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MERRY CHRISTMAS

To the readers of the "Canadian Mining Journal" we extend our best wishes for A Merry Christmas and A Happy and Prosperous New Year.

WORKMEN'S COMPENSATION

A bill of considerable importance to mining men is that which Sir W. R. Meredith, Commissioner, has recommended to be passed into law.

It has long been recognized that employees should be compensated for injuries received while at work.

In general it is also recognized that the employer must pay the cost of accidents. There are, however, many cases in which the accident is caused by the carelessness of the employee, and then naturally the employer is unwilling to bear the burden.

Where the employer accepts responsibility there still remains to be determined what sum should be paid. Where the employer refuses to admit responsibility the injured must bring suit and then whatever the judgment a large portion of the money paid out by the employer does not reach the person injured.

In recognition of these facts and in an endeavour to revise the law so as to provide for fair compensation to the employee, a Commission was appointed, June 30, 1910, to investigate the compensation laws in force in other countries and to recommend a suitable law for Ontario.

A draft bill has been presented in April, 1913, and on October 31, 1913, the Commissioner made his final report to the Lieutenant-Governor of the Province.

In this final report, Sir William says:

"**At the outset of the enquiry it was contended by those who spoke on behalf of the workingmen:** (1) That the law of Ontario is entirely inadequate in the conditions under which industries are now carried on to provide just compensation for those employed in them who meet with injuries, or suffer from industrial diseases contracted in the course of their employment; and (2) that under a just law the risks arising from these causes should be regarded as risks of the industries and that compensation for them should be paid by the industries.

"**With these two propositions those representing the employers expressed their agreement,** though it is fair to say that it was probably not intended to agree that compensation should be paid in respect of industrial diseases."

It was not considered necessary to enquire into the statements of the workingmen, as employees, employer and the Commissioner agreed that the present law is

inadequate. The best means of providing for compensation is, however, a subject which necessitates a great deal of study.

The Commissioner says:

"Agreeing as I did with the contention of the workingmen, there remained only to be considered in what form and by what means the compensation should be provided. For the purpose of reaching a conclusion as to this, and in obedience to the directions of the Commission, I made enquiry as to the laws in force in the principal European countries, in the United States of America and in the Provinces of Canada. I also visited Belgium, England, France, and Germany, and consulted those concerned in administering the laws of those four countries, and others qualified to judge as to whether they have been found to work satisfactorily. Much evidence has been taken bearing upon the general question."

Of the various compensation laws in force in these countries he says:

"**There are two main types of compensation laws.** By one of them the employer is individually liable for the payment of it, and that is the British system. By the other, which may be called the German system, the liability is not individual but collective, the industries being divided into groups, and the employers in the industries in each group being collectively liable for the payment of the compensation to the workmen employed in those industries—practically a system of compulsory mutual insurance under the management of the State. The laws of other countries are of one or other of these types, or modified forms of them, and in most, if not all of them, in which the principle of individual liability obtains, employers are required to insure against it."

The representatives of the workingmen and the Canadian Manufacturers' Association agreed on the German system as the most suitable; but disagreed as to some of the details.

"The employers insisted that a part of the assessments to provide for the payment of the compensation should be paid by the employees, and this was vigorously opposed by the representatives of the workingmen. The employers desired that no compensation should be payable where the injury to the workman did not disable him from earning full wages for at least seven days, and to this the representatives of the workingmen objected."

Mine managers in Ontario do not appear to be very much in favour of asking that employees be assessed and will doubtless not be much disappointed if this feature of the bill is not changed. The main contention of the mine managers is that the money paid out for accidents should go to the injured. At present much too large a percentage of it goes to those who conduct the suits for damages.

In comparing the British and German compensation laws the Commissioner says:

"After the best consideration I was able to give to the important matters as to which I was commissioned by Your Honour to make recommendations, I came to the conclusion, to which I still adhere, that a compensation law framed on the main lines of the German law with the modifications I have embodied in my draft bill is better suited to the circumstances and conditions of this Province than the British compensation law, or the compensation law of any other country. . . . It is in my opinion essential that as far as is practicable there should be certainty that the injured workman and his dependants shall receive the compensation to which they are entitled, and it is also important that the small employer should not be ruined by having to pay compensation, it might be, for the death or permanent disability of his workmen caused by no fault of his. It is, I think, a serious objection to the British Act that there is no security afforded to the workman and his dependants that the deferred payments of the compensation will be met, and that objection would be still more serious in a comparatively new country such as this, where many of the industries are small and conditions are much less stable than they are in the British Isles."

His opinion of the present common law is expressed as follows:

"**According to the common law it is a term of the contract of service that the servant takes upon himself the risks incidental to his employment** (popularly called the assumption of risk rule), and that this risk includes that of injury at the hands of fellow-servants (popularly called the doctrine of common employment). The doctrine of common employment is an exception to the general rule that the master is responsible for the acts of his servants when engaged in his work, and has rightly, I think, often been declared unfair and inequitable. **In my opinion there is no reason why this objectionable doctrine should not, as one of the provisions of Part II. of the draft bill provides, be entirely abrogated.** The draft bill also provides for the abrogation of the assumption of risk rule. The rule is based upon the assumption that the wages which a workman receives includes compensation for the risks incidental to his employment which he has to run. That is, in my judgment, a fallacy resting upon the erroneous assumption that the workman is free to work as he pleases and therefore to fix the wages for which he will work, and that in fixing them he will take into account the risk of being killed or injured which is incidental to the employment in which he engages.

"**Another rule of the common law is unfair to the workman.** Although the employer has been guilty of negligence, if the workman has been guilty of what is called contributory negligence and his injury was occasioned by their joint negligence the employer is not liable. The injustice of this rule consists in this, that though the employer may have been guilty of the grossest negligence, if the workman has been guilty of contributory negligence, however slight it may have

been, and his injury was occasioned by the joint negligence, the employer is not liable. It is proposed by the draft bill to substitute for this rule that of comparative negligence as it is called, and provide that contributory negligence shall not be a bar to recovery by the workman or his dependants, but shall be taken into account in the assessment of damages."

A feature of the draft bill which was objected to by the Manufacturers' Association, and which will doubtless meet with further objection, is the providing for payment to continue as long as the disability lasts. Many would prefer to pay a lump sum and have done with it. The question involves not only one of actual compensation, but also that of cost of administration. It is quite evident that the staff required to keep track of the condition of all injured workmen and to determine when they are no longer entitled to payments, must soon become a very large one. The cost of administration will certainly not be small.

Against this argument, however, the Commissioner states that it is in these very cases of long lasting disability that a guaranteed compensation is most needed. He says:

"To limit the period during which the compensation is to be paid regardless of the duration of the disability, as is done by the laws of some countries, is, in my opinion, not only inconsistent with the principle upon which a true compensation law is based, but unjust to the injured workman for the reason that if the disability continues beyond the prescribed period he will be left with his impaired earning power or, if he is totally disabled without any earning power at a time when his need of receiving compensation will presumably be greater than at the time he was injured, to become a burden upon his relatives or friends or upon the community. The payment of lump sums is contrary to the principle upon which Compensation Acts are based and is calculated to defeat one of the main purposes of such laws—the prevention of the injured workman becoming a burden on his relatives or friends or on the community—and has been generally deprecated by judges in working out the provisions of the British Act."

The bill is divided into parts. Part I. deals with the liability of employers to contribute to the accident fund or to pay compensation individually. Part II. deals with liability and with certain common law rules and contributory negligence.

In Part I. there are two groups of industries listed, schedule 1,—industries the employers in which are liable to contribute to the accident fund; schedule 2,—industries the employers in which are individually liable to pay the compensation. Mining comes under schedule I.

While there is room for difference of opinion as to some of the details there should be little difficulty in convincing the Legislature that the bill should be passed. It provides in no uncertain terms for fair treatment for the injured. If a workingman meets with an accident while at work he should, if the accident be not the result of his own gross carelessness, be taken care of by the industry. The bill provides for compensation as long as the disability lasts. The workingman is virtually insured by the Government against accidents. The employers contribute to the fund. The bill provides for a board to administer it.

The concluding paragraph of the report will meet with the approval of all who have a sincere interest in providing for fair treatment of employees. The Commissioner says:

"In these days of social and industrial unrest it is, in my judgment, of the gravest importance to the community that every proved injustice to any section or class resulting from bad or unfair laws should be promptly removed by the enactment of remedial legislation and I do not doubt that the country whose Legislature is quick to discern and prompt to remove injustice will enjoy, and that deservedly, the blessing of industrial peace and freedom from social unrest. Half measures which mitigate but do not remove injustice are, in my judgment, to be avoided. That the existing law inflicts injustice on the workingman is admitted by all. From that injustice he has long suffered, and it would, in my judgment, be the gravest mistake if questions as to the scope and character of the proposed remedial legislation were to be determined, not by a consideration of what is just to the workingman, but of what is the least he can be put off with; or if the Legislature were to be deterred from passing a law designed to do full justice owing to groundless fears that disaster to the industries of the Province would follow from the enactment of it."

THE MINES BRANCH REPORT

The summary report of the Mines Branch of the Department of Mines for the year 1912 has been issued.

The general report of the Director of Mines, Dr. Eugene Haanel, outlines the work accomplished by the various divisions.

The experimental investigation of processes for the profitable reduction of the mixed zinc sulphide ores of Canada, begun in 1910, is still being carried on. No very successful process has yet been found.

An investigation of the properties of cobalt and its alloys, carried on by H. T. Kalmus at the School of Mining, Kingston, has yielded some interesting results. Some extracts from his report will be found elsewhere in this issue.

Several reports on mineral resources and statistics have been published during the year and may be obtained on application to the Director of the Mines Branch.

The new testing laboratory at Ottawa has been equipped for experimental ore dressing and the Department is ready to make investigation as to best method of treatment of ores submitted.

Preliminary reports on field work are presented by Dr. W. A. Parks, Dr. A. W. G. Wilson, Mr. E. Lindeman, Mr H. Frechette, Mr. H. S. de Schmid, Mr. L. H. Cole, and Mr. T. A. MacLean.

Mr. John McLeish reports on statistics; Mr. G. Middleton on the Assay Office at Vancouver; Mr. B. F. Haanel on tests on lignite coal; Mr. J. G. S. Hudson on sampling lignite; Mr. Edgar Stansfield on the Chemical Laboratory; Mr. A. Anrep on peat; Mr. F. G. Clapp on oil and gas, and Mr. Geo. Mackenzie on ore dressing.

The Mines Branch is doing a great deal of useful work. In the introduction to his report Dr. Haanel says:

"The Mines Branch of the Department of Mines was organized primarily for the purpose of assisting, in a practical manner, the development of the mineral industry of Canada. This object is attained by the gathering and publishing of statistics, relative to the mining operations and economic mineral resources of the country generally; by initiating and conducting original research work, which aims at the commercial utilization of our metallic and non-metallic minerals; by mapping out magnetic ore bodies by means of magnetometric surveys; by defining the characteristics and, in well-equipped chemical laboratories, determining the properties of specimen ores and rocks. Results of the work undertaken are given to the public in the form of monographs on the scientific study of the ore deposits of Canada; and by the publication of reports and bulletins dealing with the investigation of certain processes. As examples of this latter branch of the work may be cited the electric smelting of refractory iron ores; the production of peat fuel; the economic extraction of zinc from refractory zinciferous ores, etc."

Already the Mines Branch has published several important monographs and many reports and bulletins. Important investigations are being carried on. The Branch is doing well the work for which it was organized.

THE EIGHT-HOUR SHIFT

In Ontario and in Michigan the law requires that, after January 1, underground workers shall not be required to work more than eight hours. Already in Ontario at some mines eight-hour shifts are the rule. At Cobalt, notices have been posted at several of the mines stating that the shifts are to be eight hours after January 1. In the Michigan copper mining district the eight-hour rule went into force on December 1, 1913.

The employees will doubtless be much pleased at the new regulations. Naturally the mine owners are not pleased at the prospect of increased costs of mining; but most of them are willing to do what they can to make life more enjoyable for the men in their employ.

A miner can do a good day's work in eight hours if he wants to.

MINERS MURDERED IN MICHIGAN

Houghton, December 7.

The most vicious crime of the campaign of outlawry which has accompanied the Western Federation of Miners' strike was perpetrated at Painesdale at about 2 o'clock this morning, when two miners employed by the Copper Range Consolidated Company were murdered, a third mine employee was fatally wounded and a little girl was shot through the shoulder.

The dead:

Arthur Jane, aged 21, arrived in Painesdale yesterday from Toronto.

Harry Jane, aged 24, brother of Arthur, also arrived from Toronto yesterday.

Fatally wounded:

Thomas Dally, aged 40, miner and boarding-house proprietor.

The murdered and wounded were occupants of a double boarding-house on the west end of Baltic Street, one side of which was let to William Nicholson and family and the other to the family of Thomas Dally.

All were asleep when the shooting occurred save Mrs. Dally, who was waiting up for a boarder who was expected at 11 o'clock last night, but had not arrived at the time of the shooting. A bullet whizzed past her as she sat reading at a table and she screamed an alarm to the other occupants of the house. The shot was followed by a fusillade, one bullet entering the head of Mr. Dally, who had arisen from bed when his wife screamed, and Arthur and Harry Jane being shot dead in their beds. Little Mary Nicholson, aged 8, daughter of William Nicholson, was shot in the shoulder.

The two murdered men occupied a room in the third storey of the boarding-house.—Mining Gazette.

Houghton, December 9.

There seems no doubt that the State Department will be asked by the British Foreign Office to investigate the death of the Painesdale murdered men, Arthur and Harry Jane and Thomas Dally. These men were British subjects. The facts have been reported to the proper British consular and diplomatic authorities and an investigation undoubtedly will ensue.

Working men at Painesdale yesterday broke up the strikers' parade and then held an indignation meeting. They threaten the lives of the agitators, and trouble is feared. At Baltic 150 strikers were ordered to stop when crossing mine property.

Sunday was a most eventful day. In the morning several of the Houghton business men met at Houghton Club and formulated plans of action; after this meeting they adjourned to Houghton fire hall, sounded fire alarms for several minutes at a time, gathered together all of the citizens who could be reached for the purpose of getting the views of citizens in all walks of life.

Many speeches were made, and result was chartering of a special train over Copper Range and whole party going to Calumet, where they planned a similar meeting for the citizens there.

Result of the meeting was that next Wednesday is to be a half holiday with full pay and patriotic meetings will be held in the several copper country towns. Good speakers will be engaged and it is thought that before the week is over the agitators will find things too much against them to warrant their remaining. After they go it will be a simple matter, comparatively, to adjust differences between men and mining companies.

A VISIT TO MINES OF ALBERTA AND BRITISH COLUMBIA

(Continued from November 1 issue.)

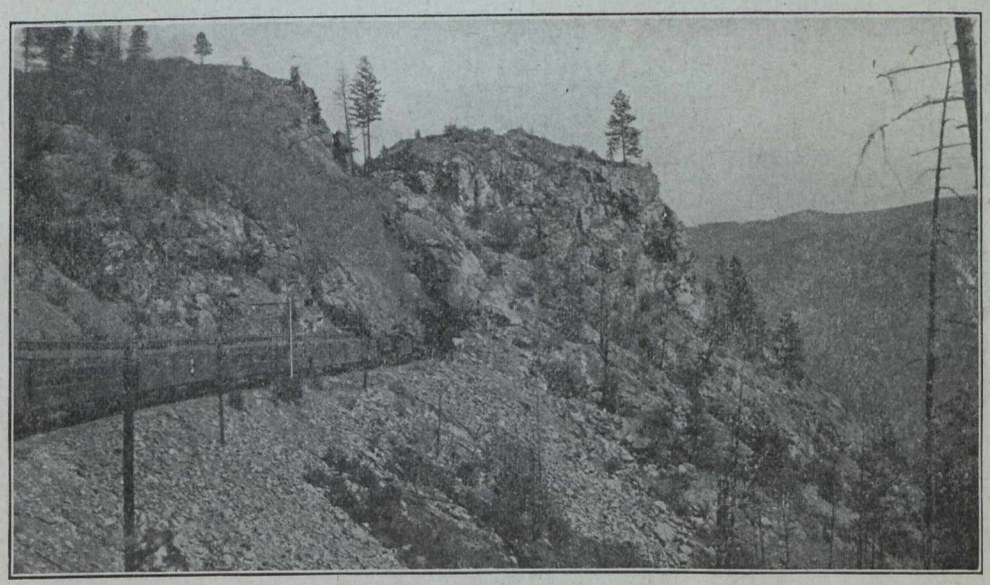
After examining the Granby mine the party proceeded to Greenwood. In the evening a visit was made to the smelter of the British Columbia Copper Company, which treats ore from several mines including the Motherlode mine at Deadwood. The copper deposits at Deadwood are, according to Mr. LeRoy, similar to those at Phoenix.

Trail.—Leaving Greenwood the party returned to Castlegar and thence to Smelter. Here was visited the smelter and lead refinery of the Consolidated Mining and Smelting Company. Recent changes and improvements in the plant were described by E. Jacobs in the August 15 issue of the Journal.

At Smelter, or Trail (the town of Trail lies just below Smelter), are treated the gold-copper ores from the Rossland mines and the silver-lead ores of the Slocan district. The product from the latter is refined silver and lead. The smelter is situated on the Columbia river a short distance above Trail creek.

"In the summer of 1890, Bourjois and Morris, who were working on the Lily May, crossed over to Red mountain and located in one day the Le Roi, Centre Star, War Eagle, Idaho and Virginia. These claims were recorded at Nelson, the Le Roi being given to E. S. Topping for paying the $12.50 recording fees. He secured specimens and went to Spokane, interesting some business men of that town in the Le Roi, and the development of the camp began. The news of the strike brought prospectors, and the Josie and most of the other claims whose names became so familiar were located shortly after the first discovery—many in the same month.

"Development was for the first few years slow, and the prospects of the camp uncertain. Lack of transportation and the financial panic of 1893 were the chief deterrent factors that nearly wrecked the fortunes of the camp. The first ore sent out of the camp



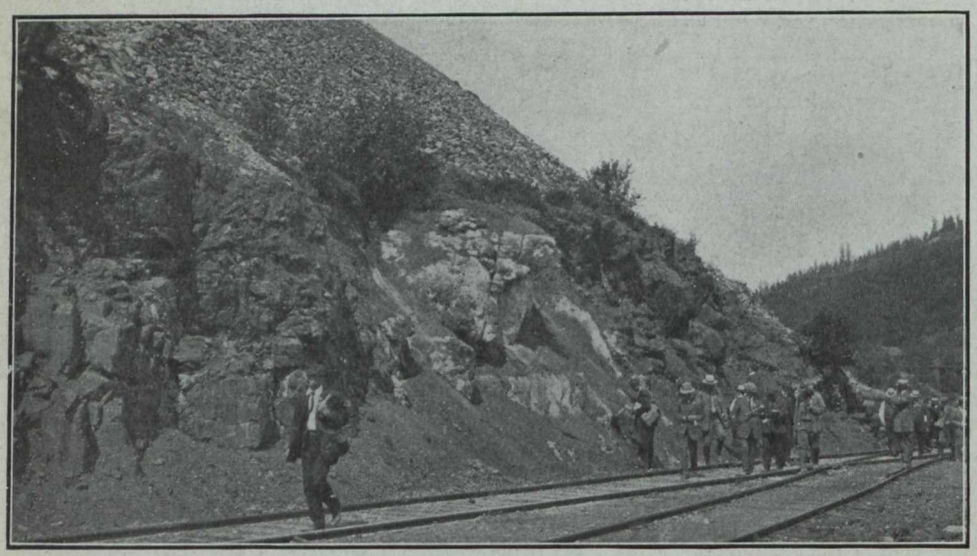
On the Rossland Branch, C.P.R.

