate to send samples and to consult a chemist or assayer Those who have claims and who require the services of a lawyer, with a thorough knowledge of Mining Law, should be very careful with whom they place their business.

ENGINEERS, METALLURGISTS AND GEOLOGISTS.

Dominion of Canada.

Ontario

Astley, J. W.
Cohen, S. W.
Campbell & Deyell.
Carter, W. E. H.
Evans, J. W.
Ferrier, W. F.
Forbes, D. L. H.
Graham, S. N.
Gwillim, J. C.
Handley, John.
Hassan, A. A.
Haultain, H. E. T.
Hille, F.
Loring, F. C.
McEvoy, Jas.
Scott, G. S.
Segsworth, Walter E.
Smith, Alex H.
Smith, Sydney.
Maurice W. Summerhayes.
Tyrrell, J. B.

Quebec

Burchell, Geo. B.
Cohen, S. W.
DePencier, H. P.
Hardman, J. E.
Hersey, Milton L.
Johnson, W. S.
Smith, W. H.
Ross, J. G.

British Columbia

Brown & Butters.
Fowler, S. S.

FOREIGN-New York

Canadian Mining & Exploration Co., Ltd.
Colvocoresses, Geo. M.
Dorr, Jno. V.N.
Hassan, A. A.

ASSAYERS, CHEMISTS AND ORE TESTERS.

Dominion of Canada

Ontario

Belleville Assay Office.
Campbell & Deyell
Heys, Thos. & Son
Canadian Laboratories, Ltd.

Quebec

Hersey, Milton Co., Ltd
Dr. J. T. Donald

Foreign-New York

Ledoux & Co.

ENGINEERS, METALLURGISTS AND GEOLOGISTS.

PROFESSIONAL : DIRECTORY.

CONTINUED FROM PRECEDING PAGE.

ENGINEERS, METALLURGISTS AND GEOLOGISTS.

GWILLIM, J. C.
Consulting Mining Engineer,
KINGSTON, ONT.

HANDLEY, JOHN
Mining Engineer and Metallurgist
SUDBURY, ONT.
Code: Bedford McNeill, 1908.

HARDMAN, J. E.
Consulting Mining Engineer
MONTREAL, CANADA.

HASSAN, A. A., COBALT, ONT.
Mining Geologist and Consulting Engineer.
61 WALDORF COURT, BROOKLYN, N. Y.
Examination, Management and Operation of Mines in Ontario, Quebec and Nova Scotia.
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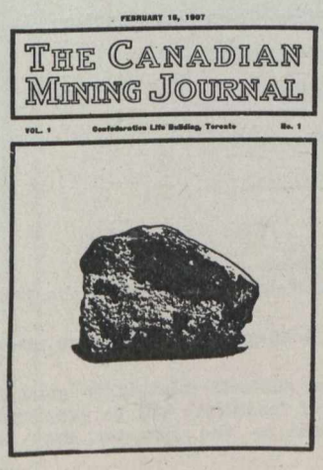

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Most of the older reports are out of print, but they may usually be found in public libraries, libraries of the Canadian Mining Institute, etc.

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MAPS RECENTLY ISSUED:

CANADA
Map 91A. Geological map of the Dominion of Canada and Newfoundland. Scale 100 miles to 1 inch.
NEW BRUNSWICK AND NOVA SCOTIA
Map 27A. Bathurst and vicinity, Gloucester County, New Brunswick. Geology.
Map 39A. Geological Map of Nova Scotia.
Map 121A. Franey Mine and Vicinity, Victoria County, N.S.
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Map 95A. Broadback River, Mistassini territory, Quebec. Geology.
Map 100A. Bell River, Quebec. Geology.
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Map 124A. Wanapitei (Falconbridge, Street, Awrey, and Parts of Maclennan and Scadding Townships), Sudbury District, Ont. Geology.
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Map 136A. Hazelton-Aldermere, Cassiar and Coast Districts, British Columbia.
1321. Diagram Showing the Geology of Texada Island, British Columbia.
Map 106A. Groundhog coal field, British Columbia. Geology.
YUKON AND NORTH-WEST TERRITORIES.
Map 113A. Canadian routes to White River District, Yukon, and to Chisana District, Alaska.
Map 58A. Explored Routes in the Lower Parts of the Drainage Area of Churchill and Nelson Rivers, Manitoba and Saskatchewan. Geology.

NOTE.—Maps published within the last two years may be had, printed on linen, for field use. A charge of ten cents is made for maps on linen.

