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The results of the informal enquiry conducted by Mr. Samuel Price, Mine Commissioner for Ontario, have been embodied in a report to the Honourable W. H. Hearst, Minister of Lands, Forests, and Mines. Taken in its entirety, despite the fact that there is much internal evidence of Mr. Price's unfamiliarity with the practical aspects of mining, the report can be described as painstaking and, in many respects, accurate. We are convinced, however, that those in authority intended from the first to pass the act limiting the time of underground labour to eight hours per day.

Mr. Price states at the outset that his investigation for the most part took the form of an informal enquiry, although every opportunity was given to employers, managers, and workmen to voice their sentiments individually and collectively. In his endeavour "to ascertain and understand the nature of underground employment in the mines and the conditions under which men work," the Commissioner communicated with mine managers throughout the Province, held public meetings in various mining centres, caused secret ballots to be taken amongst the men, and corresponded extensively with officials in other countries. He claims, in effect, to have given equal opportunities to both mine owners and employees. Whether he could or could not do this is a question that we shall touch upon very briefly. As there are about 4,000 men employed underground in the Province, and as each presumably has a vote, it is frankly to be doubted whether a Government official could handle the situation without at least a tincture of unconscious bias. The Government has far too much at stake to take unnecessary chances. Far be it from us to accuse the Ontario Government of deliberate unfairness; yet we cannot but perceive the unwisdom of the method chosen.

In discussing the attitude of the men, the Commissioner said that nearly all are in favour of an eight-hour day. Out of a total ballot of 344, only 12 voted adversely to the proposed limitation of hours. "In nearly all the mines where the ballot was taken, I am satisfied," says Mr. Price, "that the men as a rule are well treated *and not at all dissatisfied in general* with the way they are used by their employers." The italics are our own. The clause italicized is most significant. Could a similar statement be made concerning any other industrial occupation? And why, in the name of reason, should the mining industry be selected by a paternal Government when there are numberless real abuses crying for attention in other industries?

The only apparent explanation can be found in the 4,000 reasons referred to above.

The principal arguments adduced by the men in favour of the change are: That underground work is unnatural and trying; that the hydraulic air used in Cobalt is "not as good as the air of the ordinary compressor;" and that eight hours of work is the longest continuous period in which efficiency can be maintained. To these claims it may be answered that underground work is no more "unnatural" than work in any building, or on a ship, or on a locomotive. And, as a matter of fact, it is infinitely more wholesome and much more remunerative than the majority of vocations. As to the implication that the hydraulically compressed air used in many Cobalt mines is detrimental to the health, we may frankly say that we do not believe it. That eight hours of efficient work is all the ordinary man is capable of, may or may not be true. This depends much upon the men, and to some extent upon the manager. It is demonstrable, however, that under present conditions it is practically impossible to be sure of more than six, or at most, seven hours of actual labour from the men. Supervision of underground labour is costly and difficult. This is a point that has been overlooked by Mr. Price.

The mine managers, according to Mr. Price, were practically unanimous in opposing the eight-hour day. Less than half a dozen managers were wholly in favour of it. Others signified their approval of the change if the hours were to be calculated "face to face." It was specifically pointed out that an eight-hour day would induce a reduction of wages and much dissatisfaction among the men. That, further, it would decrease outputs and lessen profits, and that many low grade deposits would be removed from the category of commercial possibilities. The contention that underground labour is injurious to the health was flatly contradicted by the managers. And in this last item they had, beyond doubt, by far the best of the argument. But, as noted before in these columns, the statement that Cobalt has reason to fear competition with Mexican silver producers is vain and foolish.

In reviewing the whole matter, Mr. Price expresses the belief that no one can predict what the effect of the enactment of an eight-hour law will be. A slight increase in the cost of production will, he admits, be probable. It will not, however, have any serious effect. Amongst the specific ills to be feared is the growth of miners' phthisis, a disease not at present known in Ontario mines. Parenthetically, we would like to ask Mr. Price how an eight-hour day can prevent the development of this malady? The steps to be taken for its prevention are well known. They consist chiefly in the application of water sprays for allaying drill dust. The mechanical devices necessary can be adopted whenever occasion arises.

Mr. Price admits that there is not an abnormal percentage of sickness amongst the miners. But, in dis-

cussing the relative healthfulness of underground work, he entirely omits consideration of the fact that the miner is not exposed during working hours to inclement weather and to variations of temperature. In fact, year in and year out the miner works in an atmosphere the temperature of which is practically standardized. This applies particularly to Ontario mines, none of which are deep enough to develop an appreciable increment of temperature.

Space forbids us to touch upon many of the points brought forward in the report. Suffice it to say that there is every evidence of painstaking care. It is observable, however, that Mr. Price, in his summation of conclusions, has been at some pains to labour those points that are in favour of the proposed change. This may be illustrated by one paragraph: "I think there is something, too, in the contention that the shorter day would tend to greater skill and efficiency of the men, and that by improving conditions it would encourage a more permanent class of residents in the mining camps and lessen the very large remittances of wages now sent out of the country by those having no established home here."

From the tone of this paragraph we are led to conclude that Mr. Price forgot the important fact that his function was primarily judicial. He seems to be not the judge but the advocate.

METAL MINE ACCIDENTS IN THE UNITED STATES.

Comparative statistics show that fatal accidents in the metal mines of the United States are deplorably numerous. During the calendar year 1911, for instance, of the 165,979 men employed in the metal mines of the States, 695 were killed, a rate of 4.19 per 1,000 men employed. In the Transvaal, where labour is less intelligent, the rate is higher, 4.29 per 1,000. But in Great Britain, Germany, France, Spain, Australia, Japan and other countries it is markedly lower. The lowest rates obtain in New Zealand and Australia, where records show less than one man killed per 1,000 men employed.

As might be expected from the nature of the work, the great preponderance of metal mine fatalities mean the death of one man at a time, rarely more than ten or twelve. In coal mines the majority of reported accidents are catastrophes involving the deaths of scores.

The copper mines of the United States employ about 30,000 men underground. In these mines the death rate from accidents is 5.33 per 1,000 men employed. In the iron mines the rate is 4.29; in the zinc and lead mines, 3.43; in gold and other metal mines, 3.95; while in other mineral mines the rate is 1.73.

Striking a general average for all mines other than coal mines, falls of rock from roof or wall accounted during 1911, for 27.48% of all underground fatalities; explosions for 8.92%; haulage accidents for 2.88%;

mine fires for 5.32%; falling down shaft, 8.20%, and objects falling down shaft, 4.15%. These are the most serious causes. In addition to State inspection and Federal control of explosives, the most important work being done in the direction of prevention is the publicity being given in the form of detailed information collected and distributed by the U. S. Bureau of Mines.

TEMISKAMING ANNUAL REPORT

Few mining companies have been such storm centres as has been the Temiskaming Mining Company, Limited. Its pugnacious president, Mr. Burr E. Cartwright, however much he has been criticized, and however much he may have merited that criticism, is certainly a generalissimo of no mean ability.

The authorized, and issued capital of the company is \$2,500,000. Including \$300,000 distributed during the calendar year 1912, the mine has yielded altogether \$1,309,155.56 to its shareholders. Last year's net earnings amounted to \$413,615.87, of which sum \$300,000 went to dividend payments and the remainder was carried forward as balance, making the total surplus \$590,591.71. The production of silver for the year was 1,242,243 ounces, an increase of only 28,489 ounces over the previous year. One noteworthy item is the production of 16,037 pounds of copper, the first commercial shipment of that metal from Cobalt.

A substantial lessening of operating costs is reported by the general manager, Mr. Norman R. Fisher. The cost of breaking and raising 31,449 tons of ore was \$166,256, or \$5.28 per ton, whereas the average cost during the year 1911 was \$6.85.

Milling costs also were lowered. In 1911, the cost per ton of ore treated was \$1.99; while during 1912 the average cost was reduced to \$1.72. Mill recovery was improved, being brought up from 80% to 82.1%. In brief, the technical history of the year appears to be eminently satisfactory save for the fact that no statements, beyond vague references to promising new developments, have been made as to ore reserves. The mine maps indicate in a general way that the mine's future must depend very largely upon the results of prospecting. The ore available may not be sufficient to maintain production for more than half a year. On the other hand, the history of the Temiskaming encourages the belief that prospecting will be handsomely rewarded. And it is doubtful whether the development of regular ore reserves is commercially practicable.

The North Dome mine, the Temiskaming Company's property in South Porcupine, is dismissed in one brief paragraph. Hence there is no basis furnished for discussion.

Mr. Fisher deserves much credit for the workmanlike way in which the report has been prepared. His tabulation of costs is admirable. Both the engineer and the printer have taken pride in turning out a good job.

CONCERNING THE BARTLETT.

We have before us one of the most extraordinarily inaccurate mining reports that it has ever been our painful duty to peruse. The document purports to deal with the Bartlett mine, Gowganda, Ont., and to it is affixed, in typewriting, the name "H. Brian Pearson." From beginning to end it is a strange medley of inaccuracy and misstatement.

The author, in his opening paragraph, informs us that the T. & N. O. Railway will, in the near future, be completed to within one and a half miles of the mine. This, we fancy, will be news to the Government and to Chairman Englehart. This, however, is merely a "marker." One statement reaches the ultimate of futility. "It is noticeable," runs the report, "that in each instance when either nickel or cobalt bloom obtains at the surface, a shoot of rich silver ore has been found by sinking." Nothing more completely misleading could be put in words. Only an incompetent or a knave could write such nonsense.

It is needless to quote further. Mr. Pearson's report is a masterpiece of silliness and distortion. But, futile as the report may seem to those who know the region, it is unfortunately true that the great mass of outsiders can readily be deceived. In other words, reports like this are mischievous and dangerous. They discredit the district and the profession.

If Mr. H. Brian Pearson be actually responsible for this "pipe dream," he should certainly be visited with condign punishment should he venture to call at Gowganda in the future.

EDITORIAL NOTES

That poor dear Mrs. Ella Rawles Reader has at last come to grief. As promoter of the Calumet Metals Co. she won the confidence of not a few of our wealthy men. She sowed the wind, and now the inveigled shareholders are reaping the whirlwind.

Mr. W. A. Caldecott has calculated and tabulated the weight of tube mill pebble loads for 22-foot mills of diameters ranging from 54 inches to 63 inches. The loads are graduated by inches from 12 inches above the axis to 12 inches below, and the weight of a cubic foot of pebbles is taken as 105 lbs. For a 54-inch mill the maximum load is thus 14.21 tons of pebbles, the minimum 4.16 tons; while for a 63-inch mill the corresponding figures are 18.42 tons and 6.58 tons.

A recent writer comes to the conclusion that, to avoid errors in sampling and assaying ores that carry coarse gold, certain precautions are effective. When, for instance, relatively few grains of unusually coarse gold are present, the sample should not be put through

a finer mesh than 30 or 40-inch, and fusions should be made in triplicate, abnormally high results being rejected.

The Mines Branch of the Dominion Department of Mines has issued a bulletin giving a list of all Canadian coal mines. The tabulated information includes the names of the operator, the head office address, the colliery designation, the location of the colliery, the mine office address, and the name of the manager. This will be of great service to many engineers, machinery men and investors. Incidentally, we note that our old friend, "Dr." Hugo von Hagen is named as manager of three coal companies in New Brunswick. How this same von Hagen has eluded so long the clutch of the law is a mystery to us.

The amount of time and labour being expended upon the volumes under preparation for the International Geological Congress is astonishing. The Coal Atlas itself includes more than 70 maps, many of which are printed in four colours. The text of the three volumes, which are now in press, is three-quarters English and one-quarter French and German. The coal resources of every country in the world are dealt with. Proof reading alone is a task of considerable magnitude.

THE GOLD OF THE KLONDIKE

By J. B. Tyrrell, F.G.S.*

The Klondike gold-bearing district, in which placer deposits were discovered in the summer of 1896, is situated near the extreme north western part of the Dominion of Canada, between north latitudes 63° and 64°, and about fifty miles east of longitude 141° west, which forms the boundary between Canada and the United States territory of Alaska. Its area is not clearly defined, but for the purpose of this paper it may be considered as being about eight hundred square miles, with a width in a north and south direction of 28 miles and a length in an east and west direction of 36 miles.