Rossland.—From Trail the party were taken up the steep grade to Rossland which is 2,000 ft. above the Columbia river valley. Here excellent arrangements had been made to take the visitors through several of the mines including Le Roi, War Eagle, Centre Star, and Josie. Several small groups were formed and for each a guide was furnished. Each group was provided with plans of the workings. Underground the local geologists had in many places made conspicuous marks which enabled the visitors to find the contacts and identify the several formations. The time was thus used to best advantage.

Development of the Rossland District.—Although some of the placer miners who were working the creeks in the Boundary district had discovered evidences of mineralization on Red mountain and had done some exploratory work there, it was not until 1890 that claims were staked. The early history of the Rossland mining district is told by R. W. Brock in his report made for the Geological Survey:

was a small lot in 1891, which was packed to the Columbia river and thence shipped to an American smelter. In 1893, a wagon road having been constructed to Trail, on the Columbia, about 700 tons were despatched. The results were sufficiently reassuring to justify the erection of machinery, and with improved facilities, 1,856 tons of ore, shipped in 1894, returned $75,510. During the summer the Geological Survey, through Mr. R. G. McConnell, made a reconnaissance survey of the camp. Several of the more important properties were bonded for considerable sums and development was begun in earnest. The following year, the young camp received marked attention. The population rose from 300 to 3,000; railroad and smelting facilities were projected, and from this time forward, developments were rapid. The smelter at Trail and a tramway to connect it with Rossland and the mines, were begun in October, 1895, by Aug. Heinze, of Butte, and the first furnace was blown in the following February. In 1896 the Red Mountain railway, connecting Rossland with the Spokane Falls and

Northern railway at Northport, was completed. Then came the inevitable wild boom. The evil effects of a boom are not confined solely to the thousands of dollars squandered in worthless property, the losses sustained by the innocents, and the damaged reputation of the district, but they are manifest in careless work on deserving claims, in a rash expenditure that may for some time survive the boom; in a loss of interest in properties of merit that only require additional work to demonstrate their worth; and in a tendency to maintain prohibitive prices on promising prospects by owners who have purchased during the period of inflation and are not prepared to accept a serious loss, or by owners who, once having experienced the sensation of being millionaires, are loath to accept present conditions, but prefer to speculate on the improbabilities of the future. Rossland has been called on to pay in full all the penalties attaching to a boom. The phenomenal rise in the value of Le Roi stock, the dividends declared by this company and the War Eagle, and the sale of the latter to Toronto capitalists, for the reported sum of $700,000, produced a feeling of buoyancy that afforded every opportunity to the unprincipled boomster and the amateur mining magnate, the public for the time being cheerfully swallowing whatever was offered. The inevitable slump followed.



Outcrop of vein, Centre Star mine, Rossland, B.C.

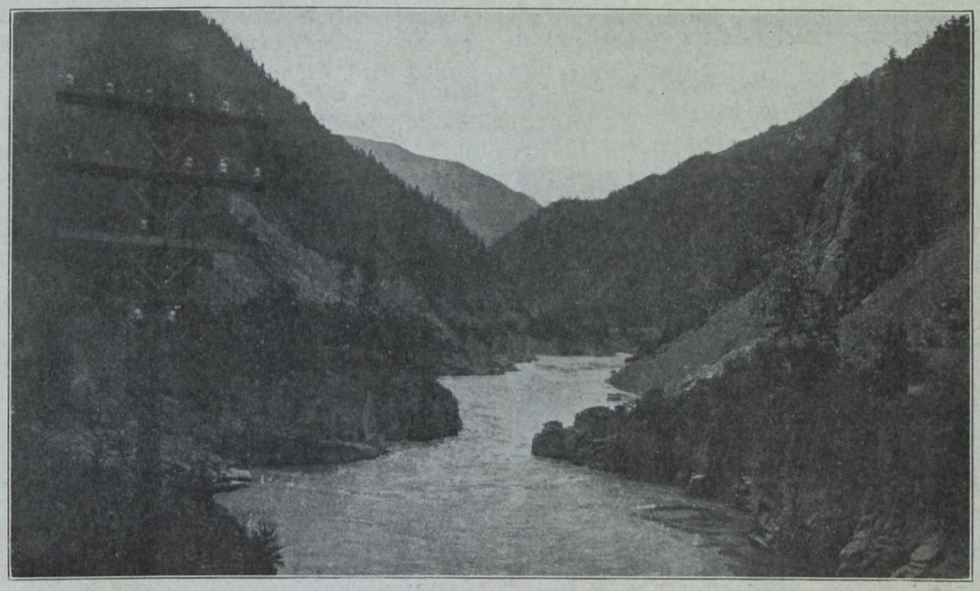
"In 1897 Rossland had an estimated population of 6,000 and was incorporated as a city. A broad gauge railway was built from Trail to Robson, giving better connection with the Canadian Pacific railway than was afforded by river navigation along this rapid stretch of the Columbia. Stronger companies were formed to take over and develop promising prospects. In particular, the British American Corporation purchased the Josie, Nickel Plate, Great Western, Poorman, West Le Roi, Josie No. 1 and Columbia-Kootenay mines. Development work had yielded most promising results. The Le Roi Company, having completed its contract for 75,000 tons with the Trail smelter, erected its own smelter at Northport. In 1898 the Canadian Pacific railway purchased the Trail smelter and railway from Heinze, and immediately made an important reduction in smelting charges. The British American Corporation secured the Le Roi mine and smelter by purchasing the stock at a price which was said to represent nearly $4,000,000 for the property. The Centre Star was purchased by Toronto capitalists for $2,000,000 cash. The construction of the Crowsnest branch of the Canadian Pacific, built through the Crowsnest coal fields to Kootenay Lake, was an important event for the camp. It meant cheaper and better fuel and coke, and a consequent reduction in cost of ore production and treatment.

"These reductions brought about a large increase in ore tonnage with a corresponding diminution in the grade of ore mined. Large plants with the most approved machinery for the economical working of the mines, were installed or planned, and operations on a large scale were projected. The construction of the West Kootenay Power Company's plant at Bonnington Falls, 32 miles distant, was another important event. Electric power was now available for the Trail smelter and the Rossland mines, although full use has not been made by the mines of this most convenient and economical form of power. At the close of 1899, the reputation of Rossland suffered from the sudden collapse in the price of War Eagle stock. This stock had been run up to a wholly unwarranted point, and was held in the hope that new machinery would permit an increased output, with a resultant advance in the stock. Unfortunately the machinery proved a failure, and the stock dropped. A general desire to realize followed and brought about a collapse, with a consequent loss of faith in the camp. In 1901, Rossland again received a set-back, this time in the form of labour troubles, which closed up the mines for a part of the year. These difficulties were amicably adjusted, but the evil effects of such troubles in discouraging investments are not quickly effaced. By 1902 the mines had resumed their normal operations and on a more business-like basis than before. Although the great number, size and value of the ore shoots in these mines have been proved, and it is known that much lower grade ore can now be profitably worked, this has so far not had the effect that might be expected in encouraging the search for other pay shoots and new veins outside the area already developed. Experiments in concentration were commenced in 1903 and are still being made, and serious efforts are being made to obtain the greatest possible profit per ton of ore."

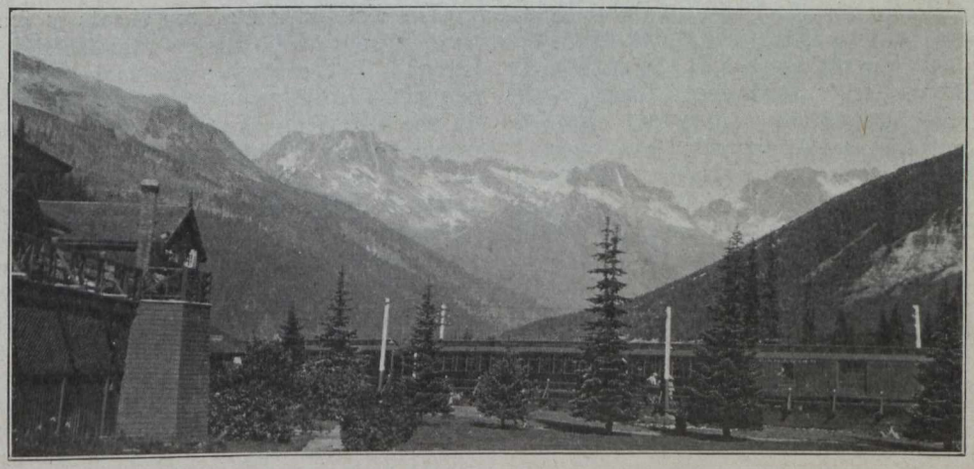
Characteristics of the Lodes.—Some of the noteworthy features of the ore bodies have been pointed

out by R. W. Brock in his report made for the Geological Survey:

"As is to be expected from the nature of these lodes, sharply defined walls are frequently lacking, the mineralization of the country rock gradually becoming less. Sometimes a fissure or fault plane bounds the ore, but often where this is the case, the slip has been formed after the mineralization. The transition from pay ore to what is—from a commercial standpoint—waste rock, is generally rapid, but such change is not proof that pay ore does not exist beyond the poor material. The pay ore is localized in shoots distributed within the lodes. These shoots vary greatly in size and shape. Lenticular bodies are commonest, but some terminate abruptly against a dike or fault, sometimes swelling to an enormous width or becoming L-shaped against the dike. In width, they vary from a foot to, in exceptional cases, 130 feet; in length, from 50 to 500 or more feet, and the vertical dimension is on an average the greatest. Stopes, 250 feet long by 20 to 30 wide, are by no means uncommon. One shoot of ore that has been followed down nearly 500 feet vertically, has averaged at least 150 feet long by 56 feet wide, and this is not the largest shoot that has been developed. The pitch of the shoots in the lodes varies from vertical to pronounced easterly or westerly and seems dependent upon purely local conditions. In the shoots themselves, the better grade ore is often confined to particular bands, which are generally parallel to the vein, but which may lie along either wall or within the shoot; more than one such band may be encountered in running a cut across a shoot. The position of such rich bands in the lode may suddenly change, owing to the mineralization forsaking one set of planes for another. In the Le Roi and Centre Star, where there are two important parallel lodes —the "Main" and "South" veins—it would seem, in the light of present developments, that where important shoots occur in the one vein, heavy mineralization is lacking at the corresponding point in the other. It is sometimes difficult to trace the vein from shoot to shoot, particularly where its continuity is interrupted by faults and dikes. In the Le Roi-Centre Star Main vein, a seam of calcite extends almost uninterruptedly along the vein, and occasionally forms a useful indicator where mineralization is slight."



On the C.P.R. in British Columbia



On the C.P.R. at Glacier, B.C.

Methods of Mining at Rossland.—In the mines visited by our party the ore is extracted for the most part by the use of square sets. In some cases, however, the shrinkage method is used. In the Josie mine

a narrow rich shoot is being extracted without using square sets. As a rule the ore and rock are very hard. The veins dip at an angle of about 70 degrees. The shrinkage method can be used to advantage where the stoping width is not great. The ore bodies, however, are commonly wide, being in places over 100 feet, and timbering by the square set method has proven to be satisfactory where the shrinkage method cannot be used.

The Rossland mines have produced very large quantities of gold and copper ores and it was pleasing to find that the owners have received considerable encouragement from the deeper explorations which have recently been carried on. Several of the engineers stated that there is good reason to expect a large output from the deeper levels.

After spending the afternoon underground the members of the excursion were entertained at the Rossland Club, and at the several hotels. The citizens of Rossland bore out the statement made by Director Brock at Fernie that the people of the west, and especially those of the mining districts are unsurpassed for their hospitality.

THE GOLD DEPOSITS OF NOVA SCOTIA

By E. R. Faribault.

(Continued from Nov. 15 issue.)

Ore Distribution.—Not all the veins are auriferous. The coarsely crystalline quartz seldom carries gold, while the laminated veins of oily quartz-bearing sulphides, generally do. In a few auriferous veins the gold seems to have had a fairly uniform distribution, but experience has shown that in most of them there was more or less segregation into pockets and shoots.

Some of the richest ore mined has been found n pockets. In the Blackie lead at Oldham the gold was found aggregated chiefly in nodules of arsenopyrite; and in the Hay lead, lying 1,800 feet (584 m.) north of the anticline of the same district, an isolated pocket carrying 60 ounces of gold was found at the intersection of an angular with the main lead.

The great proportion of the ore, however, lies in shoots having more or less definite boundaries and directions. They vary from 20 to 60 feet (6 to 18 m.) or more in breadth and are frequently accompanied by a thickening of the vein. In interstratified veins, many shoots have been worked to a vertical depth of 300 and 400 feet (90 to 120 m.). A shoot on the Hard lead, South Uniacke, was followed 1,200 feet (360 m.) on a dip of 28 degrees east; while that in the Sterling Barrel lead, Oldham, has been worked to a depth of 1,610 feet (487 m.) on a dip varying from 30 degrees at the surface to 43 degrees at a vertical depth of 900 feet (275 m.), and in 1909, the ore averaged 2.88 ounces per ton. The latter is the deepest mine on an interbedded vein.

Several shoots in cross veins have also been mined to a vertical depth of 200 and 400 feet (60 and 120 m.), and two, to a vertical depth of 1,000 feet (300 m.); one of these was worked throughout a length of 2,000 feet (610 m.).

As a rule, ore shoots occur in the rolls that have been already described, that is those parts of the veins in which there is some irregularity in size, form, structure or composition.

The interbedded leads are frequently found to be very rich at their intersection with angulars as well as in the thickened parts lying between the lines of intersection with angulars from below and above. All angulars do not enrich the leads they cut, and frequently only a set coming from some one particular direction have favoured the enrichment of the leads. The angulars themselves are usually not auriferous, but some have proved gold-bearing, especially in those parts where they cut obliquely across slate beds.

There is some order in the distribution of the ore in belts; in some, all the veins are auriferous, in some, only one, and in others, one vein will be auriferous for some depth, then becomes barren and an adjacent one becomes auriferous.

That there is some order in the distribution of the ore shoots was pointed out by Poole as early as 1878. A study of the plans made by Faribault of the different gold districts, reveals an alignment or arrangement of the outcroppings of the ore shoots in nearly every district. In the case of sharply folded anticlines, the line of ore shoots runs roughly parallel with the axis or diverges slightly from it, radiating from the centre of the dome, while in broad folds the line diverges still more from the axis. The shoots pitch in the general direction of the pitch of the anticline and at about the same or a little higher angle.

In some veins two or more parellel shoots have been found. The ore shoot on the Hard lead, South Uniacke, really consists of two streaks lying 40 feet (12 m.) apart; in the Mulgrave lead, Isaacs Harbour, a shoot 30 feet (9.1 m.) broad lay 180 feet (54.7 m.) below another 12 feet (3.6 m.) broad, both pitching west at an angle of 12 degrees.

The distribution of the shoots is frequently dependent on some subordinate flexure or crumple in the strata. For example, the large series of ore bodies worked at Renfrew is due to a subordinate undulation in the strata on the south limb of the dome. In this regard each district has its individuality, the structure of one dome never being just the same as that of another. The distribution of the ore shoots, consequently, is never exactly the same in any two districts.

In cross veins the ore body is found, in some cases at least, to lie at the intersection of the vein with certain strata or main leads. At Cow Bay, the ore body dips south at the same angle as the strata and follows certain beds at the base of the Halifax formation, highly charged with pyrrhotite. The shoot, followed 2,000 feet (610 m.) in the Libbey vein, extended from its intersection with the Mill lead on the north to the vicinity of its intersection with the Jim lead on the south.

Pay Zone.—Certain facts point to the existence in most districts of zones extending to a considerable depth, in which a succession of auriferous, interbedded, quartz veins of similar character and extent lie superimposed one above the other. On the north limb of the anticline at Goldenville several parallel veins lying close together pass under one another, and each has been worked to some depth beneath the overlying veins. An example of superimposed saddle-shape ore

bodies on the apex of the anticline is found at Isaac Harbour, where the workings of the Burke lead were carried below those of the Archie, McPherson and Saddle leads. So also at Mount Uniacke, a series of ore shoots was worked on the West Lake, Nuggety, Little and Borden leads, where they are affected at successively greater depths by a subordinate crumple with an axial plane dipping north at a high angle.

The observation of these and numerous other relations led the writer to the propounding of the "pay-zone" theory.* As has been pointed out the distribution of ore-shoots is dependent on the structure of the anticlinal fold or subordinate flexures on the fold: they lie in a line passing through similarly curved or twisted portions of the strata that during the folding process were subjected to pressures and tensions and were fractured so as to permit the transmission and deposition of minerals. The subordinate flexures and peculiarities of structure, on which the distribution of ore-shoots depends, extend to an unknown depth, and it is claimed that interbedded veins and ore-shoots should succeed one another with depth so long as the same structural conditions continue as at the surface. These structural conditions generally extend in depth parallel to the axial plane of the dome. We thus get a pay-zone the surface extent of which coincides with the surface over which the ore-shoots outcrop and which extends parallel with the axial plane of the dome to an indefinite depth.

The evidences in favour of the theory are the fact that gold mining has been carried on in the province to a vertical depth of 1,000 feet (300 m.) in fissure veins and 900 feet (275 m.) in one interbedded vein; that pay-ore is not limited to any particular horizon, but has been mined throughout the whole thickness of the Goldenville formation; and the analogy existing between the interbedded veins of Nova Scotia and the saddle-reefs of Bendigo, which have been worked successfully to a depth of over 3,000 feet (900 m.) and proved auriferous at over 5,000 feet (1,525 m.).

While the hypothesis may be of general application it is not claimed that it will hold in all particular cases. Structural features vary with depth; subordinate folds may not persist and main folds may flatten and thus the pay-zone may die out or be shifted in position with regard to the anticlinal axis. For example, in the case of the Dufferin mine, rich ore was found at the apex of the fold at the surface, but in the underlying veins owing to the flattening of the dome it was more remote from it.

Genesis.—Some of the earlier investigators such as Hind and Hunt, maintained that the interstratified veins are syngenetic, that is, were formed contemporaneously with the containing rocks, but later students of the Nova Scotia gold fields are thoroughly convinced that they are epigenetic, i.e., deposited subsequently. That the cross-veins are of later origin all are agreed.

Campbell, the pioneer in the gold fields of the province, expressed the opinion that the veins were of later origin than the rocks, and Selwyn and Poole were strong supporters of his theory. The opinion that prevails to-day is that the veins were formed during the folding of the rocks, in the openings produced by the movements of the strata. During the folding of the interstratified beds of slate and quartzite, or shale and sandstone, there was a certain amount of slipping of one bed over another. This slipping produced openings along the bedding planes, which were in general widest at the apex of the folds, and decreased in width with depth along the limb until at a depth of a few hundred feet they pinched out. During or subsequently to the formation of these openings, which took place within the less resistent beds, the vein filling was introduced by solutions. Thus is explained the dependance of vein distribution on rock structure.

The arching of the rocks on closely folded symmetrical domes produced fissures passing over the apex and down each limb; on broad domes the arches were not strong enough to sustain themselves and the fissures were formed only on the limbs; on unsymmetrical domes the slipping of the strata was such as to produce fissuring along the bedding planes of the limb with the higher angle of dip; and subordinate flexures, in which the strata were given a curve of less radius than ordinary, were especially favourable to the production of fissures.

The process of folding was long continued and the deposition of vein matter probably took place during the process. Small fissures were formed along the bedding planes and filled with quartz only to be followed by other parallel openings between the quartz sheet and the slate and further precipitation of quartz in the new openings. Films of slate adhering to the quartz forming the wall of the new fissure thus became embedded in the vein. A succession of such events produced the laminated character of the interstratified veins. It is also probable that in many cases the quartz was deposited in the slate along a number of parallel planes lying close together in an area of minimum pressure and that the quartz film increased in thickness through a widening of the spaces either by the folding of the strata or by metasomatic replacement.