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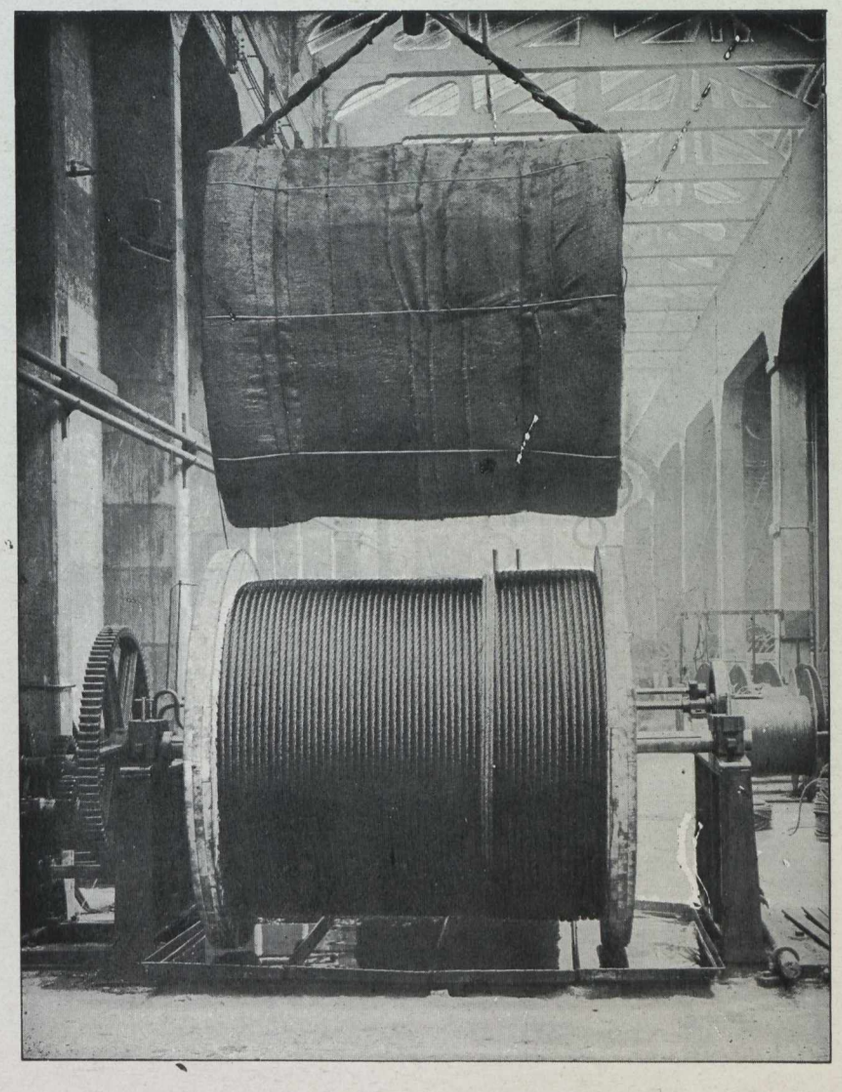

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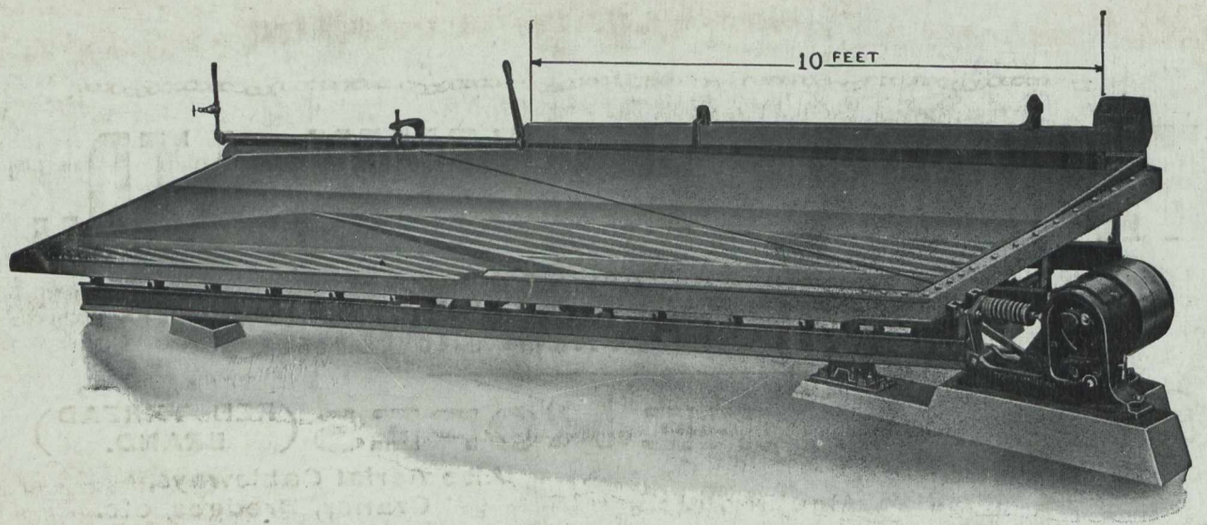

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