In general character, the Klondike may be considered as being a small and nearly isolated mountainous region lying to the east of the great valley of the Yukon river, to the south of the smaller valley of the Klondike river, and to the west of the still greater valley which runs to the south-west of the Rocky Mountains. On its southern side it is more or less closely connected with irregular mountainous ridges to the south of it, but the valley of the Indian river separates it more or less completely from them, except in the extreme south-eastern portion.

The lowest point in all this region is the bed of the Yukon river, where the Klondike river joins it at the City of Dawson, with an approximate elevation of 1,200 feet above the sea.

The highest point is situated about the middle of the area, twenty-nine miles south-east of Dawson, and is known as the "Dome." This is a hill or mountain with an approximate elevation of 4,250 feet above the sea, or 3,050 feet above the Yukon river at Dawson.

*Abstract of paper read before the Royal Society of Canada.

CORRESPONDENCE

CORE DRILLS

Toronto, March 25, 1913.

Editor Canadian Mining Journal, Toronto, Ont.

Sir,—In pursuance of your request of this date, I beg to state that the illustrated lecture given by me before the Canadian Mining Institute on March 7th consisted of an exhaustive series of notes taken on shot drill operations in various parts of this continent and Europe. It had to do particularly with core drill work where cores are being recovered from 3 inches in diameter to 29-inches in diameter. 70 lantern slide pictures accompanied the article along with many data as to costs, speed of drilling, cost of drilling outfits, etc., under different conditions. An interesting picture was shown on "Core Drilling in China" before the Christian era. In connection with this picture it may be noted that many of the drilling terms used by the Chinese are still in use to-day.

I find it generally true that mining engineers, as a whole, know but little of core drill work where cores have to be recovered of over 3-inches in diameter. Notwithstanding this, there is a large amount of core drill work going on where cores are being recovered 16½ and even 29 inches in diameter. Pictures were shown of this work.

P. H. MOORE,

Mining Engineer for the Canada Foundry Co.

From the Dome the country declines gently in all directions towards the valleys above enumerated, the drainage being carried off by short streams which radiate west, north, east and south, and flow into these larger streams.

The smaller streams are fairly mature in character. Many of them beginning in cirque-like depressions in the vicinity of the Dome, continue outwards with gradually decreasing grades without falls or other sudden interruptions, until they reach their mouths, while the smaller tributaries which join them on both sides flow quietly into them without any sudden changes of grade or without any waterfalls tumbling down from hanging valleys.

The area is completely isolated from any other drainage. No streams cross the district from any mountains or high lands outside of it, and there is no evidence that any streams have ever so crossed the district.

As, therefore, no glaciers have ever reached the country from any of the country to the north, or from the surrounding or adjoining mountains, and as no streams have crossed it, the problems of denudation and transportation which it presents are entirely confined within its own boundaries.

All the loose material which is found on its hills and ridges is derived from the immediate vicinity, and all the sand, gravel, or other detritus which is found in its valleys, was derived from the sides or bottoms of those valleys themselves, and none of it was brought from a distance.

Geology.—The rocks which underlie most of the gold-bearing district consist of altered quartz-porphyrines, and porphyrites, probably of pre-Cambrian age, which have been squeezed and altered into chloritic and sericitic schists. In most places these are now standing at high angles and are striking in various directions.

Included in these schists, and usually running with their strike, are numerous veins and stringers of light coloured quartz. In some of these veins free gold has

would not appear to contain as much gold as the veins in the chloritic and sericitic schists previously mentioned.

Intrusive masses of igneous rocks, such as granite, peridotite, diabase, andesite, etc., occur here and there around the border of the chlorite schists, but as far as is at present known, there is no definite connection between any of these intrusives and the occurrence of gold-bearing veins.

Overlying all these rocks, except the andesites and their associates, Cretaceous or early Tertiary sandstones—and conglomerates occur to the north and south of the chlorite schists. In some cases they would appear to have been somewhat folded and contorted, though not to the same extent as the older rocks.

It has been claimed, apparently on good evidence, that some of these conglomerates contain gold, and they may thus be ranked as ancient placer deposits, but gold has never been found in them in paying quantities, and consequently they have not been studied as fully as the later gravels shortly to be described.

In all these rocks, but especially in the chloritic and sericitic schists, which have been called by Mr. McConnell, of the Geological Survey of Canada, the "Klondike Series," gold is found in greater or less abundance in the quartz veins which traverse them. It has also been found in the schist in minute quantities apparently not associated with the quartz at all.

These facts should be carefully borne in mind for all the gold in the detrital and placer deposits in the Klondike has been derived directly from these altered rocks occurring in the immediate vicinity of the alluvial deposits.

The gold of the Klondike occurs originally or primarily in quartz veins in the chlorite and sericite schist chiefly of the Klondike Series, as defined by Mr. R. G. McConnell.

These quartz veins are usually lenticular in shape, and rarely continue for more than a few feet in horizontal length. As a rule very little gold can be seen in them. As a result of a number of assays I found that while they usually showed traces of the metal, they rarely contained more than \$1 to the ton. In some cases, however, notably in some quartz veins near the heads of Gay and Victoria gulches, two tributaries of Eldorado and Bonanza creeks, these veins were seen to contain coarse nuggety gold associated with pyrite. Some of it was distinctly crystalline in character, and among the crystals were a number of small triangular plates representing "spinel twins," the twinning being parallel to the octahedral face of the crystal. I had found some of these crystals in gold dust brought from Victoria gulch in the early days of mining in the Klondike, and afterwards, while examining the quartz veins at the head of the gulch, in company with Professor Henry A. Miers, F.R.S., we found a few more crystals of a similar character. Some of the crystals found on Claim No. 7, Victoria gulch, are represented on Plate 1.

In addition to the gold found in the quartz veins it is possible that some is associated with the schist itself. But none of the quartz veins so far discovered have proven rich enough to be worked at a profit, and the gold production of the Klondike has been derived exclusively from its placer deposits.

Placers.—Placer deposits may be defined as "Detrital deposits of heavy metals or minerals mechanically concentrated by natural agencies."

The Yukon Placer Mining Law gives the following definition: "Placer ground means any natural stratum or bed of earth, soil or gravel, containing gold or other

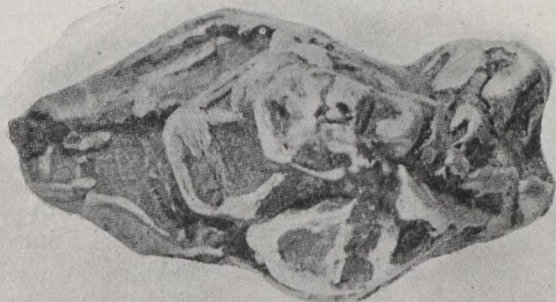


FIG. 1

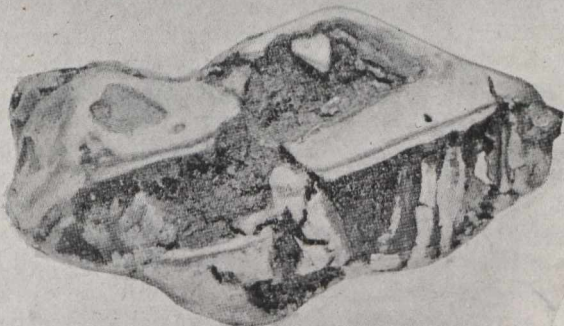


FIG. 2

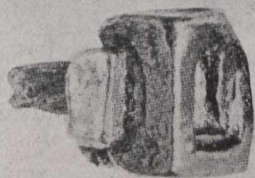


FIG. 3

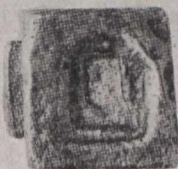


FIG. 4

Figs. 1 and 2—Spinel Twin with hollow faces. Figs. 3 and 4—Cube with hollow faces, &c. Gold Crystals.—Magnified 2½ diam.

been detected, and it would appear probable that most of the gold in the district has been associated with, or has been derived from, these quartz veins.

Both to the north and south of these fissile schistose the rocks are highly altered gneisses or hard quartz-mica schists, containing some bands of limestone. These gneisses, etc., also carry irregular quartz veins, and these veins doubtless also contain a little gold, but they

valuable mineral or stones, derived from the disintegration of older deposits, and transported to, and concentrated in, their present position by the mechanical agency of water, but does not include mineral in place, or as defined in Part III, or the disintegrated portion of a vein, lode or rock, lying above or about such vein, lode or rock and clearly derived therefrom." This is entirely too narrow for a general definition of placers, because, while those in the Yukon have been chiefly formed and concentrated through the agency of water, some few are composed of residual or slidden material, while in other countries instances have been recorded of moraines formed in front of a glacier being profitably worked as placer ground. If amended by the addition of the words "or other natural forces" after "agency of water" the definition would be improved.

Generally speaking, however, the placers or the Yukon are gravels which have been formed by the wearing down and redeposition of the rocks of the immediate adjoining country.

Of the processes which enter into the formation of placer deposits, the following are the most important: First, rock decomposition and disintegration, or weathering; second, transportation; third, concentration, and fourth, deposition.

Transportation.—As seen above this whole country once formed a moderately even plain at what is now a height of about 3,500 feet above the level of the sea. Since that time it has been reduced to its present configuration. The rocks were softened by weathering and were then transported by the agency of water down the slopes, and finally for the most part into the ocean. The weathering kept well in advance of transportation, so that the hills are still covered with softened rock.

The primary force which causes this downward movement of loosened material is gravity, but the presence of water helps to loosen and separate the particles of the rock from each other, and to allow the force of gravity to be transformed into motion. This influence, of course, differs on different portions of the rock, varying according to the relative weights or specific gravities of the various substances. For instance, the force of gravity exerts a far greater influence on gold, which has a specific gravity of 19, than it does on quartz, which has a specific gravity of only 2.6.

If water is included in the loosened or weathered rock, it causes it to move gently and slowly downwards. This movement is known as "creep," and almost all slopes are affected by it. A typical instance came under my observation on one of the hills adjoining Bonanza creek. A narrow dyke of dark basic rock cut vertically through the light green chloritic schists which formed the country rock of the district. When within ten or fifteen feet of the top, it turned sharply sideways towards the face of the hill and ran horizontally until it reached the surface, being quite clearly distinguishable from the lighter coloured rock all the way. It had been originally vertical throughout; but the creep of the upper softer portion of the schists which enclosed it had turned it over so that its upper portion assumed a horizontal attitude.

This creep has a considerable influence on the formation of placer deposits, as it tends to constantly move the loosened soil and earth down from the hills into the bottoms of the valleys.

But the principal agent in the transportation of the loosened rock, and also in its concentration, is water flowing on the surface, either in minute rivulets or in larger streams.

After a heavy fall of rain little rills are formed all over the ground, and these flow downwards, carrying a load of mud with them, and gradually join together into larger streams, and finally into brooks and rivers. As they become larger with a constant slope they increase in velocity and consequently have greater carrying power.

*The following table gives the carrying power of a stream as exerted on quartz or rock of similar weight:

	Velocity of Current.	Size of material moved.
3	ft. per sec.=1/6 mile an hr.	Fine clay and silt.
6	in. per sec.=1/3 mile an hr.	Fine sand.
1	ft. per sec.=2/3 mile an hr.	Pebbles 1/2 in. diam.
2	ft. per sec.=1.3 mile an hr.	Pebbles 1 in. diam.
2.82	ft. per sec.=1.9 mile an hr.	Pebbles 2 in. diam.
3.46	ft. per sec.=2.3 mile an hr.	Pebbles 3 in. diam.
4	ft. per sec.=2.7 mile an hr.	Pebbles 4 in. diam.
4.47	ft. per sec.=3 mile an hr.	Pebbles 5 in. diam.
4.90	ft. per sec.=3.3 mile an hr.	Pebbles 6 in. diam.
5.29	ft. per sec.=3.6 mile an hr.	Pebbles 7 in. diam.
5.65	ft. per sec.=3.9 mile an hr.	Pebbles 8 in. diam.
6	ft. per sec.=4 mile an hr.	Pebbles 9 in. diam.