The bulk of the evidence shows that the veins were filled by ascending solutions of a deep-seated origin. These found a passage upward through the fractured portions of the domes. A fracturing across the bedding as well as fissuring along the bedding planes seems to have been necessary for the formation of veins and ore deposits: veins are not commonly found along straight non-pitching anticlines although there was, no doubt, a great deal of fissuring along the bedding planes; on the other hand, where the anticlines pitch and the rocks were fractured across the bedding, veins are abundant. The cross fractures are themselves filled with quartz forming the angulars entering and leaving the interbedded veins. The cross fractures seem therefore, to have provided channels for the passage of solutions across the beds of quartzite and slate to the interbedded fissure along which deposition took place. That the solutions entered by way of the angulars is borne out by the fact that the rich portions of interbedded veins are those portions lying between the line of entrance of an angular and the line along which it leaves the main lead.

Briefly stated, the observed facts seem to be best explained on the theory that the veins are epigenetic, that they were formed by the deposition of quartz, sulphides and gold in cross fractures and interbedded openings occurring chiefly in the black or pyritous slate beds of the Goldenville formation, that the conditions necessary for the formation of the veins were a great deal of fracturing across the bedding planes, permitting the passage of ascending thermal solutions and that these fractures were produced where the two horizontal orogenic forces manifested themselves in the formation of domes or the pitching of the anticlines.

*Geol. Surv. Can. Vol. v, p. 57 A. A. and Vol. x, p. 108 A.

THE SHIELDS-THIELMAN SECTIONAL JIG CLASSIFIER AT QUINCY MILL, MICH.

Among the changes made in recent years in treating Michigan copper ores some of the most important are improved methods of classifying the product from the stamps. The jigs devised are remarkably efficient machines and treat an enormous amount of material in a short time.

Recently at the Quincy mill a very satisfactory classifier of a new type has been devised. This is a sectional hydraulic jig classifier, which is making a remarkable recovery of the copper of all sizes and classifying the remaining material for treatment in regrinders and on tables.

The following is an authentic description which has been published in the Mining Gazette:

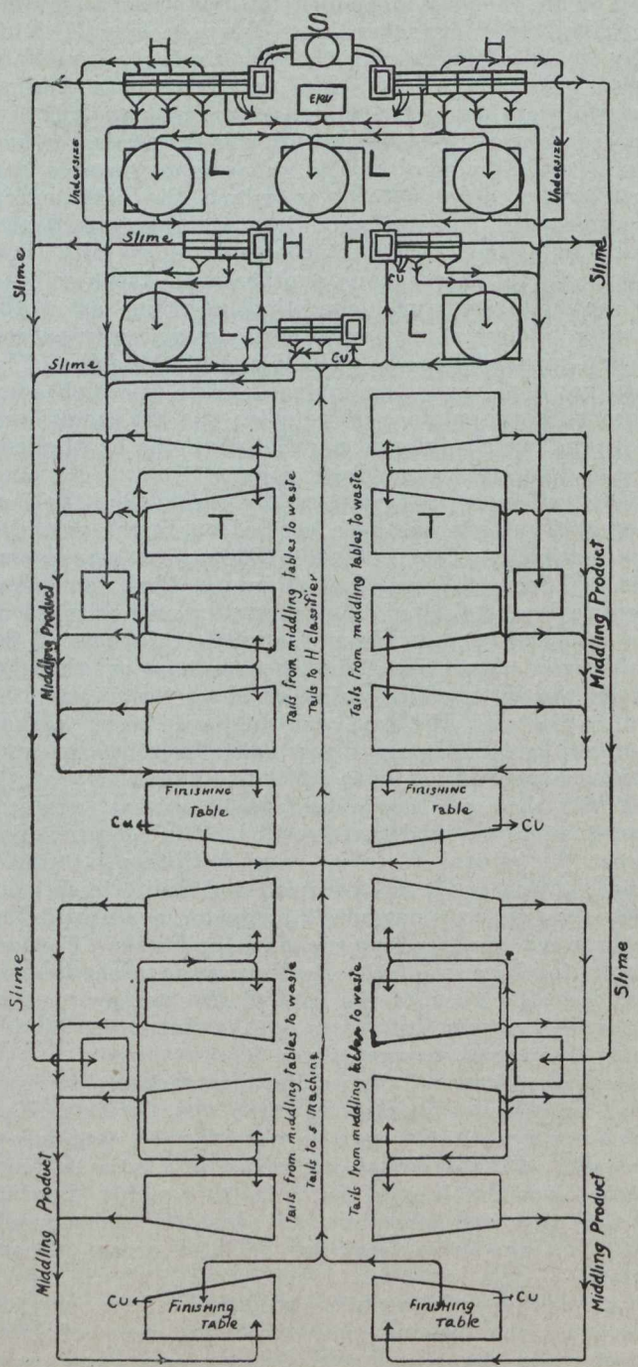
"A machine has been designed at the Quincy stamp mills that tends to revolutionize the treatment of the so-called roughing floor material or roughing jig material where at least 60 per cent. of the losses from all the mills are. It has been in successful operation for eight months and the results have been better than expected. The machine takes up a space of about 12 ft. by 4 ft. and has a capacity of 500 tons.

"At the present time the machine is taking the mixed feed direct from the stamp, the feed coming through a 5/8-inch grate and running direct into the machine. The trommel screens have been discarded together with all the shafting, belting, gearing, etc., that goes with it, also the ponderous bull jig together with its shafting, hangers, belting, etc. The roughing jigs can all be discarded as this machine does all the work of the roughing jigs also. It sorts or classifies the material in about 20 different classifications and at the same time takes out between 65 to 70 per cent. of the total copper direct from the stamps, copper ranging in size from 5/8 down to table copper.

"This simplifies the present practice as the copper at the mills on Lake Superior is scattered all over the different machines, amounting in some cases to as many as 20 to 30 on the roughing floor alone. This machine by taking out so much copper and sorting out the material to be ground, and confining it in a small space simplifies the treatment of the roughing material to a very great extent. Grinders can be placed directly in front of this machine on the roughing floor, and the material coming from the different plugs can be sampled, assayed, and, if rich enough to be ground, can be turned directly into the grinding machines after the free copper has been taken out. This treatment is very simple.

"The problem is to gather together material worth grinding and discard material practically worthless, or in baseball parlance, let the bad ones go by and hit the good ones hard. This has been accomplished to such an extent with the machine that it is hardly believable. The machine takes only from three to four horse power as against 25 to 30 horse power on the present mill practice to do the same work, and a space of 12 ft. by 4 ft. against a space of 40 by 25 ft.

"The machine is called a sectional positive jig classifier, and is made up of a number of sections that can be added to at any time without dismantling the machine. The several sections are divided into pockets of 6 by 12 and 12 by 12 in size, each having a positive plunger, and an independent adjustable stroke. This is very essential in the treatment of the different sizes of material ranging from 5/8-inch to 100 mesh. The plungers are all made of brass, and each plunger carries an oil bath inside, submerging the pin on the plunger at all times in a bath of oil. The plunger cas-



Flow Sheet of Proposed Mill for Treating Michigan Copper Ores.

S—Steam Stamps. H—Shields—Thielman Classifier.
L—Regrinding Machines. T—Concentrating Tables.

ings are made of cast iron, and are independent of each other, and can be removed or replaced at any time if necessary in quick time.

"The sections are lined with a cast iron box to protect the sections proper from wear. They conform as

to shape with the partitions in the hutch pockets. Each pocket has a plug of its own, and the material from each pocket is discharged independently. The present roughing jig practice in the mills is more or less crude, inasmuch as there is material going down on the roughs that should go on tables and into a grinder instead. To mix this material on the roughing jigs and afterwards is a difficult proposition, as it cannot be positive, and requires careful watching. The one great object of this machine is to get copper quick, and to sort out the material that is ground without scattering both copper and the to-be-ground stuff all over the mill. Another object is to get rid of the trommel screens, bull jigs, roughing jigs, hangers, shafting, sieve frames, plunger-boards, skimming, sieve wire, and all that goes with the present-day lay out. Both objects have been accomplished."

Mr. Jas. Shields, superintendent of the Quincy mill, claims that the copper stamp mill of the future will contain none of the usual jigs, trommels and classifiers, and gives the accompanying flow sheet as an example of the new type of mill in which the machinery is essentially, stamp, sectional jig, classifier, regrinder and tables.

BRITANNIA MINE, HOWE SOUND, B.C.*

By R. G. McConnell.

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.

Rocks.—The Coast range is built predominantly of granitoid rocks, mostly coarse quartz diorites or granodiorites, but contains at various points a number of inclusions of the older rocks invaded by the granitic magma. There vary in size from small angular fragments, a few feet across, to wide bands extending along the range for miles. The mineralized zone at the Britannia mine occurs in an inclusion or undestroyed area of the intruded rocks from one to two miles in width and running southeasterly from Howe sound for a distance of more than seven miles.

The rocks in the inclusion consist largely of slate, alternating with a dark intrusive, probably a diorite porphyry, usually crushed and altered into a greenish chloritic schist. Volcanic rocks, mostly porphyrites and hardened fine and coarse fragmentals, occur near the northern border of the inclusion.

The slaty rocks, when unaltered, are dark in colour and contain considerable carbonaceous matter. They are seldom regularly cleaved except for short distances and in places pass into fine-grained quartz biotite schists. A hard quartzitic variety due to silicification is common, and alterations into grayish and silvery white quartz sericite schists occur over large areas.

The crushed dioritic intrusive is economically the most important rock in the group. It forms the country rock at the Britannia mine and is also heavily mineralized at other points. It alternates with the slates and their altered equivalents, the sericite schists, in bands and lenticular areas ranging from a few feet to more than 1,000 ft. in width. Like the slates it exhibits varying degrees of alteration, often passing in a short distance from a hard, irregularly joined, gneissic rock to a soft, greenish, well foliated, micaceous schist. A light green variety, spotted conspicuously and fairly regularly with dark green chlorite films often half an inch or more in length, forms the principal country rock along the mineralized zone at the Brittania mine. The origin of the green films has not been definitely determined. They may represent crushed ferro-magnesian phenocrysts, but possibly are derived in part at least from small fragments of slate included in the intrusive and subsequently crushed and altered.

Dikes genetically connected with the surrounding Coast Range batholithic rocks, usually abundant in inclusions, are rare in the Britannia area, except near the contact.

An excellent section of the alternating slates and crushed intrusives is afforded by a tunnel driven from Britannia creek at an elevation of 2,100 ft. above sea level southward diagonally across the strike of the rocks for a distance of 4,200 ft.

Mineralization.—Mineralization at the Britannia mine is on an extensive scale. The deposits are of the replacement type and are formed along wide, irregularly fissured zones, enclosed in and striking with the greenstone schists. The most conspicuous croppings occur in the Jane and adjoining claims to the east and consist of two high iron-stained bluffs, about 1,000 ft. apart, facing each other across the drift-covered bottom of Jane Creek valley. The mineralized zone exposed in the two bluffs consists of silicified schists impregnated with iron, copper and zinc suphides, and has a width in the eastern or Mammoth bluff of fully 200 ft. It undoubtedly extends across the concealed interval separating the two bluffs and may be considered to have proved minimum length of 2,000 ft.

East of the Bluff mineral zone a number of disconnected croppings occur in the steep mountain slope covered by the Fairview claim. A tunnel driven under these from the Mammoth bluff at a depth of about 1,000 ft. below the crest of the ridge resulted in the opening of a second important mineral zone, practically a continuation of the Bluff zone, but separated from it by a short lean stretch. The strike is also 30 degrees more to the south. Development work on the second, or Fairview zone, is still in progress, and its full dimensions have not been ascertained. The work done up to the present has shown it to have a minimum width of fully 500 ft., made up of bands of commercial ore, separated by barren, or nearly barren, schists. Drifts have been carried along the zone for a distance of 1,200 ft.

*Appendix to International Geological Congress Guide Book No. 8, published by Geological Survey, Canada, 1913.

Minerals.—The metallic minerals in the Britannia ore bodies 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.

Ores and Ore bodies.—The wide Bluff mineral zone originally worked is practically a low-grade copper deposit throughout its whole extent. Pyrite, in masses, disseminated grains, and in veinlets through the silicified country gangue, is the most abundant mineral present. Chalcopyrite, in small lenses, veinlets, and scattered grains, occurs with the pyrite, but in much smaller quantities, and in places a notable percentage of blende is present. No mining is at present being done on this zone. A considerable quantity of ore was mined and concentrated before the discovery of the Fairview zone, but the venture was not commercially successful. Since then transportation to the coast has been improved and better methods of treatment largely increasing the recovery of metal have been adopted, so that the ores could probably now be mined and treated at a fair profit. The average tenor in copper is about 1.5 per cent.; in addition the ores contain 0.5 to 1 oz. in silver, and in the western portion of the zone, 40 cents in gold.

The character and distribution of the ores in the Fairview zone differ markedly from those in the Bluff zone. The chalcopyrite, the principal valuable mineral present, in place of being disseminated more or less irregularly through the whole width of the zone, is concentrated along certain lines in fairly definite ore bodies, ranging in width from a few feet or more, which have proved very persistent. The ore bodies are not confined between walls and are marked mainly by a more or less complete cessation of both metallic and non-metallic mineralization. They are approximately parallel, but occasionally diverge or unite at low angles. The dip is to the south, at an angle of about 70 degrees and is conformable or nearly so to that of the enclosing schists. In the present workings, six ore shoots have been encountered and followed for varying distances up to 1,000 ft. The vertical range has been proved for 500 ft.

The chalcopyrite in the ore bodies occurs characteristically in fairly large, nearly pure, aggregates, usually as short lenses, occasionally a foot or more across, in stringers interleaved with or cutting the schists at a low angle and in reticulating veinlets penetrating the silicified schists in all directions. Only a small percentage occurs in disseminated grains. The quantity present varies in the different ore bodies and along the dip and strike of the same ore body. The general average tenor in copper of the whole system of leads is given at 2.5 per cent. The silver content is small, amounting only to about 0.5 oz. per ton, and gold occurs only in traces.

The proportion of pyrite present is much smaller than in the Bluff zone, and zinc blende, prominent in the latter, is absent.

The production in 1912, according to published statements, amounted to 193,000 tons, yielding 14,300,000 lbs. of copper, and 76,500 ozs. of silver. The present production is approximately 600 tons per day, the full capacity of the present transportation facilities from the mine to the mill.

Development.—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 ore bodies, serve to explore the zone for a distance of 1,200 ft. along the strike and 500 ft. along the dip. A long tunnel at a depth of 1.200 ft. below the present lowest level, starting from Britannia creek and running toward the ore zone, is now completed to a point beneath and a short distance west of the ore bodies worked. This will be connected in the near future with the upper workings by a large 3-compartment shaft and an ore chute. The extension downward of the ore bodies below the 1,050 level can be reached from the shaft by short crosscuts.

Treatment of Ore.—The chalcopyrite in the Fairview ore bodies 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 concentrating 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 4 by 6-ft. trommel with 1½-in. perforations. The over-size discharges on to a sorting belt, and about 50 tons of 12 per cent. ore and 150 tons of waste are picked out 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 in these machines.

Flotation Process Used.—The tailings and the undersize from 1½mm. 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 still 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.

Equipment.—The present equipment is inadequate to the needs of the mine, and extensive improvements and enlargements are being made. A new concentrating mill with a daily capacity of 200 tons is contemplated, and work is in progress on a system of transportation of the ores from the mine to the Beach, which involves the construction of a double-track gravity tramway a mile in length with an average grade of 15 per cent.; a switchback track five miles in length with a 3 per cent. grade on which gasoline locomotives will be used; a 9 by 12-ft. tunnel, 3,600 ft. in length; and a 1,200-ft. vertical chute connecting the tunnel with the present workings.

Water power developing 1,800 h.p. from Britannia creek is largely used to operate the mill, compressors and other portions of the extensive plant, and this, with 650 h.p. obtained from steam, is ample for present requirements.

THE PHYSIOLOGICAL CHARACTERISTICS OF ACETYLENE WITH RELATION TO ITS USE AS AN ILLUMINANT IN MINES*

By E. E. Smith, Ph.D., M.D.

A modern philosopher has told us that life is the continuous adjustment of internal relations to external relations. This means, in less abstract language, that to live we must adapt ourselves to our surroundings. So long as we are able to do this, we live healthful lives. When we are unable to do so, ill-health and death supervene.

Civilization has modified in many ways the external conditions to which we must adapt ourselves. Tent life which was native to the tribe has now very largely given away to house life. That this change has involved adaptation to the new external conditions is illustrated at the present time by the American Indian. With him it appears too often that house life means being domiciled in squalid cabins surrounded with accumulations of filth which becomes the source of disease, conditions that do not exist with the fresher air, ventilation and the frequent change of site of tent life. In order that the change be beneficial, it is important to so regulate the civilized form of living that by avoiding these unhygienic conditions civilization be brought within the capacity of adaptation of the Indian.

This somewhat primitive illustration indicates the general law that new external conditions, without regard to the fact that they mark a signal advance in civilization, must be scrutinized with whatever care may be necessary to determine what is to be avoided that the new conditions may be established to our benefit. It is in this spirit, or at least it should be, that every economic advance receives attention. What are the problems of adjustment which it presents and how may they be solved so as to reap the benefit of the advance and avoid possible disadvantages?

With illuminants, the problem of adjustment have ever been definite and impelling. What concern was in the minds of the generations who worked out the problems presented by the evolution of the candle we need nothing more than conjecture. It may be that the ember of the rosin pine knot gave way to the dip in the candle without apprehension on the part of the housewives of the times, but what we know of human nature strongly suggests that the fear of spattering, the danger of clothes and hangings being fired, the matter of the formation of soot and the possibility of the extinction of the flame by draughts were problems quite as serious to the era of the candle as have been those presented to later generations by the advance which they have witnessed.

The working out of some of the problems presented by the use of oil is within our memory. The newspapers of fifty years ago gave many accounts of lamp explosions with disastrous fires, involving loss of property and life. It remained for the oil chemist of that day to point out the necessity of fractioning the oil, separating the highly volatile and explosive lighter oils and securing the safer and more efficient fraction for use as an illuminant.

The problems of adjustment in the use of common illuminating gas are yet with us. Its poisonous action has by accident ended thousands of happy lives and by intent perhaps as many unhappy ones; and is continuing to do so and, indeed, from its nature must so long as it is used. Its use has been an important factor in the development of modern city life, but it has not been without its price.

So, too, we must acknowledge the loss of life associated with the use of electricity. The innocent wires that transverse our streets and buildings have been and still are the cause of many conflagrations and violent deaths. The brilliant light thus shed by which night is made day is not without its list of fatalities.

Indeed, the fact of new external relations must inevitably carry with it the problems of the adjustment to the internal relations that constitute life. Such adjustment must be continuous. It is necessary and important to every advance to recognize the new external relations that they may be maintained within the capacity of adaption to internal relations, so that their benefits may be realized and their dangers avoided.

Let us, then, in the time at our disposal, look at some of the problems of adjustment presented by the modern use of acetylene as an illuminant.

Acetylene is not a direct poison.—Though the division of our subject naturally first directs attention to the carbide or acetylene production as any industry, we shall limit our attention to the problems of adjustment presented by the use of acetylene as an illuminant. This leads us at once to the inquiry. Is acetylene a direct poison? The answer is no. This question is asked with some seriousness, however, because on the one hand of the notoriouly toxic action of common illuminating gas, due to the carbon monoxide which enters so largely into its composition, by reason of which the mind of the inquirer is already not only prepared to believe that acetylene is poisonous, and in fact, in some instances has that idea rigidly implanted there. It is further asked with seriousness, because, in the literature of the subject, we find some views that it is poisonous. Early writers declared that it combined with the blood and had a marked poisonous effect, like carbon monoxide.

It is capable of doing injury.—Any gas, when it replaces air, if incapable of supporting respiration, is injurious and even fatal, not because it is poisonous, but because it deprives the body of oxygen. Because of this, acetylene is capable of doing injury. If it accumulate in some small, unventilated space, like the cabin of a boat, it is entirely capable of shutting off the supply of air, of preventing respiration and hence harm and even death. It suffocates because it is incapable of supplying oxygen without which man cannot live.

When acting in this way, acetylene is not a direct poison; it does not do anything to the body that injures it. It does harm only indirectly by withholding air.

*A paper read at a recent meeting of the International Acetylene Association.

The recognition, then, of injury by suffocation throws no light on our inquiry whether it is a direct poison. The presence of common illuminating gas in air even to the amount of a fraction of a per cent., is distinctly injurious and may even be fatal, though such air contain an abundance of oxygen. The carbon monoxide contained in the illuminating gas enters the blood through the lungs and attaches itself strongly to the coloring matter of the blood, rendering it incapable of taking up the oxygen of air though the air contain oxygen in sufficient amount. Thus death supervenes not because the body is denied oxygen, but because through the fixation of the coloring matter of the blood, it has lost its capacity to use oxygen. Has acetylene this or any other directly poisonous action? Some early observers said it had. They found fixation of haemoglobin quite similar to that of carbon monoxide and accordingly declared acetylene a poison. Moreover, it seemed to exercise the action of a direct poison on animals.

All this happened before the production of acetylene from carbide. It happens that the acetylene was made by the incomplete combustion of coal-gas, and that in this process more or less carbon monoxide was present in the acetylene obtained. What wonder, then, that there was some degree of toxic action of the acetylene examined! It contained carbon monoxide, the poison of common illuminating gas.

Carbide acetylene does not contain carbon monoxide.—With the discovery of carbide and its use for the production of acetylene, all of this has been changed. It is found that carbide acetylene does not contain carbon monoxide, and that it does not have the property of fixing haemoglobin, and that it does not rob the blood of its capacity to take up oxygen from the air and carry it into the tissues. Hence the old allegation that acetylene is a poison because it deprives the blood of its oxygen-carrying capacity is no longer justified.

Another poisonous product sometimes present in the acetylene made by the combustion process was hydrocyanic acid. Never in large quantities, it yet is so toxic that we can fully appreciate its effect. It is not present in the carbide acetylene and so may be dismissed from consideration.

Another charge that is no longer justified is that acetylene is a poison because of the presence of phosphine as an impurity. This forms when carbide is made from limestone containing phosphate, the action of the coke reducing the phosphate. The selection of limestone free from phosphate has practically obviated this impurity and any poisonous action of the acetylene consequent thereto.

Indeed, the present day product may be said to avoid the pitfalls of impurities so that its effect is determined by the action of acetylene itself. We may consider then whether acetylene as such is or is not a direct poison.

Small amounts of acetylene produce no effect.—My present observations have been directed to the inquiry whether it produced noticeable effect on human subjects, when present in increasing amounts up to 2½% during a period of 2½ hours. To this end, four men, including myself, were enclosed in a room of about 800 cubic feet capacity and at the beginning and four times subsequently at intervals of a half hour, acetylene was liberated into the room by throwing 450 grams of carbide into an open tub of water, this corresponding to the liberation of 4 cubic feet of acetylene, each time; that is, 20 cubic feet in all, 2½% of the capacity of the room.

To eliminate, as far as possible, the mental effect of the environment, the subjects were engaged in playing a game of cards. They were interrupted only long enough to take readings of their blood pressures, at half hour intervals. The results of the experiment were quite negative. The game was continued throughout the time, excepting as noted. The blood pressure remained constant with one subject and was very slightly lowered from the inactivity with two and, of course, in the card game two men were defeated and two won, but there was absolutely no effect noted that could be ascribed to any poisonous or other action of the acetylene. It was without effect.

This same result has been obtained in experiments on animals. In such amounts as used in the above experiments there is no effect. Indeed, acetylene may be increased up to 20% and, if the mixture is so made as not to reduce the amount of oxygen, animals may be left in the atmosphere for some time, an hour or more, and will only become drowsy, from which they quickly recover when removed into ordinary air.

Large quantities induce drowsiness.—With very large quantities or with 20% admixtures acting for a longer time, the degree of drowsiness is increased. That is to say, the effect of acetylene in large doses is that of a narcotic, producing loss of consciousness in proportion to its degree of action. When this action is pushed to a fatal termination, the final action is upon the breathing centre, inhibiting its action and so producing death.

It thus appears that carbide acetylene is not poisonous in the sense that common illuminating gas is and that in large quantities, acting for some time, it produces a narcotic action. In respect to its toxicity, it presents no problem of adjustment under ordinary conditions. It, of course, may not replace in large degree the atmosphere we breathe, but otherwise it need not be anticipated that it produce any poisonous action.

There are a number of interesting problems presented in connectiton with the use of the acetylene lamp as an illuminant in mines. I do not refer to those conditions where explosive gases are present and where protection from explosions is obtained through the use of the Davy lamp in some of its modifications, but to that large number of mines where this danger is not presented and which are regularly illuminated by the naked flame. For this purpose, the miner's oil lamp has been used. It is light in weight, but its illuminating capacity is strikingly low and, moreover, is obtained at the expense of a smoking out process that is amazing. It is a tribute to the miner's endurance that in the past he has accomplished so much under the conditions of poor illumination and soot-laden atmosphere which the use of the oil lamp of the past has meant. The use of the miner's acetylene lamp affords an illumination that is wonderfully efficient and entirely soot free. Its use raises some questions that we may at this time answer. Before considering these, let us look at some of the problems which the miner has to face upon which the choice of an illuminant may have some bearing. Of first importance is the composition of the air which he breathes.

Composition of the air breathed by miners.—For our present purpose, we may regard the atmospheric air as a mixture of 21 parts of oxygen and 79 parts of inert gas, mostly nitrogen. It is the oxygen that supports life. The proportion of oxygen may be diminished to a certain extent without noticeable effect, especially if the difference is made up by inert nitrogen. Under these conditions a reduction to 14% produces little or

no physiological effect. When the reduction reaches 12%, there is apt to be slightly deeper breathing, while 10% is an amount distintly below what is physiological. Seven per cent. may be regarded as the fatal point. It is an amount too small to support the life of animal or man for any considerable time. It must be kept in mind that these figures 10% the physiological insufficiently and 7% the fatal point are for oxygen with inert nitrogen, and without the admixture of poisonous gases.

As you know, there is always present in atmospheric air a small amount of carbon dioxide gas, commonly known as carbonic acid. This amount is very small, ordinarily not over 5 parts in 10,000. It is a product formed from the combustion of organic matter and is present in air that is exhaled from the body in breathing. As we shall see later, it is also a constituent of mine gases and so is of particular interest to us. I want to call your attention to what happens when it is added to the air.

The Physiological effects of increasing proportions of carbon dioxide.—To answer this question I have myself made direct observations. The apparatus employed was a closed cabinet, the inside measurements of which were approximately 67 by 30 by 69 inches, having a capacity of 80 cubic feet. It was provided with a sliding door. Into the top a pipe entered and connected with three "sprays," one in each third of the top. Through this system gases were introduced. There was a small sample tube, easily moveable, so that gas was withdrawn from the location desired within the cabinet, which was connected outside with (a) an exhaust bottle for withdrawing residual air from the tube; and (b) a gas sampling tube. Collections were made over mercury and analysis were made over mercury in a Hempel apparatus. The cabinet was tightly built, but not sufficiently so to prevent escape of air sufficient to equalize the pressure without and within the cabinet when gas was introduced. A moveable electric fan within the cabinet was adapted to produce motion of the air.

When carbon dioxide was mixed with atmospheric air, it was noted that such mixture produced an increased rate of respiration, even when the proportion of carbon dioxide was small. Rabbits and guinea-pigs showed a marked increase when as much as 4 to 5% of carbon dioxide was present. With increasing proportions respirations became deep and labored, frequently, as was observed in guinea-pigs, reaching a condition of diaphragmatic spasm. Loss of muscular power developed so that, with guinea-pigs, there was loss of ability to support the body when the carbon dioxide proportion reached 20-25%. These symptoms developed irrespective of whether lamps were burnt in the same atmosphere. With rabbits, when lamps were burning, loss of muscular power appeared with the same carbon dioxide proportion as with guinea-pigs, but in the single observation made without lamps, the loss of power appeared when the carbon dioxide proportion has reached 36%. There was no effort made to determine the carbon dioxide proportions that would produce death, as it was believed that the proportion producing loss of muscular power represented the limit of possible tolerance. It may be noted, however, that in the experiment carried to a 36% carbon dioxide proportion, the rabbit quickly recovered, two guinea-pigs recovered somewhat slowly, and one guinea-pig died, when the animals were removed into fresh air. Thus it appears that even with quinea-pigs, the fatal carbon dioxide proportion is not much if any below 36%, while the carbon dioxide warning point is not above 4 to 5%.

To test the effect of carbon dioxide on man, 10½ cubic feet of carbon dioxide were passed into a cabinet, when a young man entered, the door being opened for that purpose and quickly closed. After entering, the fan was started. The rate of respiration at once rose from 18 to 48, being deeper and labored. He almost immediately complained of feeling dizzy. At the end of 2½ minutes there was a feeling of impending loss of consciousness. A sample of the air mixture was at once taken and at the end of three minutes the man came out. His respiration quickly returned to normal but his face was flushed and he complained for several hours of a slight frontal headache. Analysis of the sample showed a carbon dioxide proportion of 7%. The experiment indicated that with man the warning point is reached below a carbon dioxide proportion of 7%.

There is increase in the rate of breathing which with 3 per cent. dioxide has become so marked that it gives unquestioned warning to the subject that some unusual condition of the air is rendering it unsuited for breathing. We may call this the physiological warning point for carbon dioxide. When the concentration reaches 8 to 10%, the breathing is not only rapid, but becomes very laboured, a condition termed dyspepsia. Beyond 15%, further concentration instead of increasing respirations decreases them and the animal becomes narcotized, quite as though a substance like chloroform had been administered. At a concentration beyond 35% the narcosis becomes fatal.

I have gone into these matters of the influence on breathing, and on life of oxygen decrease and of carbon dioxide increase because these are conditions that may be presented by the air in mines. Moreover, the oil lamp has been used to indicate to the miner whether or not the mine air is fit to breathe, air that sustains the flames being regarded as safe and air that extinguishes the flame as unsafe to breathe.

The disadvantages of the oil lamp are all too apparent. Its dingy light limits the working capacity of the miner from the poor illumination. Aside from working capacity, the miner is not so well able to see the elements of danger presented by weakness in overhanging structures. An even greater disadvantage is the production of soot by the flame. This both adds to the personal discomfort already great and also to the danger of dust explosions by addition of the soot to the dust-laden atmosphere.

Advantages of acetylene lamp.—These conditions render an illuminant that is brilliant and soot free a very great advantage. The acetylene miner's lamp supplies such an illuminant in an admirable manner. In connection with its use it is desirable to determine the relation to composition of mine air, so that the miner may know in what way and to what extent it replaces the oil lamp as an index of safety. That is to say, we have a problem of adjustment to which it is important to give a correct and definite answer.

First, then, let us consider the variations in composition that may be presented by mine air. Because of the limitations of access of outside air and especially because of the formation of gases in mines, mine air may present a considerable departure from the composition of outside air.

All ordinary foreign gases were known to the early miners as "damps," from the German damf, meaning vapour, the specific designation being indicated by an individual prefix. Thus, the gas characterized by its tendency to extinguish the flame was called black-

damp, or, since it tends to produce suffocation, choke-damp; the damp producing increased brilliancy of light, white-damp; that with a marked stink, stink-damp; that which readily took fire, fire-damp; the gas resulting from burning or explosion, after-damp, etc. The names were applied long before the composition of the respective gases was known. In consequence of indefinite basis of the classification, an individual name was in many instances applied to mixtures that presented wide variation in composition.

Black-damp, on chemical analysis, has ordinarily proved to be a mixture of carbon dioxide and nitrogen, the proportion of carbon dioxide varying very little up to 15% or perhaps exceptionally 20%. As it is always mixed with more or less air, a corresponding amount of oxygen is present. Other gases, such as methane (fire-damp), carbonic oxide (white-damp), hydrogen-sulphide (stink-damp), also water vapour, may be present in greater or less amount.

We may well ask, then, what the name black-damp indicates. Does it mean carbon dioxide, which is the characteristic constituent; does it mean the carbon dioxide nitrogen mixture; is it the carbon dioxide nitrogen air mixture; or is it the combination of any of these with other gases that are present in the mine air? Unfortunately, there has been no unanimity of usage in regard to this term, it having been used by different writers in almost every one of the above possible meanings.

If we were to establish anew the definition of the term, it would be doubtless wise to adopt a scientific meaning. As the matter stands, our meaning should be decided by priority, which is that black-damp is not simply carbon dioxide, but rather a mixture of that with nitrogen in varying proportions, but we must not forget the different usages of individual authors.

Our problem is: How does the admixture of black-damp modify the respirability of mine air and how is this indicated by the oil and acetylene flames? It requires no facts other than those now before us to appreciate that it affects respirability in two ways. It diminishes the proportion of oxygen which if reduced to 10%, would be unphysiological and to 7% fatal; and it increases carbon dioxide which when present to the amount of 3 to 4% would produce marked increase in the rate of breathing.

As to when the change in composition, especially the carbon dioxide increase, is indicated by the particular flames, has been the subject of personal experimental observations. The cabinet employed in the experiment with man previously described was used. In the earlier experiments with carbon dioxide, this gas was fed into the cabinet without previous admixture with air; in the later ones both air and carbon dioxide were fed into the cabinet through meters, entering the cabinet through a common tube. Thus they were well-mixed and the rate of flow of each was regulated.

Early experiments indicated that various factors influenced the extinction point, both for oil and acetylene lamps. Let me relate what these factors were and how they exercised their influence.

A. Acetylene Gas Pressure.

From the outset it was observed that the pressure under which the acetylene gas was fed through the burner exercised a marked influence upon the extinction point. That is to say, with a series of lamps in which the acetylene gas pressure varied as indicated by the character of the flame, it was not difficult in a mixture of increasing carbon dioxide proportion to foretell the order in which the lamps would be extinguished, the lamps with higher acetylene gas pressure going out first. Indeed, it was frequently observed where the escape of gas from the burner was under such slight pressure as not to give direction to the flame that the extinction point would be very much higher than was observed with the ordinary burning flame. Care was therefore exercised to make our observations on lamps in which the gas production showed a normal amount of pressure.

B. Air Movement.

When there was no movement of air, excepting such as resulted from the convection currents produced by the lamps and by the introduction of the gas mixture, the extinction points were: for the acetylene lamps 23 to 25% carbon dioxide; for the oil lamps, 12-14% carbon dioxide. With the production of a gentle movement of the air by fanning against the side of the cabinet, the extinction points were apparently affected, being lowered in the case of acetylene lamps to from 22 to 17% carbon dioxide; in the case of oil-lamps to from 12-10% carbon dioxide.

With the production of a strong movement of the air, by direct fanning of the lamps, in two experiments, the acetylene lamps were extinguished when the air contained 9.4% and 9.9% carbon dioxide, respectively, while the oil-lamps were extinguished by the same breeze in atmospheric air.

The movement of the lamps worn on the heads of the miners would produce, in quiet air, the effects that result from a breeze with the lamps stationary. We may conclude, therefore, that in the case of the acetylene lamp the extinction point is lower than 25%, in proportion to the rapidity of motion; and with the oil-lamps, correspondingly lower than 14%.

C. Oxygen Proportioned.

In the experiments mentioned, the oxygen was reduced only moderately by the admixture with air of the carbon dioxide in the form of pure gas. Undoubtedly, such reduction tends to lower the carbon dioxide extinction point. The effect, however, is only moderate, since the oxygen in all experiments was distinctly more than would sustain the flame if the specific effect of the carbon dioxide were neglected.

With the admixture of carbon dioxide in the form of black-damp, however, the question of the oxygen proportion becomes an important factor for consideration. In these preliminary investigations, we were not able to study the effect of black-damp, since with the use of so large a cabinet, the quantity of nitrogen required would be much greater than it was practical to obtain.

D. Humidity.

In a number of experiments, water vapour was introduced into the gas mixture by blowing over the surface of water within the cabinet. In this way, the humidity was raised from approximately 35 to 65—80. Any effect upon flame extinction by carbon dioxide that may have resulted was within the limits of variation from the other factors considered. The conclusion is therefore reached that humidity affects the proportion of carbon dioxide, producing flame extinction only within relatively narrow limits.

Comparing now the effects of carbon dioxide increase on flame extinction and respiration, we note that the first effect is a physiological one, when the proportion reaches 3 to 4%, there being an increase in the respiratory rate that is entirely adequate to warn per-

sons of the atmospheric conditions. Flame extinction occurs with oil at 13% and acetylene at 26% in still atmosphere, but at 10% and 17% with moderate motion. With either lamp the extinction point is too high above the physiological warning point to make it of value to the miner. The conditions will have been recognized before the extinction point is reached. Should, however, the physiological warning be unheeded, flame extinction will occur, first with the oil then with the acetylene flame, with either in ample time to prevent loss of life. The margin of safety though greater with the oil-lamp is adequate with the acetylene.

In considering the influence of oxygen decreases on flame extinction, I shall make use of observations made by Mr. Chester S. Heath, under experimental conditions different from those I have described.

He finds with the oil-flame that with moderate motion extinction occurs when the oxygen is reduced to 16.5%; in still air to 16.2%. With acetylene with moderate motion, extinction occurred at 12.6% and was dimmed in still air of the same composition, being extinguished in still air 11.5%. It thus appears that the oil-flame is extinguished with considerably less reduction of oxygen than the acetylene, but that the latter is extinguished before the reduction is fatal to man which it will be recalled was at 7%. Moreover, in actual mining conditions, where the lamp is worn on the head, there will be sufficient motion; so that extinction will occur at a point somewhere above that observed with the experimental condition.

Finally it is not to be forgotten that the condition of extreme oxygen reduction without carbon dioxide increase which was preesnt in the experimental observations is not encountered in actual mine air. The specific action of carbon dioxide admixture that will be found in such conditions will add to its effect to the oxygen decrease and bring about acetylene flame extinction that is still further removed from unphysiological atmospheric conditions and hence afford an increased margin of safety.

The miner, then, may conclude that a given admixture of black-damp and air in the absence of other foreign gases will support life: (1) If it does not extinguish flame. (2) If it does not produce markedly increased respiration. Any such atmosphere that does not give these warnings is respirable, though it does not necessarily have a composition desirable for continuous respiration. It does, however, give warning either physiological or by the flame, acetylene as well as oil, that is adequate to prevent loss of life.

EIGHT-HOUR SHIFT IN MICHIGAN

For some time the managers of Michigan copper mines have been planning to shorten the working hours for employees. On November 28, they announced that the change would take place on December 1. The men are now working, in accordance with this announcement, eight hours "face to face."

In the "Mining Gazette" the following explanation of the new arrangement was published on November 29:

The eight-hour day for underground employees and stamp mill men goes into effect next Monday, December 1.

An opportunity is offered miners to add to their monthly pay to the extent of nearly 10 per cent. of their present compensation.

Early in the history of the strike at the mines the mine managers stated in their report to the Governor and to the Federal Department of Labor that the inauguration of the eight-hour day for underground men had long been in contemplation and would be made effective on or before January 1. The statement was repeated in the report made by the mine managers to the committee appointed by the Copper Country Commercial Club.