With rocks of equal specific gravity the carrying power of a stream varies according to the square of the diameter of the pebbles; or the volume of the pebbles which can be carried by a stream increases in the sixth power of its velocity; that is if the velocity is doubled, the diameter of a pebble which can be carried is increased four times, and the volume sixty-four times. Conversely when the current is reduced one half, the volume of a pebble (weight being equal) is reduced sixty-four times.

Thus a very slight increase in velocity greatly increases the carrying power of a stream. For instance, a stream flowing at one mile an hour has power to transport particles of a certain size, and if that stream increases in velocity to a mile and an eighth an hour, it becomes capable of carrying particles of double the volume, while if the velocity is decreased from a mile and an eighth to one mile an hour its transporting power is cut in two.

In this connection it must be borne in mind that the effective weights of different substances are not the same in water as in air. For instance, quartz which has a specific gravity of 2.6 has a specific weight in water of only 1.6, while gold which has a specific gravity of 19 has a specific weight in water of 18. Gold is therefore 7.3 times as heavy as quartz in air, while it is 11.25 times as heavy as quartz if weighed in water. It is therefore the specific weight in water of different substances which must be considered in connection with their transportation by water, rather than their relative weights in air. If the specific gravity is constant, the diameter of the pebbles which a stream can carry will vary as the square of the velocity, and if the velocity of the stream remains constant, the size of the pebbles will vary according to the specific weight of the substance composing them weighed in water. Thus, if one pebble is of quartz and another is of gold, which is 11.25 times as heavy as quartz weighed in water, the volume of a pebble of quartz which can be carried by the current will be 11.25² or 126 times as great as that of a pebble of gold, and, assuming both pebbles to be cubes the diameter of the pebble of quartz will be approximately five times the diameter of the pebble of gold.

With pebbles of quartz and gold of equal size it will take a current of $\sqrt{5}$ or 2.24 times the velocity to move the gold which it will take to move the quartz.

Again, if pebbles of quartz and gold of equal size are dropped into water the latter will sink to the bottom with more than three times the velocity of the former.

Now the quantity of material, or load, which can be collected by running water from the ground when it is covered with vegetation is relatively small, but when vegetation is absent and weathered rock is exposed to the direct influence of the rain and running water the load will often be very large, and consequently streams which carry away the wash from bare but weathered surfaces are often loaded to their utmost capacity.

In addition to the work done by water in carrying away weathered and softened rock, the streams themselves cut down their channels into the hard unweathered rock.

Where the water in the streams is clear and carries but little sediment this cutting action is very slow, or almost nil, but where it carries any considerable amount of sediment this sediment is pushed along on the bottom over the rock, and wears it down like a file, so that the bottoms of the streams, which are in this way deepening their channels, rarely, if ever, give evidence of the presence of a weathered layer of rock.

In the Klondike district it is certain that the valleys, both during the Second and Third Cycles of Erosion, were cut down by this process of downward erosion as narrow V-shaped gorges through unweathered rock to base level.

By the processes of erosion and transportation, the old Dome Peneplain has had deep and wide valleys cut in it, and most of the material derived from the cutting out of these valleys has been carried away beyond the limit of the district, either to the ocean or to some lower-lying land.

The lowest point in the Klondike area, which we are now considering, may be taken as the bed of the Yukon river at the mouth of the Klondike river, opposite the city of Dawson. In 1898 this was calculated by the author to be at a level of 1,200 feet above the sea, the calculation being then based on the assumption that the Yukon river from Lake Bennett to its mouth flowed in a parabolic curve. Since that time no exact measurements of the height of Dawson have been made, but a number of approximate levellings would indicate that the height so calculated in 1898 is not far from correct. The highest point in the area is the Dome, with an elevation of 4,250 feet above the sea.

Some years ago a contour map on the scale of two miles to the inch, with contour intervals every hundred feet, was prepared by Mr. R. G. McConnell and his associates of the Geological Survey of Canada. Some corrections were made to this map by the writer and then the area of each contour line was computed. Summing these areas together it was found that the district had a mean elevation of 2,600 feet above the sea. Assuming that the Dome Peneplain had a mean elevation of 3,500 feet above the sea, which is the elevation of those remnants of it which can be clearly distinguished, the country has been reduced under the influence of atmospheric and water erosion from 3,500 to 2,600 feet above the sea. This computation may be not strictly correct, for the Dome Peneplain may have sloped off towards the surrounding valleys, so that portions of it may have been lower than its remnants which are now recognizable, but on the other hand parts of it may have been higher than those parts which remain, and

therefore it is probable that an elevation of 3,500 feet is not far from correct.

Taking a total area of 800 miles for the entire Klondike district and assuming that we are correct in our calculation that the country has been reduced 900 feet on an average, it would appear that 136 cubic miles, or 1,600 billion tons, of rock have been removed from this area since the downward erosion of the Dome Peneplain was inaugurated.

The work of removing this enormous quantity of rock must have taken a very long time, for it is not likely that rock weathers as quickly in that far northern country as it does farther south, and streams which are frozen to the bottom for half the year cannot cut down their valleys as quickly as those which have the whole year to work in. Besides that, the ground in the north has a tendency to be covered by a thick growth of sphagnum moss and other low vegetable organisms which prevent the water from wearing the surface away. In the valley of the Mississippi it has been found that the country is being worn down at an average rate of about one foot in 4,000 years. If this rate is applied to the Klondike district it would mean that it has taken 3,600,000 years to reduce the Dome Peneplain down to the present configuration of the country. However, I am satisfied that the Yukon river does not carry away as much sediment as the Mississippi, and especially is this so if the glacial mud, which is brought down by the White river and other similar streams from the mountains, is eliminated from the computation. If the Yukon and its tributaries have eroded and reduced their valleys in past times at the same rate that they are eroding to-day, it is probable that a rate of one foot in 6,000 years, or even more, should be applied, in which case the time needed for the erosion of the Klondike district to its present shape would be 5,400,000 years or more.

Concentration and Deposition.—I have shown that the Klondike area was gradually worn down as an individual unit from the Dome Peneplain to its present shape in two successive periods, which have been here called respectively the "White Channel Period" or "Second Cycle of Erosion" and the "Recent Period" or "Third Cycle of Erosion." Both these periods may have been made up of two or more sub-periods, though that question has not been discussed here. Of the two main periods, the former, or White Channel Period, was very much the longer, and the greater portion of the erosion was performed during it.

While the erosion was in progress the eroded material was being carried down into the valleys and thence outwards to or towards the sea.

At first the streams were actively deepening or wearing down the bottoms of the valleys. Therefore these valleys were in the form of V-shaped gulches, from which all the finer and lighter material was being carried away, while the heavier particles, such as gold, magnetite, etc., were being scattered along the bottoms of these narrow valleys.

The particles of gold contained in the gravel or sand would be carried along by the water of the streams, over any smooth rock, until they would settle into crevices in the rock itself or into spaces between or among large loose rock masses, from which places they could not be dislodged except by upward currents. Such currents would first lift pebbles of quartz or similar rock less than five times the diameter of nuggets or particles of gold, before they would lift the particles of gold, even if the quartz and gold were equally accessible. But as

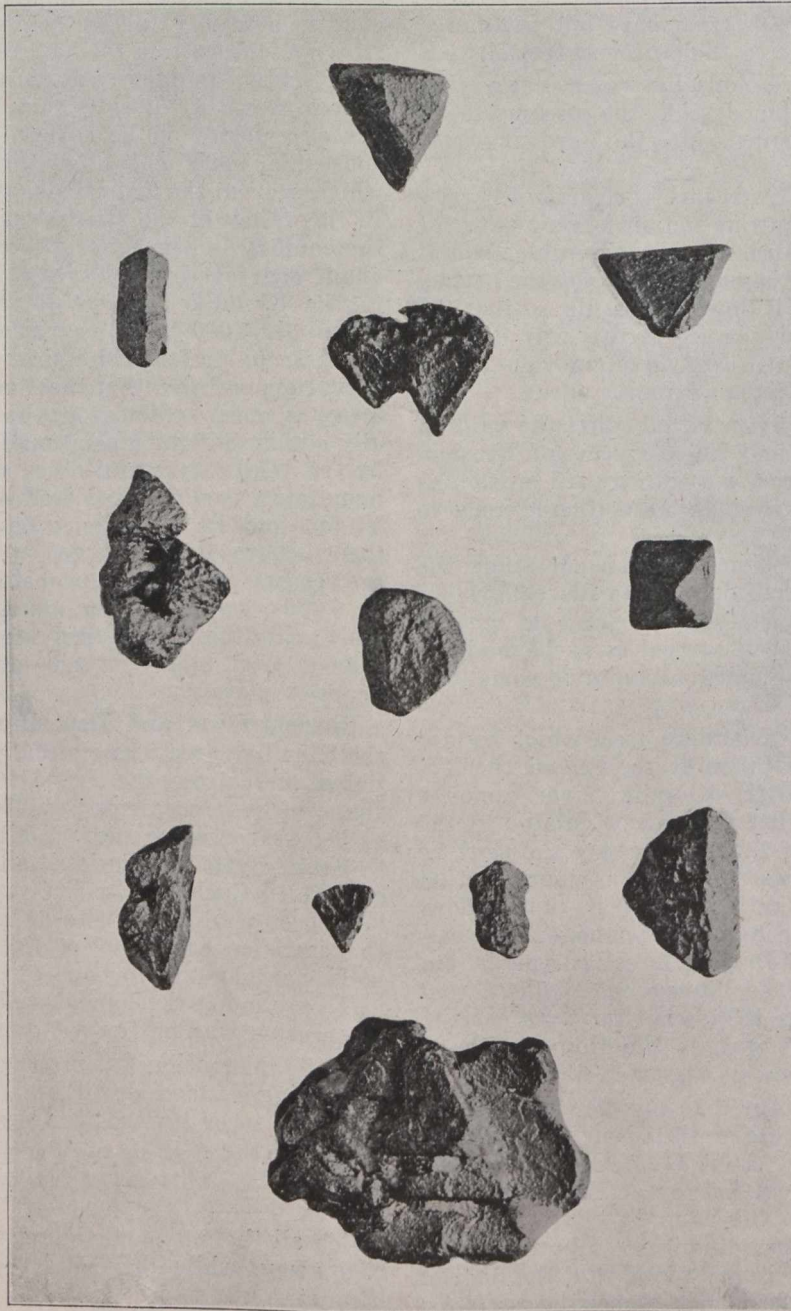
a rule they are not equally accessible, for the lighter rocks being larger would stand higher than the particles of gold, and the spaces between them would hold and protect the smaller masses of the heavier metal from the current.

Thus the removal of gold by currents, after it has once been lodged, becomes exceedingly difficult as long as the crevices or spaces in which it is lodged persist.

While a stream keeps cutting its channel downwards new crevices or lodgment places are being constantly

After the stream had cut the bottom of its valley down to grade or base level, and had ceased the process of vertical erosion, it would begin to cut laterally and to widen the bottom of the valley so formed, and to deposit sand and gravel in the form of flood-plains on it.

During this process of lateral erosion, the gold, which had already been collected from all the surrounding country into the bottom of the V-shaped valley, would be, to a large extent, below and out of reach of



Crystals of Gold from Victoria Gulch.—Magnified $2\frac{1}{2}$ diam.

developed in the rock beneath the old ones which are being cut away. The gold keeps working down or dropping into them, and thus it moves almost vertically downwards with the deepening of the valley. In this way a streak or band of rich gold-bearing gravel would be formed in the bottom of the narrow valley, distributed in the crevices of the rock and in protected places immediately on top of it.

the influence of the meandering stream with its slower current. The stream would, however, continue to widen its valley and to extend its flood-plain and in many cases to build this flood-plain up to greater and greater thickness.

In this way we can see how such pay-streaks as that of the White Channel gravels of Bonanza Creek have been formed. They represent the gold collected in the

old V-shaped valleys of that period, while the great thickness of gravel above and on both sides of them was deposited after these pay-streaks were formed.