Making the announcement at this time and making it effective immediately, but follows out the expectations of the mine managers early in the year.

The eight-hour shift will be in operation in all operating mines and mills at once, with the exception of the Calumet conglomerate mine, where practically all of the mining is contract work. There is some doubt as to the application of the new method in operations on the conglomerate lode and it will be tried out in one shaft in that mine of the Calumet & Hecla Company for a period of a week to determine the best way to apply the shorter shift to the working hours of the miners there.

Eight Hours of Actual Work.

At the different mines and mills there are different conditions and different problems to work out in making the change. In general the rule will mean that eight hours of actual work will be required. Only two shifts in every 24 will be utilized. Most of the men on the day shift will start from surface at 6.45 and be back on surface at 3.45, with 30 minutes for noon meal. At some of the mines the night shift will start at 8 o'clock and at others at 8.30.

While nothing was said about the shop forces, office men and surface forces generally, in the promise of the shorter working day, with the change to the eight-hour day for underground men, the announcement also is made that the working day for such other forces will hereafter be shortened to nine hours. In the shops and on surface this change will be very generally appreciated by the men. It is explained that all these forces work day shift all the time and do not have to alternate on the night work as do the underground forces.

Opportunity for More Pay.

The opportunity for increased pay comes to all the miners who wish to work the short shift Saturday night. For years it has been the custom in the mines of this district to pay the miners for 26 working shifts per month, when as a matter of fact they only worked 24 shifts. Ordinarily the underground men worked two weeks day shift. When on the night shift they only put in five shifts and were paid for six. This made a difference of nearly 20 per cent. additional in their pay for the night shift week. Coming twice a month it made a difference of close to 10 per cent. per month in the monthly wages. Under the new arrangement the pay will be at the top rate per day and all men who wish to put in the additional short shift, making it six shifts on the night shift week as well as on the day shift will be given the additional wages. No men will be required to work this short shift, but it is believed that most of the men will be glad of the chance to secure the added compensation because of the shortening of the regular shift to eight hours.

Copper Range's Statement.

While the announcement of the change is to be made by the mining captains to their men to-day, the Copper Range Consolidated, through F. W. Denton, general manager, issued a circular which is applicable only to

the conditions at the Copper Range mines. This circular reads as follows:

"Last winter when there was introduced in the Legislature a bill which proposed to require by law an eight-hour working day for underground employees, we, in a small way, began discussing the introduction of such a schedule, irrespective of whether the bill became a law or not. Although our consideration was by no means thorough, it became apparent at once that there was a difference of opinion on the part of the employees who would be affected as to the desirability of any change in underground hours. In general, our impression was, and is to-day, that our miners prefer the present hours because of the Saturday half-holiday and the absence of work Saturday night, but that trammers, pickers, and labourers are in favour of a change to a straight eight-hour schedule.

"It seems unreasonable and not altogether fair to have one set of hours for one class of underground labourers and another set for another class. It would appear to be better, all things considered, to have the same hours for all. However, whatever the difference of opinion there may be on this score, and there is plenty of room for it, public pressure has been sufficiently great to cause the introduction of an eight-hour schedule in the large mining districts of the country, and we believe that the time has come when we shall have to respond to the same demand, and we have promised Governor Ferris that we would arrange such a schedule by the first of January. We contemplate not waiting that long, but if no reason develops for delay, we propose to inaugurate the new schedule on December 1.

New Schedule Explained.

"In agreeing to adopt an eight-hour schedule we defined that to mean eight hours of work. There has been some discussion in regard to the allowance of time for going to and from work, and the custom in this regard differs slightly in the different districts, as far as I have been able to learn. We propose offering a schedule which calls for an interval of eight and three-quarters hours from the time of starting from the surface to the time of starting up. Of this interval one-half hour is to be taken for lunch and fifteen minutes is taken as representing the time for going down to work.

"Our impression is that the time for starting the day shift that will meet with the most approval is 6.45 a.m., and if the first cage starts down at that time, the first trip up would start at 3.30 p.m., with 12.00 to 12.30 allowed for dinner. For the night shift, it is proposed to start down at 8.00 p.m., which would call for the first trip starting up at 4.45 a.m. It was thought that these hours for the night shift would bring men home at a suitable hour. It may be that starting at 8.15 or 8.30 would be better.

"For Saturdays it is proposed to have the same day shift as for every other day in the week, but the night shift is to start down as soon as the day shift is up, and to start to come up from the mine at 11.00 p.m., making the shift an hour or more shorter than other night shifts and putting everybody up before midnight.

"As to miners working Saturday night; this we believe will be objected to by a great many because of the aversion to working Saturday nights and also because it has been customary in this district for so many years for miners not to work Saturday nights. The company would like to have the miners work Saturday nights the same as other underground labour, both because it would give better operating results and because the present schedule is objected to by the trammers and labourers on the grounds that I have mentioned at the outset, viz.: that there should be no difference in working hours for the different classes of labour. Saturday night shift will also have the advantage of enabling a miner to earn in a month two shifts extra pay.

Pay $3 Per Shift.

"We propose to make the miners' scale of wages on this new basis of hours $3.00 for each shift worked, and a man would be paid only for the shifts that he works. This rate is the same as is now being paid for actual time worked. On this basis, if a man worked his two Saturday nights in the month and thereby got credit for 26 shifts, he would receive, if being paid on a company account rate, $78.00. In fact, the time books will show credit only for the number of times that a man is in the mine, and the old method of giving credit for Saturday nights will be abandoned. If a miner did not work his two Saturday nights he would receive $72.00. The company proposes to be lenient and liberal in excusing men from work Saturday afternoons and nights during the summer months when there is a general desire to be excused for holiday purposes. Men so excused, however, would sacrifice pay for the shifts thus lost. We believe, however, that a sufficiently large majority of the miners would prefer to work Saturday nights to permit of profitable operations. With the constantly increasing burden which is being placed upon us by public demands, which expresses itself in compensation acts, an ever increasing load of taxes, and charges of all sorts, it is absolutely necessary for us to do everything we possibly can to increase our earnings if we would maintain our existence and keep up a profitable enterprise. It is believed that you underground employees will recognize the situation and meet this proposed schedule in a broad-minded spirit and with consideration of your fellow employees, even though in different occupations, and of the company as well as of yourselves. Although not included in our promise to the Governor, we have decided also to inaugurate an eight-hour schedule at our stamp mills. This will involve a very considerable increase in expenditure, but it did not seem fair to shorten hours of some employees and not of others, even though no demands were made for such shortening. For the shops and all other surface work, quitting time will be 5 o'clock instead of 6 o'clock, with one hour for dinner as heretofore."

GOLD PRODUCTION OF NOVA SCOOTIA.

Gold was discovered in Nova Scotia in 1860, and mining operations then commenced. Two years after the discovery, gold valued at nearly $142,000 was recovered from the quartz veins, and since that time the annual production has, with the exception of three years, fluctuated between $200,000 and $628,000, nearly attaining the latter figure in 1902.

The total production of gold in Nova Scotia from 1862 to 1912 inclusive, was 936,499 ounces recovered from 2,117,639 tons of ore mined, this production having a value (at nearly $19.00 per ounce) of $17,793,481, equalling an average recovery of $8.40 per ton of ore crushed.

A DEFENCE OF THE FLAME SAFETY MINE LAMP*

By E. A. Hailwood, M.I.M.E.,

(Manager to Ackroyd & Best, Ltd., Pittsburg and England).

Prior to the days of Sir Humphrey Davy, it was no doubt a natural thing to fix upon the naked flame then in common use as the probable cause of coal mine explosions.

The Davy lamp was then invented, and was thought to be a solution of the difficulties, but, unfortunately, it was afterwards shown that under certain conditions, gas when ignited inside the lamp could be blown through the gauze which surrounded the flame and an explosion created in the mine.

The Davy lamp was, however, remodelled, and the present type of bonnetted marsaut safety lamp was evolved.

It is, however, somewhat unfortunate that the tricks which could be played on the old Davy lamp have so fascinated professors and many so-called Government experts, that they have not been able to realize that the same tricks cannot be played upon the modern safety lamp. These people still devote considerable time in writing about and showing experiments on the safety lamps, and fail to draw attention to the fact that their experiments and their writings really refer to the Davy lamp and that they cannot be performed on the modern lamp.

The natural result is that an unnecessary nervousness is created in the minds of miners and coal operators who have not the time or means at their disposal of learning that these tests do not apply to the modern flame lamp, and whilst the writer agrees that experiments on the Davy lamp are instructive, he contends that it is unfair to the flame lamp manufacturers that more emphasis is not placed upon the fact that the demonstrations refer only to obsolete lamps.

One unfortunate result of these records of experiments is that at the inquiries following an explosion in a mine, many practical men or many so-called experts, get up and calmly state that in their opinion the explosion was caused by a "safety lamp."

From the writer's experience in connection with a vast number of tests on safety lamps, and from a perusal of evidence upon which these statements of experts have been based, the writer is firmly convinced that the persons giving evidence have known little or nothing about the great margin of safety possessed by modern flame safety lamps, or that the person in question has been misled by published tests on the old Davy lamp.

One of the baneful results of verdicts based on such evidence, is that instead of pursuing the inquiry further as should have been done, the actual cause of the disaster may have been overlooked, and perhaps an unnecessary change made in lamps, and yet the real means for creating a fresh disaster still retained in the mine.

Persons who have witnessed the intense heat which is necessary to cause flame to pass from the inside of a well constructed bonnetted lamp to the outside, and which can only be attained after reaching a velocity of over 3,500 ft. per minute of an explosive mixture of from 8 to 9 per cent., will realize that it is a mistake to talk of creating an explosion in a mine by the overheating of a well designed lamp. Many an explosion has been wrongly put down to this cause.

The majority of lamps now in use are fitted with bonnets or shields, and the writer has had lamps of this description in explosive mixtures and the gas inside the gauze burning for hours and the gauze red hot, and yet an outside explosion has not occurred. The writer submits that it will be a very rare occurrence to find in a mine a velocity of 3,500 ft. per minute of an explosive mixture of gas, and at the same time for the lamp to be placed in such a position as to receive the full force of this velocity, and also to have a miner stand by oblivious of the remarkable occurrence which was happening.

Such a combination of circumstances is so remote as to be unlikely to happen and may be dismissed as out of the question.

If the velocity be present, but if the enormous requisite volume of gas be absent, there is no danger. On the other hand, if gas be present, but if the requisite enormous velocity is missing it would be unlikely for an explosion to happen from the lamp. Again, it would be unlikely that the miner would remain in such gas, so that danger from "still" gas is also unlikely to occur, as the light given out from a dangerous mixture of gas burning inside a safety lamp would be so small that the miner could not under the circumstances continue working.

In another series of tests, the gas flame was kept burning in a lamp surrounded by an explosive mixture of gas. At intervals coal dust was scattered inside the lamp and also over the outside of the gauze. After the lamp had been constantly shaken about in the gas, and then coal dust allowed to remain on the crown of the gauze for some hours, the gas flame burned immediately underneath the top of the gauze and had ample opportunity to heat up and coke the coal dust.

The lamp had a single gauze only, and the test was carried out at our Pittsburg factory with natural gas, and yet the flame did not communicate with the surrounding gas, notwithstanding the fact that the gauze was often red hot. If, therefore, single gauzes will not under such conditions pass flame, it is evident that double gauzes will add an enormous extra amount of safety to a lamp.

In other tests the writer has utilized a lamp having the glass so slack that on shaking the lamp, the glass has freely rattled. The glass was split from top to bottom, and a crevice cut right across the top and also at the bottom of the split, the crevice being more than 1/32 inches wide.

This lamp was placed in a very explosive mixture of compressed gas and kept there for over one half hour with the gas blazing inside the lamp. This failed to cause an outside explosion. In the test, the gas mixture was compressed down to two-thirds its original volume, and the gas, therefore, was in a most explosive condition.

In other tests, a ready lit bonnetted lamp has been passed into an explosive mixture of gas, a hole was pierced in the top of the gauze quite ¼-inch diameter,

*A paper read at American Mining Congress, Philadelphia, Pa. (Oct. 17th to 25th, 1913).

and yet the flame failed to pass through the hole and ignite the surrounding gas. No doubt the reason for this was that the product of combustion from the lamp flame covers the hole in the top of the gauze with a barrier of incombustible gas, through which the flame could not pass to the outside gassy atmosphere. To users of flame safety lamps, this test will no doubt be interesting as it is the upper part of the gauze which is subject to the most wear and tear, and fortunately the test demonstrated that it is the top part of the gauze which is usually protected by the barrier of incombustible gas. The writer admits that if the lamp in question be allowed to be extinguished and the products of combustion allowed to escape and the lamp filled with an explosive mixture of gas, and an internal friction igniter operated so as to cause a flame to form in the lamp and ignite the gas inside the lamp, it is possible that this flame would pass through the hole in the gauze to the outside of the lamp, but this of course only refers to this particular type of lamp, and would not refer to lamps of the type which must be completely enclosed when being relit.

Some authorities have made much ado about the possibilities of the heat from the flame of the miners' lamp cracking the glass. As regards this point, it is only a question of a few dollars, as fine clear glasses can now be supplied of such quality that they may be heated up to about 340 degrees F. and sprinkled with water from a watering can, and yet the glass fails to crack.

Some people have been afraid that a fall of roof on a safety lamp may cause an explosion and ignite the gas; but the tests so far carried out by the writer seemed to prove that before the lamp is dangerously damaged the flame of the lamp is extinguished by the "crushing down force."

In one series of tests, a lamp was placed upon an iron piston, and the piston moved rapidly upwards into a cylinder containing gas, so that the top of the gauze came into violent contact with the crown of the cylinder and the gauze was crushed down. No outside explosion followed, the light in the lamp apparently being extinguished by the "crushing force" or by the concussion of the atmosphere. In the coal mine it is very unlikely that this condition of affairs would be so severe as it was in the test in question. In the event of the gas preceding the fall of the roof, the gas would most likely extinguish the lamp flame before the crush came upon the lamp. If the stone got down ahead of the gas, and crushed the lamp, the stone would crush out the light before the gas reached it. In any case there would have to be an immense volume of gas released to reach a lamp crushed on the floor.

In another test, an unbonnetted ready lit lamp was placed in a big jet of explosive gas, and the gauze smashed by a violent blow from a mallet. This also failed to ignite the gas, the blow invariably extinguishing the lamp flame.

The writer, therefore, contends that when using a well designed bonnetted lamp that fear from this "cause" may also be discounted. Whilst the writer does not, for one moment, advocate the relaxation of any possible effort to insure the supply and issue to miners of nothing but the best and safest safety lamp, he is of opinion that the tests referred to herein show that the miners' safety lamp is capable of a safety margin much greater than is generally supposed.

We now come to the consideration of the question of the detection of "gas," and the checking of the state of the atmosphere of the mine.

At a time when the prevailing craze is for more and more complication and intricacy in all appertaining to mining, the writer supposes he will be accused of sacrilege by calling a halt and asking for a hearing in defence of such a simple device for gas detecting as the flame safety lamp. It is somewhat unfortunate that the device is so simple that after, say, only a few minutes' or hours' practice in a simple gas cap observation machine, that practically any mine man can read the percentage of inflammable gas in the atmosphere. It would, no doubt, appeal more to the present generation if the lamp could be fitted with a series of levers, switches, indicating dials, and necessitate reference to elaborate tables of square root, cube root, etc. It would then, no doubt, be looked upon as a marvellously clever device and more attention would be devoted at colleges and mining schools to the elaboration of its mysterious workings.

Now, putting sarcasm on one side, the writer submits that the miners' flame safety lamp is the most simple and most accurate and most reliable device which could possibly be conceived for the practicable ascertainment of percentages of gas in the atmosphere of a coal mine.

In recent years great strides have been made in Great Britain in the organization of evening classes in all the coal mining districts. A very large proportion of both adult and young miners have attended these classes. From conversations the writer has had with many of the teachers and with men in the mines in various parts of the country and from observation of the behaviour of the mining men who visited the works with which the writer is connected, he is of opinion that this course of education will ultimately prove to be one of the biggest factors of safety introduced in recent times into the coal mines.

Up to a few years ago it was a comparatively rare thing to find miners who knew how to test for and read "gas caps." The consequence was that men have often ignorantly continued working in places so charged with gas as to be on or near the border line of explosibility, no doubt things have been done in such atmosphere which would not have been done had the miner known of its dangerous state.

It has now been established that a severe explosion can be obtained from quite a small percentage of gas if coal dust be present. The present tendency in coal mining practice is to employ vast numbers of men in each mine on each shift; to employ more electric machinery, such as coal cutters, locomotives, motors, and to push the coal face forward more rapidly and risk falls of large quantities of rock roof with the possible bringing down of gas and sparks from the grinding rock. There are also the possibilities of explosions from pipes, cigarettes, and matches. It is now, therefore, more necessary than ever to place in the hands of each miner the means whereby he may ascertain the state of the atmosphere in which he is working.

The best course to pursue will, no doubt, be to educate the miners more and more into the best methods of using the flame safety lamp and also as to how best to test for gas. It has been proposed by some parties to place a flame safety lamp at the entrance to each working place, and give it into the charge of the "gangman." This lamp will, however, generally be neglected. As the principal object of the "gangman" is to get as much coal as possible, he will, no doubt, fail to take a lamp into his working place at sufficiently frequent intervals. If each worker be provided with

a flame safety lamp the chances of early detection of the presence of gas are more certain.

Some advocate the clearing of the gas out of the mine by increased ventilation. This is all right so far as it goes; but it is a difficult matter to sweep out each and every part of an extensive mine. An explosion started in one small place, may, by the aid of coal dust, carry through the mine. From time to time we read of an explosion happening in so-called model mines, where gas has either never been known, or, at any rate, has not been observed for many years. This emphasizes the need for better education of miners and the inclusion in their outfit of reliable gas detectors.

The next question is that of illumination. Many writers on this subject appear to forget that the coal miner does not go down the mine for the purpose of reading the daily newspaper. He goes down to hew coal from a generally well defined coal face and with constant practice he gets so that he could almost do the work blindfolded. Generally speaking, several men work sufficiently near each other at the face and so get a large general lighting effect from the several lamps. A miner's light may on the surface seem to be a miserable one, yet in the darkness of the coal mine this same light is quite good and sufficient for the work. Certain parties blame the flame of the safety lamp as being the cause of certain diseases of the eyes of miners, but it would now appear that there are miners who have had the benefit of the increased light from acetylene lamps and who now complain that this increased light hurts their eyes. This would seem to raise the question as to what is the proportion of miners whose eyes are naturally weak, and who would suffer pain whether the light be good or bad. The elimination of these cases will possibly show that the remainder will be quite satisfied with the existing miners' flame lamp; if not, the illumination of the flame safety lamp can now quite easily and simply be increased to 1 1/3 candle power.

FIRE PREVENTION IN THE MINES.

Disastrous and destructive mine fires have had their origin in a majority of cases in causes of a trivial nature. Where proper safety regulations are enforced and proper equipment is at hand for fire fighting, such fires might be quickly extinguished if not prevented altogether.

The agencies for fire prevention and fire fighting should, however, be clearly separated, and the first measure necessary in connection with the former is education. Teach the miner and his children the danger of carelessness in using inflammables; point out the perils which lurk in the casual use of non-safety matches, the throwing away of cigarette butts, the careless handling of lighted candle-stumps and lamp-wicks, and the preventible fire might soon become a memory of the past. The second measure in connection with fire prevention embraces the matter of fire-proof construction, and in this connection the stable or the underground engine room should first demand attention. It is economically possible to construct stables which will be to a very large extent fire-proof, and the same thing applies to the engine room. Even where it is necessary to lay wooden floors in the stable stalls, these can be so imbedded in concrete as to be rendered practically fire-proof.

In the mine itself fire-proof materials should be used as much as possible. The shaft lining should undoubtedly be of fire-proof construction, and the use of concrete in shafts and main haulage ways opens up a large field for experimental work. Data can be adduced to show that a permanent fire-proof shaft lining is, after a period of fifteen years, cheaper than timber lining. In connection with mine timbers, also, the use of concrete and steel offers advantages over the wood, although concrete has certain disadvantages which sometimes render it unsuitable. The use of steel for this purpose, however, is gradually increasing.

Fire-proof construction in mines will undoubtedly grow rapidly in favour. The increasing strictness of workmen's compensation laws, the awakening of public sentiment, and lastly the increasing relative cost of wooden timbers as compared with steel and concrete, all point to the fact that fire prevention will, in the future, receive more attention than it has in the past.

PLACER-GOLD FIELD IN SOUTHERN YUKON.

On November 1 the Daily Province, Vancouver, B.C., printed the following account of a new placer-gold field reported to have been found in southern Yukon:

Word of a new placer-gold strike at the foot of the Golden Horn mountain within 11 miles of Whitehorse has been brought down from the Yukon by recent arrivals in the city. It is said that gold in paying quantities has been found on two creeks and that on Discovery claim some of the miners have been panning $18 per day per man.

News of the strike has been kept quiet by those interested in the new venture, in order that the district could be well staked before those on the "outside" could hear of the new diggings. Whitehorse business men and miners living in the town are the principal holders of claims in the new camp which is declared to show promise of proving rich. The discovery was made on October 7.

The district is easily accessible, being about two miles from Wigan on the line of the White Pass & Yukon route. The Town of Whitehorse has received a big impetus by reason of the new strike.

There has been no concerted rush to the new Wigan diggings on account of the lateness of the season, and the fact that the discovery was kept dark, and no big excitement outside Whitehorse is being manifested, according to advices from the north.

Most of the pay is said to have been found near the surface, none of the shafts having been sunk down to bed rock so far.

Mr. Isaac Taylor, of the merchandise firm of Taylor, Drury & Taylor, of Whitehorse, informed the Province when asked for confirmation of the reports as to the new placer strike, that from the advices he had received from his business associates the prospects in the new camp were most encouraging. He said he had been told that even if gold was not found in large quantities the conditions were particularly favourable for hydraulic mining as the claims could be easily worked and there was sufficient water available in the adjoining creeks for ten sets of sluice boxes. The surface indications were promising and he understood that the pay found so far averaged from $8 to $12 a day per man.

In view of the lateness of the season Mr. Taylor expressed the opinion that little development would be carried on until next spring.

THF METAL COBALT AND ITS ALLOYS*

By H. T. Kalmus.

The mining companies receive very little return for the cobalt content of the silver ores of the Cobalt district. There have been about 175,000 tons of silver bearing ore shipped from the Cobalt district since 1904, carrying approximately 7,000 tons of cobalt, which at a reasonable market value for metallic cobalt, should have been worth in the neighbourhood of $10,000,000. For this the mine owners received only $566,000. Much of this cobalt is lying as residues, etc., at the smelters, for practically the only market which it finds is a limited one for the use as blue colouring substance. For this purpose the smelters ship black cobalt oxide, which consumes about one-third of the present output of the camp, leaving to be cared for, the remaining two-thirds and the surplus from other years. Thus there is a potential value of many millions of dollars in the cobalt metal of Ontario which is not being realized.

Waste products running high in cobalt may be obtained in a variety of forms from the smelters, but inasmuch as the process for the production of fairly pure cobalt oxide has been very completely worked out and is being practised on a large scale by the Canadian Copper Company,† Copper Cliff, Ont., the Deloro Mining and Reduction Company, Deloro, Ont., the Coniagas Reduction Company, Thorold, Ont., and the Canada Refining and Smelting Company, Ltd.,‡ Orillia, Ont., it seemed advisable to use this oxide as an initial substance.

Purification of Cobalt Oxide.

In much of the work to follow it is important that the influence of the metal cobalt be sharply differentiated from that of iron and nickel which are the principal metallic impurities of the original oxide. Also before undertaking the investigation of a large series of alloys of cobalt, it is important that the properties of the pure metal itself be established. For these reasons a purification of a certain amount of the oxide was undertaken. The method employed was in principle that in standard practice in the Canadian cobalt oxide plants, but the author wishes to express his indebtedness to Prof. S. F. Kirkpatrick, of the School of Mining, Kingston, for many important details.

The iron was removed from a solution of the oxide in hydrochloric acid by precipitation with marble, and a separation of the nickel was brought about by use of the differential precipitation of the hydrates of nickel and cobalt by means of a bleach soluton, and finally the sulphur was removed with sodium carbonate and hydrochloric acid.

The original oxide analyzed:	Per cent.
Cobalt	70.36
Nickel	1.12
Iron	0.82
Sulphur	0.45

The oxide purified by this method (June, 1912), analyzed:	Per cent.
Cobalt	71.99
Nickel	0.04
Iron	0.11
Sulphur	0.02

Preparation of Metallic Cobalt by Direct Reduction of Oxide.

From the fairly pure cobalt oxide (Co_2O_3) there are several possible methods of obtaining metallic cobalt in a reasonably pure form.

(1) By reduction with hydrogen gas.
(2) By reduction with carbon monoxide gas.
(3) By reduction with aluminum.
(4) By reduction with carbon.

With the present commercial possibilities for the production of water gas, of producer gas, and, indeed, of pure hydrogen as practised by the General Electric Co., of Schenectady, N.Y., for the reduction of metallic oxides, any of these four methods might ultimately be used on a large commercial scale. Hence, an investigation of the chemical equilibria involved in these reactions has been and is being made.

Reduction of Cobalt Oxide by Hydrogen Gas.

One set of experiments has been completed and another set is under way to determine the rate of the reaction $Co_2O_3 + 3H_2 = 2CO + 3H_2O$, in the presence of an excess of hydrogen, and at various temperatures from 500° C. to 1,100° C.

Electric Furnace or Reaction Chamber.—The furnace employed had a horizontal tube heating chamber 2½ inches in diameter by 15 inches in length. It operated at 25 volts and absorbed up to 12 KW. The resistor was a series of concentric carbon rings which could be pressed more or less tightly together by means of suitable adjusting screws. By this means the temperature could be controlled at will to be anything from 500° C. to 1,500° C.

Charge and Run.—Alundum boats were charged with a shallow layer of cobalt oxide (Co_2O_3), both boat and oxide having been dried to constant weight. This charge was kept within the heating chamber for various lengths of time at various temperatures in an excess of hydrogen. At the end of a definite measured time the boats were cooled and reweighed to ascertain the amount of reduction.

All the observations were made in duplicate with two boats in parallel, and concordant results were for the most part obtained. A series of observations was made, of about 20 weighings each, at the following temperatures, 585° C., 724° C., 825° C., 964° C., 1,065° C.

Preliminary Conclusions.—The reduction at the lower temperatures takes place much more slowly than at the higher temperatures, and at each temperature, after a short time, the rate of reduction becomes so slow that the reaction could not economically be carried further. For example, at 585° C. at the end of 15 minutes the reduction is 28 per cent.§ complete, whereas at the end of an hour it has only increased to 30 per cent.§ complete. As against this, at the higher temperature 1,065° C. at the end of 7 minutes the oxide is 89 per cent.§ reduced, and shows less than 1 per cent. further reduction during the next half hour.

Obviously from such complete data it will be possible to determine, for any given type of furnace and with a definite cost of power, what would be the most

*Extract from preliminary report of investigations at the Research Laboratory of Applied Electro-Chemistry and Metallurgy, School of Mining, Queen's University, Kingston, Ont., for the Mines Branch, Department of Mines, Canada.

†Cobalt plant recently closed down.

‡Main buildings destroyed by fire, January, 1913.

§These percentages are based upon cobalt oxide analyzing 71.99 per cent. Co which was used, and which is somewhat higher in Co than Co_2O_3.

economical temperature of operation for this reduction, balancing the cost of maintaining the higher temperatures against the increased rate of the reaction at those higher temperatures.

Reduction of Cobalt Oxide by Carbon Monoxide Gas.

In a manner similar to that of the reduction of cobalt oxide (Co_2O_3) by hydrogen, the reduction with carbon monoxide (CO) gas at various temperatures was studied.

Electric Furnace or Reaction Chamber.—This furnace was identically that used for the reduction of cobalt oxide (Co_2O_3) by hydrogen and has been described above.

Charge and Temperature Measurements.—Alundum boats were charged with a shallow layer of cobalt oxide, and placed within the reaction chamber, and temperature measurements were made with a platinum, platinum-rhodium thermo-element, both just as described above under hydrogen reduction.

Removal of Boats for Weighing.—After allowing the reaction $Co_2O_3 + 3Co = 2Co + 3CO_2$ to proceed for a measured length of time, boats run in parallel were removed, cooled, and weighed to determine the amount of reduction. In this case, apparently contrary to that of the hydrogen reduction, there was a considerable amount of reoxidation during cooling, so that it was necessary to cool the boats in an atmosphere of carbon monoxide (CO). A special container was devised to allow the charges to be removed from the furnace and cooled, remaining throughout in a carbon monoxide atmosphere.

Preliminary Conclusions.—The runs with carbon monoxide are still in progress, but a sufficient number have been made to denote that the curves showing the rate of reaction at different temperatures are similar to those for hydrogen, but that carbon monoxide (CO) is a much more vigorous reducing agent. We find, for instance, that at the low temperature 585° C., reduction is nearly 90 per cent. complete at the end of 15 minutes with CO, whereas at the same temperature with H_2 at the end of 15 minutes the reduction was less than 30 per cent. complete.

Reduction of Cobalt Oxide by Carbon.

The theoretical amount of powdered carbon, charcoal, or coke to reduce a charge of approximately 5 pounds of cobalt oxide was intimately mixed with it, and heated in an oil crucible furnace or in an electric crucible furnace.

In this way it was found possible to obtain a yield of metallic cobalt in the neighbourhood of 95 per cent., and in many cases between 99 per cent. and 100 per cent. At a temperature of 1,200° C., a run of about one hour serves to bring about complete reduction, while at a temperature of 900° C., 2½ hours are not sufficient.

Analysis shows that the metal obtained by carbon reduction is fairly free from carbon, running in the neighbourhood of a few tenths of one per cent. Moreover, by adding a small quantity of lime to these melts at the temperature of the electric furnace, the carbon may be almost completely removed. Some of the analyses for carbon before adding lime are given with the yields.

This method of preparation of metallic cobalt by direct reduction with carbon could be practised industrially at very low cost. We are able, in electric furnaces not especially designed for this work, to reduce enough oxide to make 15 pounds of metal in about 1 hour, absorbing 20 KW. Thus on a commercial basis the power charge for this reduction would be small.

Properties of Metal Cobalt.

The properties of the metal cobalt and of its alloys have been and are being studied under the following headings:

Melting points;
Casting properties;
Turning, rolling, and forging properties;
Hardness;
Tensile strength;
Compressive strength;
Corrosion in acids and atmosphere;
Structure as determined by micro-photographs;
Magnetic properties;
Thermo-electric power;
Electro-motive force as electrode of voltaic cell;
Plating properties.

Melting Point of Metallic Cobalt.—A long series of melting point determinations was made in a General Electric Co. Arsem. Electric Vacuum Furnace, using pure alumina crucibles and a charge of about 50 grammes of metallic cobalt. The mean of a set of 6 measurements, the average deviation of the single observations from the mean being 1.8°, gives the melting point of pure cobalt to be 1,497° C.

Casting Properties of Metallic Cobalt.—Cobalt when prepared in a fairly pure state by reduction from the oxide with hydrogen, with carbon monoxide, or with carbon, was poured to make various sizes and shapes of castings, both in sand moulds and in iron moulds. Cobalt, similar to iron, shows a marked tendency to occlude gases in casting. We obtain perfectly sound castings by degasifying with manganese and by soaking, that is by holding the melt for about one hour at a temperature not very far above its melting point.

Turning, Rolling, and Forging Properties of the Metal Cobalt.—Castings of cobalt in the neighbourhood of 99.5 per cent. pure may be readily turned with the ordinary lathe tools. It is a beautiful metal resembling nickel, but tougher and more lustrous. Observations of the rolling and forging properties are being made.

Hardness of the Metal Cobalt. Testing Machine.—The hardness of this metal and of its alloys was tested on a Standard Olsen Hardness Testing Machine of 10,000 pounds capacity (Tinius Olsen and Co., Philadelphia, Pa.).

About 25 Brinell hardness measurements have been made with fairly pure cobalt, which vary among themselves depending upon the method of casting and upon the heat treatment of the sample. Some attempt is being made to differentiate the hardness of cobalt cast in sand moulds, in iron moulds, and to give some figures showing the effect of annealing and quenching. These data will be given in the subsequent complete publication, but for the present we may give as the mean of a number of determinations the following values:

Brinell hardness, metallic cobalt, chilled from melting point	90.8
Brinell hardness, metallic cobalt, annealed from 250° C.	77.3

These figures, while not final, serve to show that cast cobalt has about the hardness of wrought iron.

(To be Continued.)

PERSONAL AND GENERAL

Mr. Phil H. Moore, lately mining engineer and manager for the mining, crushing and cement department, Canadian Allis-Chalmers, Ltd., has accepted the position of general manager of Rock & Power Machinery, Limited, head office Toronto.

Mr. J. B. Tyrrell, who has been for several weeks in England, expects to sail from Liverpool for Canada on December 13th.

Mr. H. P. Watson attended the Toronto branch meeting of the Canadian Mining Institute, November 29th, and outlined what had been done by the Mine Owners' Association in reference to the proposed Workmen's Compensation Act.

Mr. C. L. Randolph has opened an office at 150 West 57th Street, New York.

Mr. R. E. Hore has returned to Toronto after visiting mines at Cobalt and Porcupine.

Mr. C. A. Foster has sailed from England for Canada.

A meeting of the Council of the Canadian Mining Institute was held in Montreal Saturday, December 13.

A meeting of the Executive Committee of the International Geological Congress was held in Montreal, Saturday, December 13.

Mr. W. E. H. Carter is in Toronto.

Mr. A. A. Hassan left New York on December 8 to examine placer gold deposits in Arizona. His address will be Kingman, Arizona.

The Rock & Power Machinery Co. has opened offices in the Royal Bank building, Toronto. Branch offices will be at Halifax, Montreal, Sudbury, Cobalt, Winnipeg, Calgary, and Vancouver.

On Friday evening, December 5, 500 engineers attended the twenty-fifth annual dinner of the University of Toronto Engineering Society, held in the big drafting room of the 'School.' Graduates from all parts of the country gathered to do honour to Dr. John Galbraith, Dean of the Faculty of Applied Science of the University of Toronto, and to celebrate the fiftieth anniversary of his entrance at the University and the thirty-fifth anniversary of his founding of the School of Practical Science.

At a meeting held in Cobalt on November 29th, a Northern Ontario club of Michigan College of Mines alumni was formed. A banquet will be held at Haileybury on January 3rd to inaugurate the permanent organization.

A meeting of the Toronto branch of the Canadian Mining Institute was held at the Engineers' Club on November 29th. The report of the Commission, appointed by the Province of Ontario, on Workmen's Compensation, was discussed.

Mr. Ralph Scott, mine engineer at the Dome mine, Porcupine, and Miss Myrtle Harris, of Calumet, Mich., were married in Calumet on October 29th.

Mr. A. D. Acland, of Ottawa, Deputy Minister of Labour, has been at Nanaimo, Vancouver island, B.C., endeavouring to bring about a settlement of the labour dispute at coal mines in that district.

Mr. M. W. Bacon, of Butte, Montana, manager for the Stewart Mining Co., operating in Coeur d'Alene district, Idaho, has lately been to a group of mineral claims situated in the northern part of Vancouver island, B.C., which property is being developed, under option of purchase, by United States mining men. There is stated to be a large showing of copper ore on the claims, and much prospecting work is to be done under the bond.

Mr. Chas. A. Banks, manager for the Jewel-Denero Gold Mines, Ltd., operating the Jewel mine and 15-stamp mill near Greenwood, Boundary district has returned to British Columbia after having examined a graphite property in the Province of Quebec and gone thence to New York City. During his absence Mr. H. D. Quimby, who recently arrived from the United States, was in charge at the Jewel, at which both mine and mill have been worked steadily since the beginning of last July.

Mr. P. M. Collins, formerly of Butte, Montana is mill superintendent for the British Columbia Copper Co. at Boundary Falls, B.C, where the first unit of a concentrating plant is being put in with which to treat ore from the company's Lone Star and Washington mines.

Dr. Chas. W. Drysdale, of the Geological Survey of Canada, who had been for six months engaged in continuing the structural survey of Rossland camp on which R. W. Brock spent much time several years ago, left Rossland for Ottawa on December 1st. He was accompanied by Dr. B. Rose, also of the Survey, who for two or three months had been assisting him.

Mr. A. W. Davis, of the Consolidated Mining and Smelting Co.'s mining engineering staff, is in charge at the company's Sullivan Group mines, in East Kootenay, B.C., during the absence of the superintendent, Mr. C. H. McDougall, who for the last two months has been in Montreal, receiving surgical treatment for a bad knee which has incapacitated him from carrying out his ordinary duties.

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., is mourning the death of his mother, who died recently at Boston, at an advanced age.

Mr. J. D. Galloway, acting assistant to the Provincial Mineralogist for British Columbia, has returned to Victoria from a trip to mining camps in Similkameen and Boundary districts of that province.

Mr. A. H. Gracey, who is working the Venus gold mine under option of purchase, has returned to Nelson, B.C., after a short stay in Spokane, Washington.

Mr. Ronald Harris, of London, Ontario, has returned to Canada after having spent the summer in Alaska, where he was engaged in supervising the development of a gold mine.

Mr. Arthur Hickling, of London, England, managing director of the Princeton Coal and Land Co., owning a coal mine and much other property in British Columbia, has been at Princeton, Similkameen, where the company's chief activities are carried on.

Mr. Douglas C. Livingston, who, after graduating at McGill University some years ago went to Mexico and later joined the mining engineering department of the University of Idaho, Moscow, Idaho, has lost his little son, whose death occurred last month.

Mr. Anthony J. McMillan, liquidator of the Le Roi Mining Co., formerly operating in Rossland camp, British Columbia, was recently hurriedly recalled to England, owing to the serious illness of his only son and child. Mr. McMillan had been in the East a short time, investigating the affairs of the Londonderry Iron Co., of Nova Scotia, for which corporation he was recently appointed receiver.

Mr. E. G. Montgomery, assistant superintendent of the Consolidated Mining and Smelting Co.'s Centre

Star group of mines, left Rossland, B.C., on December 1st, on a six weeks' vacation trip to Montreal and lower Quebec.

Mr. J. W. D. Moodie, vice-president and general manager of the Britannia Mining and Smelting Co., Howe sound, B.C., was in New York City recently.

Mr. A. C. Seaton, formerly with the Nicola Valley Coal and Coke Co., has been appointed assistant superintendent at the Corbin Coal and Coke Co.'s colliery in Southeast Kootenay, B.C.

Mr. Chas. H. Stewart, of Messrs. Alex. Hill & Stewart, mining engineers, London, England, was expected to reach Rossland, B.C., about December 4th on a visit of inspection to the mines of the Le Roi No. 2, Ltd., for which company and the Van-Roi Mining Co., operating near Silverton, Slocan, his firm has for years been managing engineers.

Mr. R. H. Stewart, general manager for the Consolidated Mining and Smelting Company of Canada Ltd., has gone on a visit to Los Angeles, California. He will shortly proceed to Toronto to attend the annual meeting of shareholders in the Consolidated Co.