Gold is usually not entirely absent from the upper and lateral gravels, for some of the precious metal was being constantly washed down from the adjacent hills with pebbles of quartz, schist, and other rocks; but the coarse gold of the pay-streak on and in the bed-rock was collected into its present position before the gravel was deposited on top of it, and it was not concentrated out of the gravel above it, as has often been assumed.

It may therefore be accepted as a definite law, that pay-streaks were formed on, and indicate the positions of, the bottoms of old V-shaped valleys.

If the bottoms of the present valleys are much wider than the paystreaks, this greater width represents the amount to which these valleys have been cut out by lateral erosion after they had been originally outlined to their present depth, and the gravels with which these valley bottoms are covered are later in age or newer than the pay streaks.

For instance, the old pay-streaks in the White Channel gravels on Bonanza and Hunker creeks which are well shown on Mr. McConnell's map accompanying his "Report on Gold Values in the Klondike High Level Gravels," run in very straight lines approximately down the middle of the old valleys, though possibly a little nearer their western than their eastern sides. The outlines given on that map for the approximate original boundaries of the White Channel gravels show the widths of the old flood-plains, and the extent of the gravels deposited over and around the pay-streak. The pay-streaks mark the positions of the bottoms of the original V-shaped valleys, and the gravels are flood-plain deposits which were subsequently laid down over and around them.

Similarly the pay-streak can be traced down the bottom of the present valley of Bonanza creek, marking the line of the bottom of the old V-shaped valley. In places this old valley bottom at one time crossed terraces in the present valley and then short strips of the pay-streak were left across these terraces. Later as the stream deepened its valley the bottom swung round the terraces. Very often the pay-streak is not so rich around these curves, for it had to start anew without any gold to work on. The gold which is contained in this new portion of the pay-streak is not that which descended vertically with the growth downwards of the valley, but is rather that which was brought down the valley by the stream after the terrace was formed, or the little which was brought into it from the sides.

At the present time I am collecting information on the presence of these low terraces and their influence on the value of the pay-streak in the adjoining deeper valley; but the matter is not yet ready for publication.

In this connection attention may be drawn to the fact that while the gold and the heavy minerals associated with it in the pay-streak represent a concentration from the whole of the material first eroded from the Dome Peneplain, that in the overlying and surrounding gravel only represents a concentration from the surface of the country after the present valleys were cut down to base level at practically their present depths, and after flood-plains began to form in them.

It may also be interesting to point out that the law above announced, namely, that the pay-streak marks the bottom of the old V-shaped valley, should be of interest to all students of physical geography, since, wher-

ever it can be found, it furnishes a datum line from which the growth of the valley outwards can be followed and studied. Even where a pay-streak carrying gold is not present in a valley, a band of heavy minerals or coarse rock fragments might be detected which would indicate the original position of the bottom of the V.

It is not improbable that gold may have a tendency to settle down through gravels and to collect on bed-rock below them; but this tendency exerts a minor influence in the formation of workable placers.

In McConnell's Report, pages 9 and 10, the gold values per cubic yard of two columns of gravel are given, taken from the hills beside Bonanza and Last Chance creeks, one 159 feet high and the other 90 feet high. These columns were unfortunately taken over the pay-streaks in which the gold existed before the gravel was deposited over it; but omitting the lowest 6 feet in each column which appears to contain the pay-streak, the rest shows an increase in value downwards, in the one case from .6 cent to the cubic yard to 18 cents a cubic yard, and in the other from .7 cent to the cubic yard to 11.4 cents to the cubic yard.

In the first column the total amount of gold contained in the upper 51 yards is \$1.27, while the lowest 2 yards contained \$8.26. In the other column the upper 28 yards contained \$1.07, while the lowest 2 yards contained \$4.40.

These values may give some indication of the relative amount of gold which was concentrated into the valleys, first, in the earlier stages of erosion when the pay-streak was formed, and the lighter material was carried away, and secondly, in the more mature stages of erosion, when the pebbles of quartz and other rocks were deposited with the gold.

The upper gravels probably contain almost all the gold that was eroded out of the rocks of the surrounding country while these gravels were being deposited, and if we knew the relative sizes of the particles of gold in the gravels and in the pay-streak, we might be able to form some idea of the percentage of the gold which had been worn out of the rock of the country and had been collected in the pay-streak; but unfortunately this information is not available at the present time. However, it is quite certain that the gold in the gravel is, on the average, much finer than in the pay-streak, and as the gravel gold doubtless represents closely the general character of that contained in the country rocks, we must assume that in the pay-streak much of the finer gold has been carried away, and that the coarser particles are all that have been left. It is hoped that it may be possible to compare these two runs of gold more fully at some future time.

If the erosion of a valley were to continue downwards uninterruptedly in rock of similar character throughout until its bottom should have reached base level before the stream which formed it began to erode laterally, the gold would be distributed in a continuous line along the bottom of such a valley and when the stream had afterwards widened it and had formed alluvial flats and flood-plains the pay-streak would be continuous through and under these alluvial flats.

But streams rarely, if ever, deepen their channels uninterruptedly in this way. Harder bands of rock cause obstructions, and elevations and depressions of the land cause the water to flow with different velocities at different times, so that at one time, or in one part of its channel, a stream may be cutting into the bottom of its valley, while at another time and in an-

other part of its channel it may be filling it up and covering it with alluvial sand and gravel.

In this way a stream with a valley of any considerable depth has probably formed a number of flood-plains at different periods in its history, and remains of these flood-plains may often be seen as terraces on the sides of its valley.

When a stream has formed a flood plain the pay-streak will, as we have seen, run beneath that flood plain on a line marking the original bottom of the old V-shaped valley and if, when the stream again begins to cut through this flood plain and into the rock beneath it, it follows the line of the former stream, or, in other words, if it follows the line of the pay-streak, it carries the pay-streak down with it; but if it diverges from this line, a portion of the pay-streak remains on the terrace. If it continues to deepen its channel until all the terrace is removed, or at least until that portion of it is removed which contains the pay-streak, the gold will also all be in the pay-streak in the bottom of the new valley; but if it reaches a new base level before the pay streak is all removed from the terrace a new condition is introduced. The stream may begin to cut into the side of its valley and may cut into and remove the old terrace containing a portion of the old pay-streak. In that case, the gold may drop down into the bottom of the valley with the eroded rock and gravel and form a rich pocket at one side of, and often quite off the line of the original pay-streak or it may be distributed along the channel which the stream happens to be following at the time. If the renewed stream happens to cut in to the old valley bottom to one side of the original pay-streak, or across it at several places and to diverge from it at a number of other places, the new pay-streak may be weak and indefinite, or it may be rich in spots and very poor between those spots, with other rich spots to one side or the other. In fact, it may assume a variety of characteristics, according to the manner of growth of the valley in which it has been formed.*

From these considerations it may be seen that continuous and regular formation of a valley will tend to the existence of a regular pay-streak, while discontinuous and irregular growth of a valley will form an irregular and disjointed pay-streak with many lateral apophyses.

In some cases it may happen that the rejuvenated stream will abandon the old valley altogether and in this way be removed from the influence of the old pay-streak. An example of this condition occurs on the lower portion of Bonanza creek, where, at about claim 80 below Discovery, the new valley leaves the old one, the stream having turned westward to cut out an independent channel through the country rock. As the creek during this later stage of its existence gathered but little gold from the rocks of the surrounding country, but rather depended for the richness of its placers upon that which had already been collected into the pay streak of the White Channel period, and as in leaving the old valley it had here left this old pay-streak entirely, the gold which occurs on this lower portion of Bonanza creek has either been carried down the creek itself from the higher parts of its valley, or has been brought into it by the stream flowing from Lovett Gulch which taps the White Channel pay-streak. The pay-streak is consequently not as rich here as it is farther up Bonanza creek, where it is directly beneath the former position of the old White Channel pay-streak,

and contains much of the gold which that pay-streak formerly contained.

When we recognize that a pay-streak was formed in the bottom of a V-shaped valley at a time when that valley was being actively deepened, and when the bottom of the channel of the stream was composed of hard unweathered rock of the country, we can readily appreciate the influence that the character of the rock would have on its richness or poverty.

If the rock were hard and smooth the gradient of the stream would in that case continue higher than the average until base level had been reached throughout, the current would consequently be stronger, and the gold and coarse gravel would tend to be carried down to a more favourable location for settlement.

If, on the contrary, the rock were soft and fissile the gradient would be lower than over hard rock, the current of the stream would be slacker and the gold would have a better opportunity to settle down into the fissures and points that form riffles to collect it.

The conditions would be similar to those in a sluice-box. If the water flowed over a smooth bottom the gold would be carried away, and if it flowed over a rough and broken bottom with many openings in it, the gold would settle down in these openings.

As the stream cuts down into the bottom of its valley it will not under ordinary conditions, again pick up this gold that has settled into the fissures, except in cases where the supply of gold becomes too great for the natural riffles to hold, but rather as the surface of the rock is gradually worn down by the stream, the gold will be allowed to settle deeper and deeper below its original point of sedimentation. For instance, if gold particles have settled in fissures in a schistose rock these particles will continue to sink vertically for hundreds of feet if the fissures continue to persist, as long as the stream continues to deepen its channel on the same course.

Character of the Gold.—The general character and value of the gold found in the Klondike has been given in Mr. McConnell's "Report on the Gold Values in the Klondike High Level Gravels" and need not be repeated here. It all contains a considerable percentage of silver, but the quality varies to such an extent in different places that while the value of the gold on parts of Dominion creek is as high as \$17.75 an ounce some of that from Last Chance creek is not worth more than \$12.50 an ounce. The average value of the gold exported from the Klondike in 1905 was \$16.02 an ounce after it had been melted.

That in the bottoms of the valleys is generally well rounded and water-worn, or perhaps it would be more correct to say beaten round while it had been carried along by the water. But much of the gold in the White Channel gravels is more or less angular, and some of it is quite clearly crystalline. Many of the crystals are feathery and very delicate, and it is possible that some of these may have been deposited on the sides of other fragments, or around nuclei through the agency of water carrying gold in solution, which percolated downwards through the overlying gravel. But other crystals were undoubtedly formed in quartz veins and have been mechanically removed to the positions which they now occupy in the gravel. Those represented on Plate II are clear examples of this class. Figures 1 and 2 are two views of a twinned octahedron. Figures 3 and 4 show a cube with hollow faces and with the angles modified by the faces of the rhombic dodekahedron. Other crystals found by the writer have already been

*See paper by the same author on The Law of the Pay-streak, with illustrations, in Trans. Inst. Mining and Metallurgy, Vol. xxi (1912) pp. 593-605.

recorded by Professor Miers. They occur in a vein of quartz at the head of Victoria Gulch, and similar crystals have also been washed out of the gravel on some of the mining claims on the Gulch itself. They are octahedral twinned parallel to the octahedral face, and are usually in the shape of flattened triangular plates. Those shown on Plate I were obtained from Mr. Philip Holloway's claim Number 7, on 7 Pup, Victoria Gulch where Mr. Holloway very kindly allowed me to sort over his gold and take away these crystals.

Associated Minerals.—The minerals associated with gold in the camp are the following: Meteoric iron, native copper, graphite, magnetite, haematite, pyrite, cassiterite, quartz, rutile, garnet, epidote, kyanite, scheelite, awaruite, almandite, etc.

Production.—The ordinary creek claims in the Klondike had a length of 500 feet up and down the creek, and several of these yielded more than a million dollars, or an average of more than two thousand dollars to the running foot. Fraction A on Bonanza creek, at the mouth of Skookum gulch, had a length of 86 feet, and Richard Low, the owner, informed me that he had extracted gold to the value of between half and three-quarters of a million dollars from it, giving an average yield of from \$5,800 to \$8,700 a running foot of the claim. I was present at one clean up on this claim, after thirty hours' work by six men, and the clean gold recovered filled eight gold pans as full as it was possible to carry them without breaking.

Up to the present time placer gold mining in the Yukon territory has produced gold to the value of \$140,879,500, about 99 per cent. of which has been taken from the Klondike district.

As we have shown this gold has been concentrated by ordinary stream and atmospheric agencies into the bottoms of the valleys from the rocks of the surrounding and adjoining country. As far as we know, it was first concentrated into the bottoms of the valleys of the White Channel period or Second Cycle, and part of it

was again reconcentrated into the bottoms of the valleys of the Third Cycle.