Mr. R. P. Trimble, formerly of Portland, Oregon, who for a year or two has been actively interested in arranging for the development of mineral claims in the Rocher Deboule Mountain section of the Skeena district, B.C., is at the head of a movement to prevent a Butte, Montana, syndicate from taking possession of and working a mining property on the mountain under terms and conditions that it is claimed are unfair to minority shareholders and damaging to their interests.

Mr. Frederick R Weekes has returned to New York City after having been for more than a year resident engineer at the Copper Mountain mining properties, Similkameen, B.C., which the British Columbia Co. and allied interests have been developing under option of purchase. He continues as supervising engineer, in which capacity he will visit Copper Mountain camp periodically.

Dr. Wesbrook, president of the newly-organized University of British Columbia, has arranged to deliver an address before the Vancouver, B.C., Chamber of Mines, which has a largely non-technical membership, on a subject bearing upon the relation of the university's activities to the mining industry.

Mr. George H. Aylard, general manager for the Standard Silver-Lead Mining Co., which since April, 1912, has paid $50 000 a month in dividends to its shareholders, and is reported to now have much more ore in sight in its mine near Silverton, B.C., than when it was acquired by the company nearly three years ago, spent the month of November with his family at their home in Victoria.

Mr. J. C. Edwards, superintendent of the Treasure Mountain Silver-Lead Mining Co., which is opening a mine in the district known as Summit camp, situated near the headwaters of Tulameen river, B.C., has lately been in Spokane, Washington, consulting with the directors of the company relative to continuing development work at the mine throughout the winter.

Mr. W. J. Elmendorf, general manager for the Portland Canal Tunnels, Ltd., which during the last year has been driving a long crosscut adit on a group of claims in Portland Canal mining division, British Columbia, recently made a business trip to Tacoma, Puget Sound, Washington.

COAL MINING IN SOUTH-WESTERN ALBERTA

The following information concerning coal mining companies operating in southwestern Alberta has been published in Spokane, Washington:

International Coal and Coke Co.—It is stated that the output of the International Coal and Coke Co.'s mines in October was 38,800 tons of coal and 6,000 tons of coke, practically all of which was shipped immediately. The bulk of the coal shipments were consigned to places in northern part of Washington, and the coke is being taken by British Columbia mining companies for use in their smelters.

The properties, situated near Coleman, Alberta, are producing from 250 to 300 tons of high-grade coal daily, in addition to coke material. The report states that the coke orders have increased in the last 30 days from 250 to 450 tons daily, and the capacity of the coke ovens is being taxed to fill the orders. Extensive additions to the plant are under consideration, and as soon as a sufficient fund is in reserve construction will be commenced. The mines operated 26 full days during October, employing 525 men, 35 less than in the preceding month, the approach of winter having necessitated curtailment of the force.

The Canadian Pacific Railway Co. is taking the surplus output of the mines and is furnishing all the cars.

McGillivray Creek Coal and Coke Co.—The McGillivray Creek Coal and Coke Co., which operates mines at Carbondale, in Crowsnest district, a large portion of the output coming to Spokane, shipped more than 14,000 tons of commercial coal in September, according to a report which reached Spokane stockholders lately. This is the largest monthly production in the history of the company. The report says also that there is blocked out in the mine now, ready for immediate extraction, 400,000 tons, and that the shipments for October undoubtedly will exceed the September mark, lack of cars having curtailed consignments.

The McGillivray Creek Co., whose holdings adjoin those of the International Coal and Coke Co., has made a remarkable record during the comparatively short time the collieries have been operated. The cost of development of the mines and the installation of machinery and equipment, representing an expenditure in excess of $300 000, has been paid for out of the property's earnings and the officials of the corporation state that they expect to be able to start a surplus fund soon.

MORE DISCOVERIES AT CHISANA.

At the end of October the Dawson News said: "Lem Gates arrived at the mouth of White river after mushing alone from Discovery, Chisana, in twelve days over a bad trail. He reports strikes on four new creeks and all are claimed to be rich. The prospectors on the benches off Bonanza and Elorado creeks are said to have uncovered pay that will go as high in places as an ounce per hour to the man. Many have claimed these benches are the hope of the camp. Pay has also been found on Frying Pan creek on the Canadian side. There are at least 400 cabins at the mouth of Johnson creek, and about the same number at the mouth of Snag. Practically the whole of the population of Donjek has moved to Snag. It was reported at Johnson creek that the Copper River & Northwestern Railway people were within ten miles of the diggings with a trail, and it was said that the packing rate to the diggings will be fifteen cents per pound when the trail shall be completed."

SPECIAL CORRESPONDENCE

COBALT, ELK LAKE, AND SOUTH LORRAIN

Plans to Drain Cobalt Lake.—There now appears no opposition to the draining of Cobalt lake. The town of Cobalt has never been actively against the scheme since it was assured that the health of the municipality would be safeguarded. All pretentions to beauty, which the lake ever had, have long ago disappeared under the tailings from the many mills. The principal opposition came when the plan was first mooted, from the township of Coleman, under whose jurisdiction the lake is. Their opposition was based mainly upon the idea of loss of revenue, the town agreeing to the scheme of draining the lake if the Cobalt Lake Co. were brought into the town. This the township strenuously opposed. Friends of both parties have been quietly working all the fall to bring them to an agreement and the directors of Cobalt Lake Co. met representatives of the township of Coleman in the last week in November. At this conference an agreement was reached whereby the township receives a certain consideration for permitting the Cobalt Lake Co. to be brought into the town. There then remained the rights of the mines round Cobalt Lake to be safeguarded. Those chiefly interested were the Nipissing, the La Rose, the Chambers-Ferland, and the McKinley-Darragh. Representatives of these mines met the solicitor and manager of the Cobalt Lake Mining Company in Cobalt the first week in December, and an agreement has finally been reached. The Cobalt Lake Mining Company engaged to supply all the mines and mills on the lake with water, and on this basis all opposition was withdrawn. Official application to drain the lake will come before the Mining Commissioner in Toronto the middle of this month. As the opposition has, in the main, been placated there is no reason to suppose that it will be any more than a formal sitting.

The eight-hour day for underground miners will come into force automatically in Northern Ontario without the slightest hitch. The majority of the mining companies in Northern Ontario opposed the eight-hour day strenuously, but once it was passed they resolved to abide by it without protest. All through the North preparation is now being made for the change. In Cobalt notices have been posted at nearly all the mines, stating the new hours for miners. According to these notices the working hours will be from 7 to 12, and from 1.15 to 4.15.

These hours will, of course, be from "face to face."

It has also been officially announced by the mine managers' organization, to which four-fifths of the companies in the camp belong, that there will be no cut in wages when the eight-hour day goes into operation. The decision not to cut wages was arrived at early in the year, but no official pronouncement was made until the last week of November. All but a very few of the working mines have subscribed to it.

There is, therefore, every reason to suppose that the new law will go into operation automatically and smoothly on the first day of the new year. Representatives of the companies have been in other camps in Northern Ontario observing the working of the eight-hour day shift.

Workmen's Compensation.—The issuance of the final draft of the Workmen's Compensation Act is not likely to meet with any strenuous opposition in Northern Ontario. When Sir William Meredith visited Cobalt two years ago to obtain the opinion of the men and the employers here, he found practically no opposition to the principle that the employer should be liable for the injuries of his employees, and, in the main, there was assent to the principle that the burden of proof should lie on the employer to show that there had been wilful negligence.

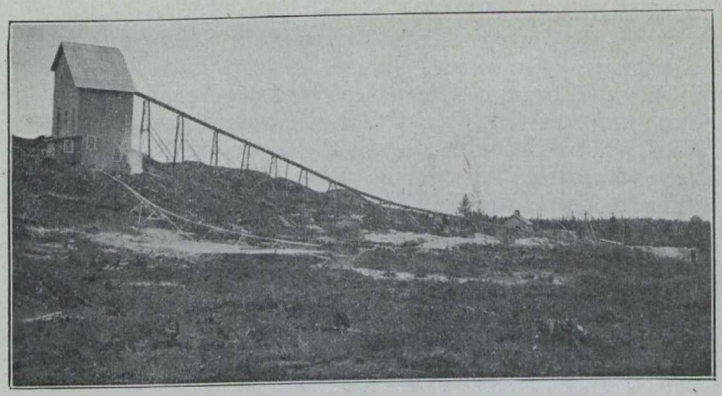
The mining companies are almost ready to exchange any state of affairs for the wearisome and interminable litigation which now follows the injury of a workman. The numerous cases have always aroused an antagonism between the miners and the companies which could be entirely done away with under a well drafted Compensation Act.

Motor Car Service and Government Telephone for Gowganda.—The announcement of a motor car service and a government telephone line between Elk lake and Gowganda has been variously received. It is recognized on all hands, however, that to make the motor car service of any utility to the Montreal River camps, the road between Elk lake and Gowganda must be improved. There are but a few months in the summer—in a dry summer—when a motor car could be run with any regularity There is now no competition in the stage service and the traveller does not get into Gowganda in less than one day. In the winter when the roads are dry and when the sleighing is good, the time can be cut down very materially.

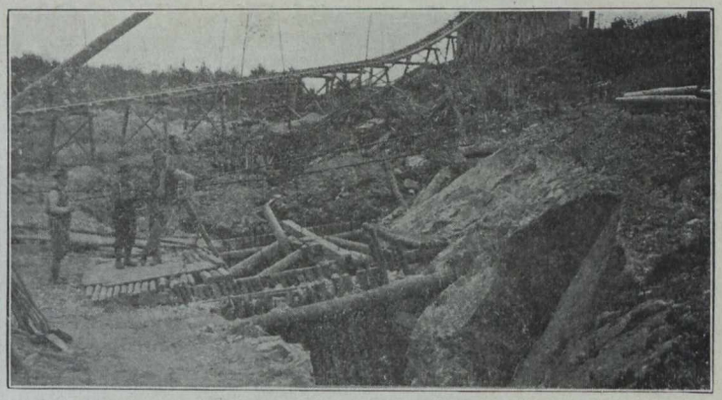
Drummond Fraction.—Work has commenced on the Drummond Fraction, the seven and three-quarter acres of lake bottom bought from the Caribou-Cobalt by the Kerr Lake and Crown Reserve. The Wright shaft of the Caribou-Cobalt has been leased and the shaft-house has been repaired and a rock house added. Before the Drummond mine was sold a drift had been run for 75 or 80 ft. on a vein of high-grade ore, so that production will commence almost at once.

The draining of Kerr lake has also exposed a promising vein on the surface. The Drummond Fraction is being worked as a separate unit by the two companies jointly.

New Northern Customs Concentrator.—One-half of the 80-stamp battery of the Northern Customs concentrator will be dropping on ore before December 15th, while the remaining forty will be ready about a month later. The mill has been rushed up in record time. It was during the first week in September that the first ground was broken for the foundations. A full month ago the building was housed in and awaiting the machinery. Thus only three and a half months have elapsed from the removing of the soil on the hillside at 104 to the dropping of stamps. The system of concentration to be used is identical in all essentials to that built by Mr. Bourne on the Cobalt Townsite property. The first forty stamps to be operated will drop on La Rose ore. This contract for 200 tons a day is now being filled at the old Northern Customs mill, but will be transferred to the concentrator at 104 as soon as the company is ready for it. Thirty of the other stamps will be reserved for the Chambers-Ferland, a contract having been signed recently between the two companies. This contract comes into force next May, and gives the Chambers-Ferland the privilege of using 30 stamps for five years.



The 5-Stamp Mill at Tough-Oake's Mine, Kirkland Lake, Ont.



Tough-Oake's Mine in July, 1913

McKinley-Darragh-Savage.—The production of the McKinley-Darragh-Savage mine for the month of October amounted to 192,749 ounces, comparing with 242,266 ounces in the previous month. Of the total 60,017 ounces came from the Savage. From No. 40 vein alone 43,000 ounces were mined during the month. On the Savage an entirely new vein has been discovered and 64 ft. of it was opened up before values became lean in the face.

Caribou-Cobalt.—During the month of November the Caribou-Cobalt made in profits between $17,000 and $18,000. There were mined and sent to the Dominion Reduction Company for treatment 1,500 tons of 36.6 ozs. ore. In addition to the low grade the high grade sorted and bagged amounted to between 12,000 and 14,000 ounces.

Hudson Bay.—The total production of the Hudson Bay mine for the month of October was 38,306 ounces. The concentrator crushed 1,742 tons of ore, the average assay of heads to mill was 23.4 and the percentage of extraction was 86.

Downey.—From the Downey claim just east of Silver lake in the Elk lake section there will be shipped about 11 tons of high grade ore this winter as soon as the road is good. This ore has been known to be in place for years, but till within a short time ago the claim was in litigation. The vein has now been open cut for a distance of about 30 ft. long by 15 ft. deep, and 250 sacks of high grade taken therefrom. This ore will run between two and three thousand ounces to the ton. Larry Downey, who is working the claim, is now sinking a shaft to endeavor to pick up the vein at the 50-ft level.

PORCUPINE, SWASTIKA AND KIRKLAND LAKE

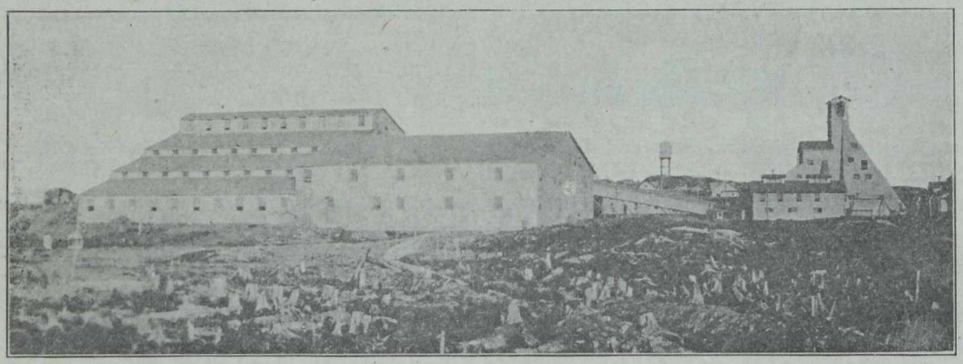
Tough-Oakes.—Cables from Mr. C. A. Foster in England confirm the report of the sale of the Tough-Oakes, the Burnside, the Robbins, the Wright, and other claims in the Kirkland lake area to a powerful English syndicate. It is reported that a company will be formed at once embracing all these claims with the Tough-Oakes as a nucleus.

Mr. Foster sailed from England at the beginning of the month, until he arrives full details of the deal will not be known, but it will certainly mean the interesting of a large amount of British money in Northern Ontario. The Tough-Oakes mine is being worked at the 100 and 200-ft. level. About 13 tons of $30 ore is being treated in the little mill every day, while the high grade from the vein is handpicked and sacked.

Sinking Shaft on Gold Quartz Vein at Burnside Mine, Kirkland Lake, Ont.

Hollinger.—The gross profits from the operations at the Hollinger mine for the four weeks ending November 4th were $124,495, as compared with $131,510 during the previous four weeks. The average value of all

ore treated amounted to $15.40, against $17.39 for the previous four weeks. Mr. P A. Robbins, general manager, states in his report the mill ran 95 per cent. of the possible running time, treating 13,401 tons, of which 310 were treated for the Acme Gold Mines. The approximate extraction 91.1 per cent., milling costs $1,407 per ton. The total cost of $5.5 per ton shows a reduction from previous results. Mr Robbins points out that this cost per ton includes everything. The actual cost for mining, milling and general charges amounted to about $4.25 per ton. Satisfactory development has continued in the mine, drilling amounting to 1,284 ft. The winze below the 425-ft. level had reached a depth of 22 ft. on November 4th. The vein is 8 ft. wide and carries $17.20 per ton at the bottom of the winze. The profits to-day minus dividends amount to $757,574.



Shaft House and Mill, Hollinger Gold Mine, Porcupine, Ont.

Dome Lake.—The Timiskaming and Hudson Bay Mining Company has purchased full control of the Dome Lake mine at Porcupine from the General Assets Company of Montreal and the shareholders. At a special meeting, the Dome Lake shareholders agreed to sell 250,000 shares, all of the treasury stock remaining at seventeen and a half cents per share. The General Assets, Limited, had previously sold 200,000 shares to the same Cobalt company, at the same figure, so that the latter have now 400,000 shares. The total outlay of the purchasers is $70,875. The new management lost no time in electing their new board. This board is Messrs. George Taylor, president; Angus McKelvie, vice-president; T. McCamus and C. L. Sherrill, directors. The president declares that after valuation of the property has been made, development will at once be resumed.

McIntyre.—Official figures from the McIntyre mines show that while ore ran $9.57 ton, the ton costs amounted to $6,133. Total production, $41,098. Detailed figures are, ore milled 4,131 tons at $9.57 per ton. The total amount of bullion shipped and on hand is $39,242. The running time was 720 hours, or 96.77 per cent. of the possible running time.

The North Thompson claim has been taken over by the Associated Gold Mines of East Australia. This is the same company that has the option on the Keeley in South Lorrain. The Elrich-Hamilton interests are world-wide operators. The option on the North Thompson was held by Baron Von Polenz. The new company is to be capitalized at $1,000,000 at par.

BRITISH COLUMBIA

Production is being continued at all the larger lode mines of the Province, and the total quantity of ore produced is steadily increasing. The chief producing mining divisions or districts are Fort Steele, in East Kootenay; Ainsworth, Slocan, Nelson and Rossland, in West Kooteney; Greenwood and Hedley, in Boundary-Similkameen; and Britannia mountain, on the Coast. The larger mines are the Sullivan, East Kootenay; Bluebell, Ainsworth; Standard, Slocan; Silver King, Nelson; Le Roi, Centre Star-War Eagle group, and Josie, Rossland; Granby, Rawhide, and Mother Lode, Boundary; Nickel Plate, Hedley; and Britannia, on the Coast.

EAST KOOTENAY.

Fort Steele Division.—About one hundred men are employed at the Sullivan Group mines. Much development work is being done, and production of lead ore is being steadily maintained, the output in 1913, to the end of November, being approximately 32,000 tons. The lead ore is sorted out and shipped to Trail, while the zinc-lead ore is stored to await the provision of suitable facilities for separation of the ore metals.

From 20 to 25 men are regularly employed at the St. Eugene mine, at which a small amount of development work is being done and lead-silver ore is shipped, though in much smaller quantity than in earlier years. The ore is shipped crude, as the mill is not now being operated. There is believed to be a fair prospect of finding another large shoot of ore in this mine, but at present the quantity of ore available for mining and shipment is small.

WEST KOOTENAY.

Ainsworth.—The total quantity of ore from Ainsworth mines received at the smelting works at Trail during four weeks ended October 30 was 2,041 tons. Of this, 798 tons was chiefly lead concentrate from the New Canadian Metal Co.'s Bluebell mine, situated on the eastern shore of Kootenay lake, opposite the town of Ainsworth; 85 tons from Retallack & Co.'s mines near Whitewater; and 79 tons from the Utica mine, on Paddy's mountain. The shipments from Ainsworth camp proper—that is from mines in the vicinity of the town of Ainsworth—were as follows: From the Highland mine, 455 tons; No. 1 mine, 425 tons; Silver Hoard mine 199 tons. Other properties being operated were the Gallagher, near Ainsworth; Florence Mining Co.'s properties, on Princess creek; Sun, on Woodberry creek; Eagle Lode Co's Eureka mine, near Sproule's; U.S., in Jackson basin; Panama, in the mountains above Bear lake, and several others. In addition, there was considerable activity at the marble quarry, situated at Marblehead, eight miles from Lardo, which is at the north end of Kootenay

lake; also, preparations were advanced toward providing another plant for dredging for placer gold on Lardo river, near Goldhill.