Altogether there has been removed since the age of the Dome Peneplain about 136 cubic miles of rock, and the gold which was contained in these 136 cubic miles has, to a large extent, been concentrated into the pay-streaks and gravels in the bottoms of the valleys. The exact proportion of gold that has been retained in the valleys and that which has been carried away is not known, but the two hundred million dollars worth or ten million ounces of gold which was retained in the valleys would, if evenly distributed through the rock from which it was derived, amount to .013, or approximately 1/75 of a cent to the ton. It is thus clear that the Klondike placers owe their richness entirely to the peculiarly favourable conditions of concentration which have existed through a long period of time in that unglaciated district, rather than to any particular richness of the rock from which the placers were originally derived.

Another feature of interest may be worthy of mention. The rocks in the Klondike are schists and slates of pre-Cambrian age, such as are generally recognized as being favourable to the occurrence of gold-bearing veins. Many quartz veins occur in these rocks, and in many of these quartz veins gold is distinctly visible, while in other veins it can be recognized in small quantities by assaying. The rock of the country is therefore distinctly a gold-bearing rock.

One hundred and thirty-six cubic miles of this gold-bearing rock were put through nature's mills and the gold contained in it was concentrated in nature's sluices, and from it a total of ten million ounces of gold, worth about two hundred million dollars, was extracted, proving the rock to contain an average gold content of at least 1/75 of a cent to the ton. What percentage of the gold contained in the original rock was saved we do not know; but if nature's concentration processes were not grossly inefficient the average gold contents of the gold-bearing pre-Cambrian rocks of the Klondike must have been very low.

NOTES ON THE SAN FRANCISCO MILL, PACHUCA, MEXICO*

By J. P. Holcombe, Student.

Some notes on this mill may be interesting, not only because it was the first cyanide mill erected in Pachuca, but also because it was the pioneer mill, in the western hemisphere, to use the Brown agitating tank, since called the "Pachuca" tank in America.

Originally built as a pan amalgamation custom mill, it was taken over by the Maravillas Mining Co. in 1910, since when both mines and mill have been worked under the same management.

The whole plant has been electrically equipped throughout, the power being supplied by the Mexican Light and Power Company from their hydraulic plant at Necaxa, some 90 km. (about 56 miles) away.

The capacity of some of the motors is much greater than is now required, owing to constructional changes in the past.

After many alterations the mill now consists of three 10 in. \times 12 in. Blake rock-breakers; one 16 in. \times 22 in.

set of rolls; forty 1,250 lb. stamps; eighty Wilfley concentrators; four Dorr classifiers; three 13 ft. \times 4 ft. 6 in. Krupp and one 15 ft. \times 5 ft. Denver Engineering Works tube-mills; four 10 in. \times 54 in. Frenier pumps; four Dorr pulp thickeners, three of these 24 ft. \times 10 ft., and the fourth 30 ft. \times 10 ft.; eight "Pachuca" tanks 45 ft. \times 15 ft.; two 22 in. bucket elevators, buckets set 18 in. apart; one Moore vacuum filter (movable type) with the necessary sumps, solution tanks, pumps, pulp storage tank, compressors, etc.

The ore, which comes from several mines and dumps varies in character a great deal, the value being chiefly in the form of silver sulphides, with some manganese, galena, zinc blende and pyrites, these latter being eliminated to a great extent by coarse concentration. The mill-heads for the past six months averaged 595 grm. (19.12 oz.) of silver, and 2.84 grm. (0.091 oz.) of gold per metric ton (2,204 lb.).

*From the Bulletin of the Institution of Mining and Metallurgy.

The ore is received in the "patio" or yard adjoining the mill, where it is weighed, and then trammed to the rock-breakers and rolls situated immediately above the ore-bin, which holds 450 metric tons. After passing over a grizzly of 2 inch spacing, the coarse ore is crushed to pass a 2½-inch ring, the rolls acting as a fourth primary crushing machine with distribution by means of a 18-inch Robins conveyor belt.

The ore is fed by "Challenge" feeders to the stamp-mill, which is driven from one line shaft by a 200 h.p. motor; the stamps make 100 drops per minute, the height of drop being 7 inches. The mortars stand on concrete blocks which extend to the masonry of the ore-bin, thus making a very substantial battery foundation and feeder floor. The screens in use have either six or eight holes to the linear inch, according to the class of ore treated.

Crushing is done in cyanide solution, and the pulp, after leaving the stamps, is concentrated on "Wilfley" tables, about 14 per cent. of the value being obtained by concentration. It then flows to the Dorr classifiers, the sand to be ground and re-ground in the tube-mills; the overflow, which for all practical purposes may be considered as slime, being conveyed direct by elevator to the cyanide plant. There are no cones in the mill.

The concentrate is conveyed by pipes directly from the tables to sumps in the concentrate storage room lower down the mill, thus obviating chances of theft and saving labour, the clear overflow from these sumps joining the mill solution.

The three Krupp mills make 28 revolutions per minute, being driven from one line shaft by a 200 h.p. motor, and the Denver mill, 26 revolutions per minute, by a separate motor of 75 h.p. The battery motor and the large tube-mill motor are so placed that, in case of a breakdown of either, one-half of the mill can still be run by mounting belts on pulleys, which are always in position on the battery line shaft and tube-mill countershaft. One motor drives the Frenier pumps and Dorr classifiers.

The stamps have a much greater capacity than the tube-mills, this fact explaining the low stamp duty, which for the past six months has averaged 5.570 metric tons per 24 hours.

The tube-mill feed is kept as thick as possible and contains about 35 per cent. moisture as it enters the scoop feeder. The Denver mill does better work than the others. The four mills are fitted with "El Oro" lining and mine rock only is used, it being fed as large as possible through a 6½-inch spiral while running. Formerly, imported flint pebbles only were used, then different proportions of pebbles and rock were tried, but the so-called selective action of the former in remaining in the ribbed lining was not apparent, and for the last year nothing but mine rock has been used. Even considering loss of time due to re-lining and extra expense of new liners, the difference in cost between the use of pebbles and mine rock is greatly to the advantage of the latter in this mill. The mills are kept as full as possible with rock, the consumption being 30.7 kg. (67.5 lb.) per ton of ore ground. This rock contains approximately 200 grm. silver (6.43 oz.) and is included in the mill tonnage.

The average life of locally-cast white iron liners is 8.5 months. Experiments are now being made with liners containing 25 per cent. steel, but no data are yet available. The pulp delivered to the cyanide plant averages 80 per cent. through 200-mesh screen.

All the tube-mills are placed in one line, end to end, with a space of 4 ft. between the discharges of Nos. 1

and 2, and 3 and 4, one man attending to the feeding of rock to two tube-mills. One 48-in. × 10-in. Frenier pump returns the discharge from two tube-mills for re-classification.

The overflow from the Dorr classifiers, having a consistency of 8 to 1, is elevated by an elevator with a belt speed of 250 feet per minute, and is discharged through pipes to the Dorr thickeners; the clear overflow from three of these joins the mill solution and that from the fourth is precipitated. The pulp from these thickeners has a consistency of 1.2 parts of solution to 1 of ore, and flows by gravity to the "Pachuca" tanks, where sodium cyanide is added to bring the strength of solution up to 0.4 per cent. potassium cyanide. The protective alkalinity is kept at about 2 lb. CaO per metric ton of solution, by adding lime to the tube-mill feed, the consumption being 4.4 kg. (9.7 lb.) per metric ton of ore.

Each tank is filled separately, and when filled, titrated and sampled, agitation is maintained for 36 hours, then follows a rest for 10 or 12 hours, after which as much agitation as time will allow before filtering.

While describing these tanks, I may say that the experiment of removing the top length, measuring 13 feet of the central column, has been tried on one tank for several months, giving no apparent benefit. Also for the air lift, plain unprotected nipples, 15 inches long, are in use in all these tanks and have not given any trouble.

No lead acetate is used in the "Pachuca" tanks, but an amount equal to 300 grm. (0.66 lb.) per metric ton of ore crushed, is added to the mill solution at regular intervals. The consumption of potassium cyanide per ton of ore crushed is 834 grm. (1.83 lb.).

The pulp after treatment is pumped by centrifugal pumps to the storage tank which feeds the filter plant.

One basket of 40 leaves is constantly working. There is a complete spare basket, also spare leaves. The working leaves are given an acid bath every month. This filter treats, with one basket only in use, 220 tons of ore per 24 hours; it started working 13 months ago, and has given very satisfactory results. The cakes are discharged by water under a 20-ft. head.

A cycle is as follows:

	Minutes
Making cake 1¼ inches	20
Transfer to barren solution tank.....	3
Barren solution wash	40
Transfer to water and discharge tank...	3
Water wash.....	15
Discharging cake.....	5
Total.....	86

The filtered strong solution, and the first ten minutes or so of solution wash, is pumped to the pregnant solution tanks for precipitation, afterwards joining the mill solution, the rest of the solution wash being precipitated apart, then returned to the filter for cake washing.

The precipitation and melting house contains ten 5-compartment zinc boxes, each compartment being 36 inches × 33 inches × 39 inches high, above the trays where 4-mesh screen is used. Nine of these boxes are packed with zinc, and a clean-up is made every week. The zinc consumption per kilo of bullion produced is 1.101 kilos (2.42 lb.). Precipitation is good, the zinc box effluent hardly ever reaching 2 grm. (30.8 gr.) of silver per ton of solution. All zinc washing is done in solution, the discharge from the precipitate press being pumped to the head compartments of two zinc boxes.

The precipitate is washed through a 40-mesh screen and pumped into a ½-ton Shriver press; it is given no acid treatment, contains 80 per cent. to 85 per cent. bullion, and is discharged after passing compressed air through it for 20 minutes, the precipitate then containing about 28 per cent. moisture. There is a strong-room in which the car containing the precipitate is kept overnight for melting the next day. There is also a bullion safe inside the strong-room.

Originally there were six coke furnaces, but three of these have been converted into oil furnaces with good results. Morgan No. 300 crucibles are used, and the flux is borax glass 7 per cent., soda ash 5 per cent., lime 1 per cent., and sand 2 per cent. With this flux the bars assay from 910 to 940 fine in silver, with four to five parts gold, and weigh from 32 to 35 kilos (70.4 to 77 lb.) each.

The consumption of fuel oil per kilo of bullion produced is about 1.49 litres (0.328 gall.).

The air compressor equipment is as follows:

One Ingersoll-Rand duplex, class "J," simple air cylinders, 12 in. × 14¼ in., making 160 revolutions per minute, capacity 595 cubic feet per minute.

One duplex Ingersoll-Rand, 16 in. × 10 in. and 10 in. × 10 in. (converted compound), making 130 revolutions per minute, 675 cubic feet of air per minute.

One Ingersoll-Rand type XI, vertical, capacity 270 cubic feet per minute.

One of the first two supplies enough air for the agitation of six Pachuca tanks, one pulp storage ("Pachuca" type) and pulp tank of Moore filter, also blacksmith's shop. A pressure of about 30 lb. per square inch is maintained. When the melting furnaces are used the type XI compressor also runs.

The average cost per metric ton of ore milled during the period January to June last, was as under:

Rockbreakers.	\$0.11	2.64d.
Batteries.	0.24	5.76
Concentration.	0.04	0.96
Tube-mills and classifiers. . .	0.29	6.96
Agitation.	1.05	25.20
Filtration.	0.16	3.84
Pumping.	0.09	2.16
Precipitation and melting. . .	0.41	9.84
Sampling and assaying.	0.13	3.12
General repairs	0.17	4.08
Surface expenses	0.05	1.20
Power.	0.81	19.44
General expenses	0.31	7.44

Total. \$3.86 92.64d.=7.72s.

A Mexican peso is approximately 2s.

The actual extraction during this period was 92.4 per cent. of the silver, and 94.5 per cent. of the gold.

With the exception of the superintendent, day and night foremen, and precipitation house man, who are all English, local Mexican labour is employed throughout the mill.