The Taylor hydraulic air compressor, put in on Coffee creek in the nineties, has been acquired by the Consolidated Mining and Smelting Co., which will use power from it in doing development work on several properties in the neighbourhood which it has under option of purchase. Water falling down a steel shaft forces air into storage tanks which provide sufficient pressure to admit of the air being used for power purposes. In former days of activity in Ainsworth camp air pipe lines were laid from the compressor to several mines and drills were operated by the power thus obtained.

Slocan.—The increasingly satisfactory development of the Surprise mine is reported, the opening of an important shoot of ore of good grade having been announced. Development work has been persisted in for years, despite many discouragements, and now it is stated that results justify all the confidence and outlay of the owners.

Recent developments in the Standard mine have shown the existence there of a large quantity of ore and of extensions of ore shoots beyond previously known limits of productiveness. The condition of the mine above No. 6 level is decidedly satisfactory, with much more known ore available for extraction than at any previous time in the history of the mine. Meanwhile No. 7 level is being advanced as quickly as possible, the purpose being to get under the ore shoot being worked in No. 6. To do this, however, will necessitate constant adit-driving for about four months longer. No. 7 is already in about 2,200 ft., but it will have to be driven between 1,000 and 2,000 ft. farther before the face will be under the productive zone in No. 6. One shoot of ore has already been passed through, but exploration of this ore body is being deferred so as not to risk interruption with the more important work of advancing the level to determine whether or not the ore shoot of so great value in and above No. 6 continues down to the level of No. 7.

In the Van Roi mine there is considerable improvement, the work of prospecting for more ore having been successful. The Van Roi concentrating plant is again being worked, and the expectation is that there will be a gradual increase in the output of ore and a corresponding enlargement of the production of silver, lead and zinc.

Nelson Division.—At the Silver King mine, the Dandy tunnel is being driven to connect with the main shaft of the King at the 800-ft. level, and it is expected the connection will be made by about the first of next year. Much work has been done recently in other parts of the group, chiefly in the direction of making the old workings safe for operating and developing ground not previously opened. No ore is being stoped, but that taken out in the course of development has been shipped to Trail. To the end of November about 3,000 tons had been shipped. The number of men working on this property is 70 to 75. The Consolidated Mining and Smelting Co. is at the head of this enterprise.

The British Columbia Copper Co. is working about 30 men at its Queen Victoria mine, situated about nine miles west of Nelson, near Beasley siding. Shipments of ore to the company's smelting works at Greenwood during eleven months to December 1 have aggregated about 25,000 tons. Latterly the output has been higher than during previous months, and it is expected that hereafter shipments will be maintained at from 2,500 to 3,000 tons a month. The property was purchased outright by the company about a year ago, and since then it has been worked continuously.

On the opposite side of Kootenay river, in the mountains a few miles to the southward, is situated the Eureka mine, which the British Columbia Copper Co. is developing under option of purchase. Some 27 men are employed and in the course of development work done several fair-looking bodies of ore have been opened. In past years a quantity of ore was shipped by those then operating the property, but under cost conditions that left little or no profit. The company now in possession has not attempted to ship ore in quantity, but has been giving its attention to development work, so as to determine whether or not the construction of an aerial tramway will be justified. An opportunity for securing a 3,000-ft. tramway at low cost having presented itself, advantage was taken of it, and the cables and other materials were stored at Granite, below the property. If it shall be decided to make provision for transporting ore to the railway, sites for main entries to the Eureka mine will first be determined, and thereafter construction of the tramway will be undertaken. Meanwhile further development work is being done, and ore shoots are being made accessible, so that production may be kept up after once commenced.

The Molly Gibson mine is distant from Nelson about 20 miles in an opposite direction to that of the Queen Victoria and Eureka. It is one of the properties of the Consolidated Mining and Smelting Co., which has been developing it at greater depth by driving a lower adit than that previously driven. Results have proved satisfactory, a shoot of silver-lead-zinc ore having been opened by this lower level. While not wide, this ore shoot is nearly continuous and the ore is of fairly high grade in silver and lead. The first-class ore is shipped as a crude product, while the second-class material is milled on the property and the resulting silver-lead concentrate is also sent to the company's smelting works at Trail. The high grade zinc middling is stored for treatment in the future, whenever conditions shall be favourable to its profitable utilization.

Rosslard.—Dependable information concerning the condition of the Le Roi, Centre Star-War Eagle, and Josie groups of mines, is of most satisfactory nature. Reserves of ore in both Le Roi and Centre Star groups are larger than at any other time in recent years, and since value as well as quantity is good, prospects of the camp are decidedly gratifying. While the Le Roi No. 2 Co.'s Josie group has not had developed in its mines so large reserves of ore as have the others mentioned, the position is cheering, for ore shoots have been opened on various levels. At the deep levels, bodies of good ore have been found that promise well for later production. In the South Belt of the camp, the Richmond Consolidated Co. is crosscuting on the 200-ft. level of the Lily May mine. Employment is given to 25 men. Plant and buildings are in good condition and provide facilities for doing a large amount of work.

Trail Creek Mining Division.—The Canadian Pacific Railway Co. is reported to have announced an increase of ten cents a ton in the freight charge on ores in transit to the smelting works from places beyond Rossland shipping through that town to Trail. Heretofore the rate from Rossland to Trail on ore from outside mines has been 20 cents a ton; soon it will be 30 cents. The

mines chiefly affected by the increase are several in Republic camp, Washington, shipping by the Great Northern Railway to Rossland, and there transferring to the Canadian Pacific Railway for the 12-mile haul thence down-hill to Trail.

Trail—Ore receipts at the Consolidated Mining and Smelting Co.'s smelting works at Trail during the five weeks ended November 27, were as under:

	Tons.	Tons.
From East Kootenay—		
St. Eugene	144	
Society Girl	20	
Sullivan	2,764	
		2,928
From Ainsworth Division—		
Bluebell	847	
Cork	5	
Highland	714	
No. 1	352	
Revenue	16	
Silver Hoard	184	
Utica	82	
		2,200
From Slocan Divisions—		
Eastmont	59	
Ottawa	30	
Rambler-Cariboo	276	
Slocan Star	61	
Standard	1,053	
Surprise	54	
Van-Roi	32	
		1,565
From Nelson Division—		
Emerald	119	
H. B.	33	
Molly Gibson	160	
Perrier	6	
Queen	45	
Second Relief	39	
Silver King	1,192	
Stewart	5	
		1,599
From Rossland—		
Centre Star group	14,588	
Josie	2,062	
Le Roi	8,745	
		25,395
From Lardeau—		
Ajax		37
From Boundary—		
Sally		20
From Kamloops—		
Iron Mask		232
From State of Washington—		
Ben Hur	2,953	
Bonanza	140	
Hope	153	
Imperator	27	
		3,273
Total		30,626

SIMILKAMEEN.

The directors of the Hedley Gold Mining Co. have decided to push on the construction work in connection with the new power system to be established on Similkameen river, below Hedley. The building of a dam across the river will be the first work undertaken, and excavations for this have already been made. The dam, which will be constructed diagonally across the river, will be 400 ft. in length; it will be of cement concrete, reinforced by a network of one-inch cable, of which the company has an ample supply, having for years been accumulating discarded cable from its long gravity tramway running part of the way between the 40-stamp mill at Hedley and the mines of Nickel Plate mountain.

ROBB CORLISS ENGINES.

Those who have wanted to profit from the economy of a Corliss engine, but have hesitated to install this type because its speed is too low, especially for driving a generator direct-connected, must be interested in the Robb Corliss engine. With shorter stroke, much higher speed, positive operation of valves, and complete enclosure of moving parts this type overcomes every possible objection to the old forms of the well-known Corliss engine yet at no sacrifice to the usual advantages of this valve gear—almost perfect steam distribution, independent adjustment of the events of the stroke, small clearance, and separate cylinder ports for admission and exhaust which reduce cylinder condensation.

Successful operation at speeds from 90 to 225 revolutions per minute is the principal advantage resulting from the modified Corliss valve gear as used in the Robb engine. This high speed is made possible by simplifying the valve gear so as to eliminate all springs, dash pots, latches, cams, and disengaging parts. In fact, the Robb gear contains only about half the number of working parts necessary in the usual forms of Corliss valve gears.

In addition to the higher speed, the absence of these delicate parts means a smoother running engine and so little wear on the valve gear that steam economy and good regulation are maintained for years. The economy does not fall off rapidly after a short period of operation because the valve is not under the strain caused by the continual lifting of dash pots; and the valves cover the ports so firmly and seal them so tightly that there is no chance for leakage.

In other respects the engine is designed on the lines of modern heavy-duty Corliss engines. A relatively short stroke and compact substantial frame overcome the vibration always found in the long-stroke girder-frame design. The reciprocating parts are carefully balanced.

Full pressure of steam comes very quickly into the cylinder of the engine because of the triple port opening through the admission valves; and there is free exit through the exhaust valves at the proper time because of the double port opening. The steam pressure is well taken care of by the large surfaces of the valves which are nearly balanced by carrying the metal around the top, resulting in a long life and a minimum wear of valves and seats.

Accurate machining of the ports is possible because in this type of engine the valve seats are separate bushes, which are machined before being put in place, and these renewable cast-iron linings are made of closer grained cast-iron than the cylinder castings which makes them wear very much longer. Also the valves and ports are so machined that they register accurately with each other.

A valve action that does not depend upon a releasing gear for quick opening and closing is the distinct feature of the engine. But the motion imparted to the valves is identical with that of drop cut-off gears which

pick up the lifting arms then drop them. Two small links between the wrist plate and bell crank do away with springs, dash pots, latches, and cams, making a positively-driven valve gear which may be operated at high speed.

A LARGE ELECTRIC HOIST.

During the first week of November the directors of the North Butte Mining Company, in a meeting at Duluth, voted to award to the Westinghouse Electric & Manufacturing Company, the contract for what will be the largest electric hoist in the two American continents, and one of the largest of its kind in the world. The hoisting drums, which will be 12 ft. in diameter, will be driven by a direct connected electric motor running at a speed of about 71 revolutions per minute. Power will be supplied to this motor from a motor generator set equipped with a 50-ton flywheel to secure elimination of the peaks that would be drawn from the power line during period of starting and acceleration.

Hoisting with this equipment will be done in balance, but the equipment is large enough to take care of unbalanced hoistings. Skips will be used for handling the ore and each skip will have a capacity of 7 tons of ore. Round rope 1⅝-in. in diameter will be used and the equipment is designed for a normal rope speed of 2,700 ft. per minute with a maximum of 3,000 ft. per minute. The capacity of the hoist will permit 300 tons per hour being hoisted from the 2,000 ft. level or 200 tons per hour from the 4,000 ft. level.

The system of control and power equalization used will be that commonly known as the Ilgner System, in which a flywheel driven by the motor generator set is permitted to give up some of its stored energy to supply the peak load drawn by the hoisting motor. In order to reduce the flywheel losses to a minimum, the flywheel will be encased in a smoothly finished steel housing and provided with special type of self-lubricating bearings.

The hoisting motor will be of the type used in steel mills and will be of a very heavy construction. In fact, all of the equipment has been designed with absolute reliability as the paramount consideration. The electrical equipment alone will weigh in excess of 250 tons. A number of special safety devices are included in the equipment, including electrically released brakes; automatic slow-down devices to prevent skip or cage ever going through head sheaves and a special controller to limit the speed when hoisting men.

The hoist motor will have a maximum intermittent rating of 4,500 h.p. and the motor generator set will be driven by an induction motor having a continuous normal rating of 1,400 h.p. The difference between these ratings represents approximately the amount of energy that will be supplied by the flywheel momentarily during starting. The installation is so designed that the draft of power from the power line will be practically constant throughout any cycle of hoisting.

This Granite Mountain Hoist of the North Butte Mining Company will be the largest electric hoist anywhere in the Western Hemisphere, and will be one of the largest using the Ilgner System of power equalization installed anywhere in the world. There are larger electric hoists in South Africa, a few of which use the Ilgner system of power equalization, but most of these South African hoists do not attempt to obtain power equalization.

HOLLINGER.

The report of Hollinger Gold Mines, Ltd., for four weeks ending November 4, 1913, says, in part:

Gross profits for the four weeks amounted to $124,995.11. There was hoisted 13,210 tons ore, and 1,153 tons waste rock. The average value of the ore hoisted was $15.04 per ton. The total cost of mining was $5,055 per ton

The mill ran 95 per cent. of the possible running time, treating 13,401 tons, of which 310 tons were treated for the Acme Gold Mines, Limited. The average value of Hollinger ore treated was $15.07 per ton; approximate extraction 96.1 per cent.; milling cost $1,407 per ton.

The total cost of $5.05 per ton shows a reduction from previous results. It is well for shareholders to remember that this cost includes all development, shaft sinking, timbering and other dead work. If this development cost were carried as a deferred charge to be distributed over all ore developed or made available, the total working cost would be reduced by some 70 or 80 cents. That is to say, our actual cost for mining, milling and general charges amounts to about $4.25 per ton, but we consider it advisable at present to burden operations with the cost of work from which future benefits will be derived.

Satisfactory developments have continued in the mine. Drifting has amounted to 484 ft. The winze below the 425-ft. level had reached a depth of 22 ft. upon November 4th. The vein is 8 ft. wide and carries $17.00 per ton at the bottom of the winze.

COBALT ORE SHIPMENTS.

The bullion shipments for the week ending Dec. 5th were:

	Bars	Ounces	Value
Nipissing	140	165,651.73	$96,192.15
Townsite	14	10,780.00	6,144.00
Penn. Can.	10	8,096.00	4,695.00
	164	184,527.73	$107,331.15

The ore shipments for the week ending Dec. 12 were:

	High.	Low.	Pounds.
La Rose	68,000	100,000	168,000
McKinley-Darragh	60,810	.....	60,810
Beaver	109,780	.....	109,780
Timiskaming	87,220	.....	87,220
O'Brien	82,210	.....	82,210
Cobalt Townsite	82,810	.....	82,810
Right of Way	86,800	.....	86,800
Cobalt Comet	66,200	.....	66,200
Penn. Canadian	65,580	.....	65,580
	709,410	100,000	809,410

The bullion shipments for the week ending Dec. 12 were:

	Bars.	Ounces.	Value.
Nipissing	112	131,850.79	$76,903.08
Dom. Reduction	62	70,112.00	42,600.00
Crown Reserve	58	65,189.00	37,809.00
	232	267,161.79	$157,212.08

MARKETS

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Standard Bank Bldg., Toronto, Ont.). December 8, 1913.

New York Curb.

	Bid.	Ask.
Alaska Gold	21.00	21.50
British Copper	2.12	2.37
Braden Copper	7.37	7.50
California Oil	220.00	222.00
Chino Copper	37.50	38.00
Giroux Copper	.75	1.25
Green Can.	6.00	7.00
Granby	....	....
Miami Copper	21.37	21.87
Nevada Copper	14.87	15.00
Ohio Oil	138.00	140.00
Ray Cons. Copper	18.00	18.12
Standard Oil of N. Y.	170.00	171.00
Standard Oil of N. J.	397.00	399.00
Standard Oil, (old)	1185.00	1210.00
Standard Oil (subs)	785.00	800.00
Tonopah Mining	5.50	6.00
Tonopah Belmont	7.62	7.75
Tonopah Merger	.56	.58
Inspiration Copper	14.12	14.62
Gold Field Cons.	1.43	1.56
Yukon Gold	2.00	2.12

Porcupine Stocks.	Bid.	Ask.
Apex	.00¾	.01¼
Dome Extension	.06½	.07
Dome Lake	.27½	.28
Dome Mines	18.00	18.25
Eldorado	....	.01
Foley O'Brien	.17	.20
Hollinger	17.25	17.75
Jupiter	.06	.06½
McIntyre	1.90	2.00
Moneta	.02	.04
North Dome	....	.40
Northern Exploration	1.00	1.25
Pearl Lake	.09½	.09¾
Plenaurum	....	.50
Porcupine Gold	.14½	.15
Imperial	.01	.02
Porcupine Reserve	....	.06
Preston East Dome	.01	.02
Rea	.12	.16
Standard	....	.01
Swastika	.02½	.03
United	....	.01
West Dome	.05	.10
Porcupine Crown	1.23	1.26
Teck Hughes	.26	.30
Caribou Cobalt	.57	.61

Cobalt Stocks.	Bid.	Ask.
Bailey	.05¾	.06
Beaver	.29½	.30
Buffalo	2.00	2.03
Canadian	....	.15
Chambers Ferland	.16¼	.16½
City of Cobalt	.30	.35
Cobalt Lake	.53	.60
Coniagas	7.00	7.50
Crown Reserve	1.76	1.78
Foster	.06	.07
Gifford	.03½	.04
Gould	.03	.03⅛
Great Northern	.10½	.10¾
Hargraves	.03	.04
Hudson Bay	75.00	79.00
Kerr Lake	4.45	4.50
La Rose	1.95	2.00
McKinley	1.23	1.26
Nipissing	8.00	8.10
Peterson Lake	.26	.26¼
Right of Way	.04½	.05
Rochester	.02	.03
Leaf	.01¾	.02
Cochrane	....	.40
Silver Queen	....	.05
Timiskaming	.14	.14½
Trethewey	.25	.26
Wettlaufer	.07	.09
Seneca Superior	2.00	3.00

TORONTO MARKETS.

Dec. 10.—(Quotations from Canada Metal Co., Toronto).
Spelter, 5 cents per pound.
Lead, 5½ cents per pound.
Tin, 41½ cents per pound.
Antimony, 8½ cents per pound.
Copper, casting, 15½ cents per pound.
Electrolytic, 15½ cents per pound.
Ingot brass, 10 to 15 cents per pound.

Dec. 9.—Pig Iron—(Quotations from Drummond, McCall & Co., Toronto).
Summerlee No. 1, $26.00 (f.o.b. Toronto).
Summerlee No. 2, $25.00 (f.o.b. Toronto).

Dec. 9.—Coal—(Quotations from Elias Rogers Co., Toronto).
Anthracite, $8.25 per ton.
Bituminous, lump, $5.25 per ton.

GENERAL MARKETS.

Dec. 8.—Connellsville Coke (f.o.b. ovens).
Furnace coke, prompt, $1.75 to $1.85 per ton.
Foundry coke, prompt, $2.50 to $2.75 per ton.

Dec. 8.—Tin, straits, 37.70 cents.
Copper, Prime Lake, 14.50 to 14.75 cents.
Electrolytic Copper, 14.25 to 14.50 cents.
Copper wire, 15.50 to 15.75 cents.
Lead, 4.10 cents.
Spelter, 5.12½ to 5.25 cents.
Sheet zinc (f.o.b. smelter), 7.25 cents.
Antimony, Cookson's, 7.40 to 7.50 cents.
Aluminum, 19.00 cents.
Nickel, 40.00 to 45.00 cents.
Platinum, soft, $43.00 to $44.00 per ounce.
Platinum, hard, 10 per cent., $46.00 to $47.50 per ounce.
Platinum, hard, 20 per cent., $49.00 to $51.50 per ounce.
Bismuth, $1.95 to $2.15 per pound.
Quicksilver, $38.00 per 75-lb. flask.

SILVER PRICES.	New York cents.	London pence.
Nov. 25	58½	27 1/16
" 26	58⅜	27
" 27	..	26¾
" 28	57⅞	26¾
" 29	57⅛	26 7/16
Dec. 1	56⅛	25 15/16
" 2	57⅜	26½
" 3	57⅝	26⅝
" 4	57¾	26 11/16
" 5	58⅜	27
" 6	58⅞	27¼
" 8	58½	27 1/16
" 9	58¼	26 15/16
" 10	57⅞	26¾