U. S. COAL MINE ACCIDENTS

The coal-mine accidents occurring in the United States during the year 1912 have been compiled by the United States Bureau of Mines under the direction of Frederick W. Horton. The publication which is now ready for distribution gives a resume of the accidents from 1896 to 1912 inclusive with monthly statistics for the year 1912.

Mr. Horton in reviewing the year says: "During the calendar year 1912 there were 2,360 men killed in and about the coal mines of the United States. Based on an output of 550,000,000 short tons of coal produced by 750,000 men, the death rate per 1,000 employed was 3.15 and the number of men killed for every 1,000,000 tons of coal mined was 4.29. The number of men killed was the least since 1900, the death rate per 1,000 employed was the smallest since 1899, the death rate per 1,000,000 tons of coal mined was the lowest, and the number of tons of coal produced in proportion to the number of men killed was the greatest on record. These facts offer indisputable evidence that conditions tending toward safety in coal mining are actually improving and that coal is now being mined with less danger to the miner than ever before. The general improvement in 1912 as compared with 1911 is shown by the following facts:

"In 1912 the number of men killed in the coal mines of the United States was 339 less than in 1911—2,360 as compared with 2,719—a decrease of 13.2 per cent., and this in spite of the fact that there were more men employed in the mines and more coal mined than in any previous year.

"The death rate per 1,000 men employed in 1912 was 3.15, as against 3.73 in the previous year, a decrease of 15.5 per cent.

"During 1912 for every 1,000,000 tons of coal mined 4.29 men were killed, as compared with 5.48 men in 1911, a decrease of 21.7 per cent.

"There was 233,000 tons of coal mined for each man killed in 1912, as compared with 183,000 tons in 1911, an increase of 50,000 tons, or 27.3 per cent.

"Although the improvement in 1912 was greater than in any previous year for which accurate statistics are available, partly due, perhaps, to exceptionally mild weather during the last few months of the year decreasing the likelihood of disastrous coal-dust explosions, there has been an annual improvement for a number of years, as indicated by the accompanying table:

Number of men killed in and about the coal mines of the United States in the calendar years 1907 to 1912, inclusive, with death rates:

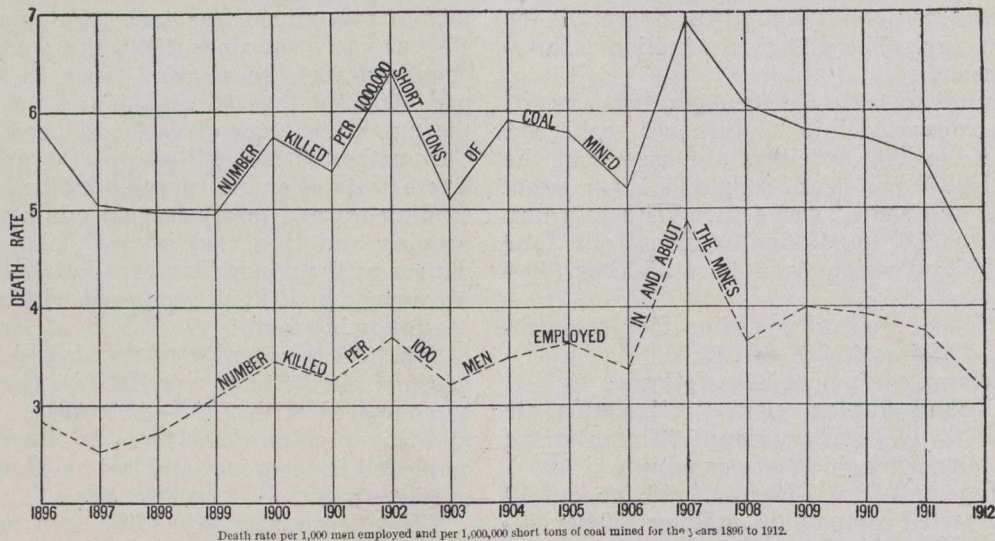
Years,	NUMBER KILLED			Production per death short tons.
	Total.	Per 1,600 employed.	Per 1,000,000 short tons mined.	
1907	3,197	4.88	6.93	144,000
1908	2,449	3.64	6.05	165,000
1909	2,668	4.00	5.79	173,000
1910	2,840	3.92	5.66	177,000
1911	2,719	3.73	5.48	183,000
1912	2,360	3.15	4.29	233,000

"It will be noted from the foregoing table that the death rate per 1,000,000 tons of coal mined has decreased annually, that the production per death has increased each year since 1907, and that the death rate per 1,000 men employed has steadily decreased during the last four years.

"This general improvement has been brought about by a combination of causes, the principal one of which has been more efficient and effective mine inspection on the part of the State mining departments and State mine inspectors throughout the country, supplemented by greater care on the part of both the operators and the miners. The investigative and educational work of the Bureau of Mines has kept both the operator and the miner alive to the various dangers connected with coal mining and has shown what precautions should

be taken to avoid these dangers. The bureau is therefore gratified with the improvement shown, particularly as the greatest improvement relates to dangers concerning which the bureau has been conducting special investigations, as is shown later. The bureau,

crease in the death rate can be effected. Whether or not such an improvement will be made in 1913 depends largely on the care exercised by the operators, superintendents, foremen, and all others in authority, and by the miners as well, to prevent the rise of dangerous



however, can not too strongly express its appreciation of the co-operation of the State mining officials and the operators in the work of making coal mining safer.

“Although there has been an annual improvement in mine-safety conditions since 1907, and a particularly notable one in 1912, a still greater de-

conditions and to avoid unnecessary risks when such conditions have arisen.”

Copies of this report, Technical Paper 48, may be obtained by addressing the Director, Bureau of Mines, Washington, D.C.

MOTOR FOR STAMP MILL DRIVE

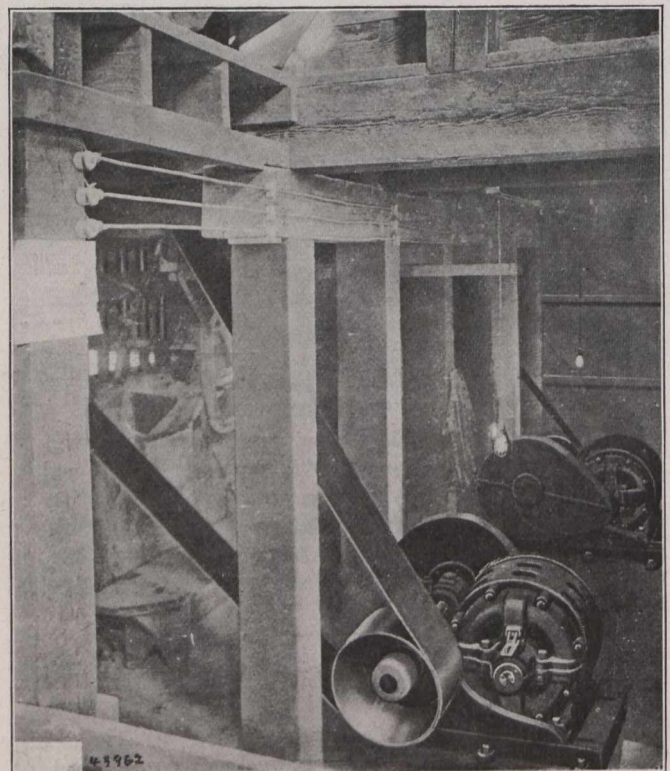
A special motor for driving stamp mills has been recently placed on the market by the Westinghouse Electric and Manufacturing Co. after thorough tests in actual service have proved its suitability for this work.

The motor is mounted in a cradle which in turn is mounted on a heavy base plate. The cradle carries a back shaft to which the motor is geared. The back shaft pulley runs at slow speed so that it can be belted directly to the bull wheel of the stamp mill, thus eliminating the jack shaft and saving space, belting, the loss of power due to belt slippage, and the expense of maintenance of the jack shaft. The motor cradle can be slid along the base plate for belt adjustment, an especially long range of adjustment being provided.

The pulley is outside the bearing on the cradle so that the belt can be easily removed. The motor, gear and pinion can be removed without disturbing the line-up of the pulleys or handling the belt. The back shaft bearings are split and can be inspected or renewed after merely slackening the belt. The gears are enclosed in a dust-proof case and run immersed in oil.

The motor itself is extremely strong and rugged and is built to withstand the very severe service encountered in stamp mill drive. It is of the type originally designed for steel mill work where the worst operating conditions found in any industry must be successfully withstood.

This outfit can be supplied for driving mills of from



3 to 20 stamps, with stamps weighing from 80 to 1,250 pounds. One motor is ordinarily used for each battery and is shut down when the battery is not in use, thus avoiding a waste of power.

SURF INLET GOLD MINES.

The following information concerning the Surf Inlet gold mines was recently contributed to the B. C. Mining Exchange, Vancouver, B.C., by Mr. Fred M. Wells, and is reproduced here for the reason that several Eastern investors were at one time interested:

The Surf Inlet gold mines are situated on Princess Royal Island on the coast of British Columbia, about 400 miles north of Vancouver City. The island, which is about 60 miles long and 25 to 30 miles wide, is a mass of rugged mountains with heavily-timbered valleys and beautiful fresh-water lakes, making it an ideal country to live in and operate mines.

The first discovery of gold quartz here was made many years ago by an Indian who reported the find to some Victoria people. An investigation was made, this resulting in the discovery of the quartz vein and location of the ground now known as the Princess Royal mines. Eastern people became interested in the property and a large amount of development was done. Ore was mined and shipped in small quantities, but eventually the work was given up because it did not return a profit. This gave the camp a "black eye," and for some years it was difficult to get mining men to visit the camp to investigate for themselves the merits of the mines.

It is not for me to say what was the real cause of the failure, but I understand the ore was sorted, packed out to salt water on horses, and shipped to the smelter. I am sure no profit could be made on the ore in that way, and I suggest that this was the cause of the failure. The owners had nice ore, and I feel sure a small mill installed on the ground would have made for them the success the eastern investors expected.

During the operation of the property some miners traced the fault line across the creek and up the mountain side opposite Princess Royal camp, and discovered the large outcroppings of ore that are now the Surf Inlet gold mines. In some way Mr. E. A. Cleveland, civil engineer, of the firm of Cleveland & Cameron, of Vancouver, became interested in the property and attempted in a serious way to make a mine out of it. About this time the work was closed down on the Princess Royal claims and Mr. Cleveland, being unable to interest capital to assist in continuing development, finally closed the camp down. About four years later the camp was brought to the notice of Mr. A. B. Clabon by some interested parties in the East, and it was arranged that I should make the trip in to examine both properties.

Late in the fall of 1909 I made the trip, and spent about ten days in the camp, and after returning to Vancouver secured from Mr. Cleveland an option for Mr. Clabon and myself. In the following spring I took in some men over the snow on snowshoes and commenced work under our bond. The results were so good that we at once formed the Surf Inlet Gold Mines Co., interesting in it prominent Vancouver business men, who have carried on work continuously since that time.

Though we are isolated from steamer routes, we have a regular force of 12 to 15 men working. Our camp is well equipped, and includes a complete assay outfit with an assayer on the ground, who keeps us informed on the value of the ore as developed—a necessary thing in a gold camp.

The country formation of Princess Royal island is mostly granite, locally called "coast" granite, rather

dark in colour and somewhat stratified. The ore bodies are well defined and were formed along a great fault line. The fault has been subjected to much shearing and crushing along its course. The effect of this great rock movement has been in places very marked, brecciating and altering the granite rock for a distance of from 50 to 100 feet from the main fracture. The ore is a hard rose quartz, containing iron pyrite, outcropping boldly where cut by small creeks.

Work has been done and ore proven for some miles along the fault line, but no large amount of work except on the Surf Inlet Gold Mines Co.'s property, and the adjoining claims on the south belonging to the Princess Royal company.

There are often two parallel veins, and where the altered rock exists these veins or ore shoots seem most apt to form along the outer sides and in the contact of the solid granite and the altered rocks. The country has been very much eroded by glaciers, which have left a hard and unoxidized surface to all ore outcroppings, practically doing away with surface accumulations of value from weather effects. From a close observance of the ore as development attains depth, I would say that there was no re-enrichment of these veins near the surface, and that the gold value at present established will be permanent.

The quartz veins so far developed are rather small, except on the Surf Inlet property the vein on which has been proven to be from 10 up to 20 feet in width.

A strong feature of this mineral belt is that there never seems to be barren quartz bodies. The value may go low, and it does in places, but wherever a shoot of quartz exists it is safe to figure on gold value sufficient to pay to mine, while the better-grade ore at times runs up to \$100 a ton, and even higher, often showing free gold specimens.

Development.

On the Surf Inlet property there are two veins, called respectively the east and west veins. The west vein is running at such an angle that we expect it to make a junction with the main vein at some point ahead of our present workings. Both of these veins have been cut to some depth by a small creek, and development of each has been by drifting on the vein from this creek. The west vein has been drifted on for 150 feet, and the vein cross-cut in several places, proving an ore body from 4 to 10 feet wide, and sometimes containing remarkably high gold value, with an average of about \$20 a ton.

At a level of about 150 feet vertically below this work the No. 2 tunnel was driven on the main vein. This drift has just reached the 630 foot mark; it has continued on ore all that distance and has proved a most valuable gold ore body. It has been my practice to drive the tunnel along the footwall side of the vein wholly or partly in ore and then, at intervals of 50 feet cross-cut to the hanging wall.

Throughout all this work the vein is shown to be a perfect type of fissure vein, and to vary in width from 10 to 29 feet. This tunnel attains a depth of 400 feet following the vein. A shaft has been sunk on the vein from the surface to a depth of 50 feet and cross-cut at the bottom shows the width of the vein there to be 18 feet.

At about the 150-foot mark in the tunnel a cross-cut shows the vein to be 16 feet wide, at 350 feet in it is fully 15 feet, at 400 feet the width is 12 feet, at

450 feet, 20 feet, with not less than 10 feet at any place cut up to the 600 foot cross-cut, just completed and showing a width of 20 feet of clean ore. This is the deepest point yet developed in the mine, and the orebody seems to be the largest and containing best average value. Carload samples of ore from this cross-cut run as high as \$35 per ton, while the orebody will average about \$15 in gold, for the 20 feet. I estimate the average width of this vein at 12 feet, which is easily inside the mark.

At the present time we are pushing the main drift ahead along the ore body and raising to the bottom of the 50 foot shaft, a height from No. 2 tunnel of more than 200 feet. This rise will prove the orebody between the level and bottom of shaft and serve to give air to our workers below.

A cross-cut has been driven from the main tunnel to cut the west vein at this level and prove the ground between. Ore has been encountered, but we are not sure at present whether it is the real vein or not. Some remarkably high value has been obtained, but it is possible the larger orebody has not yet been reached by this cross-cut.

Orebodies.

While at the 600-foot cross-cut the orebody is large, it is still probable the west vein is somewhere nearby, and in the hanging wall of the altered rock belt, which at this point is probably about 100 feet thick. It is my intention to make a thorough cross-cut to the solid granite by continuing the 600-foot cross-cut, which will prove this point.

The oreshoot is proven to be more than 700 feet long, and the strongest showing developed is the deepest down and farthest into the hill. It is impossible to say how much farther this shoot will continue without a break, but there is no good reason for it to give out for some distance.

On the contrary some of our best surface territory is on ahead, and I believe after machines shall be installed large orebodies will be developed in that direction by following the sheared zone, as we are at present doing with such good results.

The company's ground covers nearly a mile in length along the fault line, all of which will be developed in time, and no doubt the finding of many good oreshoots will be the result.

The present tunnel level is several hundred feet above the creek, so several lower levels can be driven with moderate cost for amount of ore such work would develop.

While it is true that until the rise is completed there is not much ore technically developed, yet with an orebody of this character and proven to be so well defined, much latitude can safely be allowed an engineer in attempting an estimate of ore developed. Presuming that the vein as shown in all the development work is to be a fair average of the ore through to surface, there should be at least 150,000 tons of ore above the No. 2 level. The orebody averages stronger throughout the tunnel than the surface showings, so I think ore figured below this tunnel for a reasonable distance perfectly safe base to reckon on. If you allow the first 100 feet below you have 70,000 tons, making 220,000 tons practically in sight to begin milling on, and this is without bringing the ore in the west vein into the calculation.

Regarding the value, which is all in gold—while some parts of the vein are low there are no barren areas, and to offset the low parts some rich ore occurs. Ore \$8 to \$10 a ton is most common, and we hope to make a mill-feed average of about \$10.

Ore Treatment.

The treatment of the ore has been given some exhaustive tests during this season. The last test was made on a one ton sample taken from all parts of the orebodies. This was placed in the hands of Mr. C. E. Verrill, an expert mill man of Vancouver. This ore was tested in the works of Messrs. Falkenberg & Luks, Seattle, Washington. These tests have been perfectly satisfactory, and they have resulted in determining the simplest method of treating the ore and making about the highest saving known on any plant.

The ore contained fully 10 per cent. iron sulphides, in a brittle and clean quartz, which admits of a very clean concentration, but it was found that both the iron sulphides and the quartz sands yielded a higher saving by simple cyaniding. So test swere made of fine grinding the straight ore and cyaniding the whole product. This gave such good results that this simple process has been recommended to the company.

THE PULMOTOR IN MINE RESCUE WORK.

By Henry E. Bertling.*

The need for an improved substitute for mechanical resuscitation has been felt for a long time, medical practice offering a wide field for such experiments in the frequent cases, for instance, of poisoning by gases, fumes, lysol, etc., drowning, electric shock and the always imminent risk of collapse in narcosis.

For a long period, however, mechanical assistance by means of the human hand has been the only form available in such cases. The hand is, naturally, soon tired, and, while in operation, introduces fresh air only very slowly into the lungs, so that success entails strenuous endeavor continued for hours. When, later on, the al-

most miraculous action of oxygen on the almost entirely stagnant lungs and heart began to be recognized, the desire for some improved method became all the more urgent, and we are now offered in the Pulmotor, an automatic resuscitation apparatus which renders the healing power of oxygen available in rescue work.

It produces the flow of the inhaled and the exhaled air by a single nozzle, the rhythm of respiration adjusting itself as automatically to the dimensions of the lungs and thus the astonishing result is produced that a seemingly lifeless body begins to breathe regularly, directly the Pulmotor is placed in connection with it.

*Paper presented at Ottawa Meeting, C. M. I.

Of course the apparatus cannot bring any person back from the dead, and no such claim is made for it; if, however, even the slightest trace of blood circulation, through the action of the heart, be present in the apparently lifeless body, the lungs are supplied with oxygen just as in natural respiration, so that the most favourable conditions imaginable for resuscitation are provided. The Pulmotor works directly on the respiratory organs and, if the spark of life still exists, will fan it into flame and give the heart and lungs a chance to fight their own battle which they will do more valiantly than any mechanism that has ever been invented.

The whole of the apparatus is contained in a case weighing altogether 46 pounds, and is carried easily by one person. Besides the special apparatus for artificial respiration, housed in the case itself, it contains mounted on the lid of the case an oxygen inhalation apparatus for ordinary oxygen inhalation. The two apparatus have in common the oxygen cylinder, and the pressure reducing valve, and either of them can be set in operation simply by turning a suitably arranged lever to the right or left. The oxygen cylinder is closed by a valve and as soon as this valve is opened, one or other of the apparatus begins to work. The cylinder contains $11\frac{1}{2}$ cubic feet of oxygen and, when full, will keep the Pulmotor in operation for 40 minutes in succession.

The oxygen passes to an injector, which has the property of drawing in a large volume of air which it propels with equal force through the flexible tube in front of the injector, thus alternately filling the lungs by pressure and emptying them by suction; the pressure is equivalent to 8-inches water gauge and the suction to 10 inches. Other important parts of the apparatus are the air reversing chamber and a small batter accordian bellows which effects the automatic reversal of the apparatus from suction to delivery and vice versa without ceasing, and which is perhaps the most striking invention of the Pulmotor. The operation of the bellows is extremely simple, it is connected with the air tubes and during inflation, the same pressure obtains in the bellows as in the lungs, but as soon as the latter are filled, the bellows becomes inflated and in moving forward causes the valve to be automatically reversed into position for suction. Then the operation is reversed and as soon as the lungs have been emptied the bellows contracts and automatically reverses the valves again into position for suction and so on. The great advantage is, as may readily be seen, that the respiratory rhythm of the apparatus really adapts itself absolutely automatically to the capacity of the lungs in every case, and that the apparatus performs all these functions, without any assistance being required from the hands. Consequently the whole attention of the operator may be directed to the patient and to the important tasks of keeping the windpipe open and of closing the gullet.

The keeping open of the windpipe is always the most difficult point in artificial respiration, this pipe being, in asphyxiated patients obstructed by the contracted and retracted tongue, and also by the epiglottis. The tongue should therefore be drawn forward in the proper manner, for which purpose a pair of forceps is provided in the case, before attaching the face mask covering mouth and nose of the patient, so as to ensure airtight connection between the Pulmotor tubes and the organs of respiration. The mask is secured to the face by two pairs of straps, which branch from a padd-

ed ring that is placed under the back of the head, so effecting a close fit all round.

It is further necessary to prevent any air or oxygen from entering into the gullet, i.e., the passage leading from the mouth to the stomach, as this would risk a distension of the stomach, if the apparatus is used for long at a time. The gullet is a flaccid, muscular tube, lying between the semi-rigid windpipe and the osseous spinal column. Consequently all that is necessary is the application of gentle pressure on the windpipe in the middle of the throat, which will compress the gullet against the spinal column in such a manner as to prevent the passage of air to the stomach, this pressure does not restrict the circulation of air in the semi-rigid windpipe. The accuracy of this reasoning has been proved beyond doubt through very interesting and subtle experiments with a surgical subject undertaken by Professor Dr. Roth, of Lubeck, Germany.

The inhalation apparatus attached to the lid of the case is intended for ordinary oxygen inhalation after artificial respiration has been successfully applied and the sufferer is again able to breathe naturally.

The success of the Pulmotor during the short period since it has been known, has been almost miraculous; it was first introduced to America by the Commonwealth Edison Co., in Chicago, who purchased the apparatus for the benefit of their employees in the frequent cases of electric shocks and at the same time put it at the disposal of the general public. According to their statement the Pulmotor has been called to resuscitate fifty-five persons overcome by poisonous gases in Chicago between January 16 and February 18, 1912. Of these forty-one were revived, four were dead before the apparatus arrived, four attempts at resuscitation were unsuccessful, and the others were not Pulmotor cases. The first call for the apparatus came on January 16. The patient had been overcome by illuminating gas, and when the operator reached the house with the Pulmotor there was just the faintest breath of life perceptible and the pulse was so feeble it could hardly be distinguished. No doctor could be reached and the operator went to work. The response was almost instantaneous and in half an hour the man was breathing naturally.

In another case a physician had already declared the patient dead and told the family there was no possible hope from any source when the Pulmotor arrived. In a few minutes, after the apparatus got to work, the pulse of the man showed great improvement and there were other encouraging signs. The doctor returned to the task, and a few hours later the patient recovered consciousness.

According to the statement of the above company the Pulmotor is practically infallible in cases of asphyxiation, drowning or any poisoning that produces sleep, and electric shocks, as long as there is still any action of the heart left.

The great usefulness of the Pulmotor for all those that work in mines or such establishments that necessitate the handling of chemicals, etc., is obvious, and a great number of mines in the States and in British Columbia are already equipped with Pulmotor.

The special Pullman car, which is used as a portable rescue station in American mining districts is also equipped with a Pulmotor, and it seems only a matter of time until the apparatus will be considered an indispensable part of any rescue station.

EXTRACTS FROM REPORT OF S. PRICE, LIMITATION OF THE HOURS OF LABOR OF UNDERGROUND WORKMEN IN THE MINES OF ONTARIO

Dear Sir,—Pursuant to your instructions of August 10th, 1912, I have inquired into and considered the matter of legislation for the limitation of the hours of labour of underground workmen in the mines of Ontario and I now beg to make my report.

Mode and Nature of Investigation.

My investigation has been for the most part informal. I have endeavoured by personal examination and by inquiry from the men and the mine managers to ascertain and understand the nature of underground employment in the mines, and the conditions under which the men work, and to gather what knowledge and information I could as to the effect which an eight hour law would be likely to have upon the mining industry. The fullest opportunity has been given for expression of the views of those chiefly concerned. Public meetings, advertised in the press and by posting up and distributing notices, were held in the most important mining centres and every one interested was invited to be present to make known his views, or to hand in or send me in writing anything he desired to say. The mine owners throughout the province have been communicated with and data collected from them regarding the number of men employed, the present hours of labour, the means of descent and ascent, the time taken for meals or rest and other matters which might have a bearing upon the question in hand. I personally visited a number of the mines in various parts of the province, spent considerable time underground seeing the men at work, and examining the character of their employment and the conditions surrounding it, and conversed with large numbers of the men and with their foremen and employers.

By these means and from petitions and letters, and other statements and material handed or sent to me by the men and the mine managers, by discussion with a large number of them, by taking a secret ballot from the men at a number of the mines, and by consultation with the mine inspectors and other officers of the province, and interviews with other disinterested persons having knowledge of mining affairs, I satisfied myself as fully as I could as to the views and wishes of both parties, and as to the facts and conditions having to do with the matter under inquiry.

I have obtained copies of and perused the eight hour laws in force in other countries, and collected what information I could get regarding their operation and effect.

The reports of Commissions elsewhere upon the eight hour question, and various articles and comment, opinions of political economists and other literature upon the subject, have also had consideration.

Mine Workmen and Importance of Mining in Ontario.

About 7,700 men in all are employed in and about the mines at which there are underground workings (excluding smelters, concentrators and mills not operated in immediate connection with the mine). Of these 7,700 about 4,000 are underground men, who would be directly affected by the proposed legislation. These 4,000

underground men are distributed among the different mining districts of the province approximately as follows: Cobalt 1,800, Porcupine 440, Sudbury 1,000, Michipicoten 281, Elk Lake and Gowganda 74, Hastings and vicinity 154, Grand River district 57, various places in eastern Ontario 43, and in northwestern Ontario 124, the rest belonging to Swastika, Temagami and eastern Algoma.

There are no statistics as to the men's nationality, but the great majority of them are foreign born, especially in the Sudbury and Michipicoten districts, coming largely from Italy, Finland, Austria and Poland.

In most of the mines the greater number of the men are lodged and boarded by the mining company, being either unmarried or having a family living elsewhere.

The total annual wage list for these mines is over \$6,000,000, and if the smelters, concentrators and mills in the province were all included this would add some three or four million dollars more.

It need hardly be pointed out that by reason of this large wage bill and by reason of the great quantity of provisions, machinery and supplies of various kinds used in and about the mines, the province generally reaps great advantage from its mining industry. The enviable position which Ontario now occupies as easily the premier mining province of the Dominion, and one of the great mining districts of the world, is not only a matter to be proud of, but is something that brings substantial benefit to a large part of our population. The farmer, the merchant, the manufacturer, the railway man and many others of various occupations reap advantage from the prosperity of this industry, and all are interested in its welfare.

Present Hours and Conditions.

The present hours of labour underground vary from 8 to 10 hours, mines which are side by side often differing. Of the 86 mines from which complete returns have been received 40 work 10 hours a day, 32 work 9 hours, 10 work 8 hours, 2 between 8½ and 9 hours and one works 9½ hours. The average for the province would be a little over 9 hours. A number of what are called prospects, not included in the above, work more or less irregularly.

The depth of the mines varies all the way to 1,300 or 1,400 feet, but the great majority of the workings are less than 400 feet and very many of them less than 200 feet deep. In 46 of the mines the means of descent and ascent is by ladder, in 24 by lowering and hoisting of cage, in 13 both means are used, and in 4 entrance is by tunnel or adit. The number of mines using the cage is increasing, but for depths not exceeding 200 feet the ladder seems preferable by reason of being safer, though the men as a rule no doubt generally prefer the cage.

Nearly all the mines in the chief mining districts work two shifts a day—a day and a night shift, each commencing at 7 o'clock morning or evening as the case may be and quitting at 6, 5, 4 or 3.30, an hour or less being usually taken for dinner or lunch about the middle of the period. When shafts are being sunk or

other work is desired to be specially rushed three shifts a day of 8 hours each are usually put on. It might also be mentioned that for shaft-sinking or other very wet work extra pay is generally allowed. Often the hours are shortened or changed on Saturdays by reason of Sunday intervening or to give a part holiday.

What the Men Say.

Careful inquiry and test by ballot, where that was considered desirable, satisfies me beyond doubt that the men, under whatever system of pay they are working, are nearly all in favour of an eight hour law. The meetings held at Porcupine and Cobalt, which were largely attended, and those at Sudbury, Marmora, Kingston, and elsewhere, at which the attendance was slight, expressed themselves unanimously, so far as the men were concerned, in favour of the eight hour legislation, and this after the matter had been explained and discussed and after the mine manager's statement declaring that it would involve a deduction in pay, had been read to them. Petitions purporting to be signed by a number of men at Elk Lake (not all, however, miners), and by nearly all the underground men of two of the important mines at Sudbury, and resolutions and addresses from the miners' unions, asking and arguing for the law, were presented to me. Owing, however, to statements from the mine managers that many of the men were really not in favour of the eight hour law, but against it, but that they sometimes did not like to say so, I determined to test the matter by distributing a ballot by which the men could express their wishes secretly if they desired. Care was taken to include a number of the mines as to which I was satisfied the relations generally between the owners and the men were good. In nearly all the mines where the ballot was taken I am satisfied that the men as a rule are well treated and not at all dissatisfied in general with the way they are used by their employers. In a number of cases I know a good deal of pains have been taken by the employers to look after the men's welfare. The result of the ballot, however, was to show that even in these cases and in cases where the men did not belong to any miners' organization nearly all the men desired the eight hour law, 332 ballots being returned in favour of it and only 12 against it. Six of the ballots marked for it, however, had the words "with a minimum wage" written upon them, and 3 of those marked against it asked for a 9 hour day. The most significant feature in regard to this ballot was the fact that where the men are paid by the piece and depend for the amount of their pay on the amount of work they can do in a day they are almost as strongly for the law as in the places where the pay is by the day, and before the vote was taken the difference in their position as compared with other places and the effect the proposed law would have in reducing their pay, unless they could do as much work in eight hours as they are now doing in ten, was carefully pointed out and explained to them. As expressed at some of the meetings, the feeling of the men seemed to be "get the law passed anyway and see about the matter of pay afterwards."

The chief grounds urged are as follows: First, the humanitarian aspect — that working underground is working under unnatural and trying conditions, being away from the surface and the sunlight and in air more or less impure and inferior to the natural air, being often contaminated with fumes of gas and with injurious dust or particles from the drilling and other operations. They complain at Cobalt that the hydraulic air used in a large number of the mines there is not as good as the air of the ordinary compressor. It is a frequent

occurrence they say in underground mines to have men overcome by gas from the blasting powder and sometimes to lose their lives thereby, and they say headache and sickness from the powder are common. They say that the work is dangerous and a strain on the system, and that the working places are often wet or damp and the work usually strenuous and more exhausting and harder on the constitution than similar work would be on the surface, and that the mining life of an underground miner is short. They claim that eight hours efficient work is all the ordinary man is capable of, and that exhaustion or dulling of faculties causes accidents to be more frequent in the latter part of a long shift. They point to the various other mining countries where the eight hour law is in force, and ask why Ontario should not be as good as these. Some say that a better and more efficient class of men would be induced to come into Ontario if the hours of labour were as favourable as in British Columbia and the Western States. Many say that those who oppose reduction of hours think only of dividends and are willing to sacrifice the health of the men for money.

Most of the men also claim that with proper system and management as much work can be done in eight hours as is now done in nine or ten, and that there would be no decrease in the output of the mines or increase in the cost of production. There will always, they say, be objections made to any change in existing conditions, and they claim that the cries of injury to the industry raised in other places when the law was being put in force there have proved ill-founded.

They urge that the eight hour law should apply to all mines, with no qualification or exemption, except only for cases of emergency where life or property is in imminent danger, and that it would be fatal to the usefulness of the law to exempt contract or piece work or to complicate the Act by special provisions or exemptions.

What the Mine Managers Say.

The mine managers generally oppose the eight hour law. Less than half a dozen are wholly in favour of it, a few are not strong one way or the other, while others would not object to it if it was made eight hours face to face and not bank to bank and provisions were inserted to meet special conditions and contingencies. Quite a number would have no objection to a nine hour day.

The arguments urged against the adoption of the eight hour legislation are very numerous, but those in which the greater number of its opponents concur are: That it would mean reduction of wages and consequent dissatisfaction of the men; that it would decrease the output and profits of the industry, make low grade propositions unworkable and discourage influx of capital; that the eight hour law has in fact had disastrous effects in British Columbia, Australia, and parts of the United States, and is driving capital and labour out of England and the United States; that the popular belief that underground employment on the present basis is injurious or objectionable is not correct, experience, the hospital records, and the fact that men prefer underground to surface work being appealed to in support of this contention; that legislation upon such a question is not wise, and that it would be inexpedient to disturb existing conditions, which it is claimed are generally satisfactory to the men who are willing to work.

It is also urged that by a large number that, even if such a law were proper or desirable in very large mines or in more advanced stages of the industry, it is not

justified in Ontario, where most of the mines are comparatively small and the industry largely in the development stage; and it is pointed out that while some of the mines pay very large dividends many others in different parts of the province have but a slight margin of profit and cannot bear increased expense.

By the Cobalt mine managers it is also urged that they have to compete in silver with Mexico, which has cheaper labour and less expense by reason of a warmer climate; that they have to pay supplementary revenue taxes and some of them royalties, and that freight and other charges are high; that a shorter day would necessitate greater speed and conduce to increase of accidents; that as the time of actual operation of the drills is only 6.45 hours a day, the rest of the 10-hour day being taken up in going to and from work, taking down and setting up drills, blasting, etc., a reduction of two hours in the working day would mean only 4.45 hours of actual drilling, and would therefore cause a reduction of 31 per cent. in the output and in the dividends.

Operation and Effect of Eight Hour Laws.

In addition to what information I could glean from articles and reports and from interviews with persons having more or less knowledge of conditions in places where eight hour laws are in force, a number of the mine inspectors of British Columbia and of the Western States have been good enough to answer a list of questions which I submitted to them regarding the operation and effect of the law in their country, and to give me their opinion generally as to the expediency of such a law.

Chief Inspector Graham, of British Columbia, where the eight hour law has been for a long time in force, thinks it increased the cost of mining slightly, but very slightly, but that it does not decrease the output, though it may mean a reorganization of the working forces. He says the men unanimously and the operators generally favour its existence, and that instead of being injurious it is beneficial to the mining industry. He is decidedly in favour of having such a law. Inspector Strachan, of the Nicola Valley district, gives answers generally much to the same effect, but thinks the law does not increase the cost of operating, and believes the eight hour day is better for the company financially, and he says he has found none of the operators now desiring to have the day longer than eight hours, and he is even more strongly in favour of the eight hour law than the Chief Inspector. The inspector of the West Kootenay district thinks the eight hour law does decrease the output, but does not think it is injurious to mining industries, and thinks an eight hour law in mining is desirable.

Mr. Henahen, Commissioner of Mines, Colorado, where the eight hour law has been in force since 1904, thinks the law does not raise the cost of operating and that such a law is desirable in mining. He says the workmen favour it, and that the metalliferous mine operators generally favour it also. Mr. Bartholomew, Secretary of the Bureau of Mines, Missouri, which has had the eight hour law since 1899, is not prepared to answer as to the effect of the law on the output, but says the men and the operators generally favour its existence, and that he thinks it is desirable to have such a law. Inspector Walsh, of Montana, where the eight hour law came into force in 1907, does not think it raises the cost of operating and says that the men, and in most cases the operators, favour its existence, and his opinion is that the law is desirable in mining. Inspector Jones, of Wyoming, says the eight hour law

raises the cost of operating at first, but thinks, with proper adjustments to meet the altered conditions, this can be more than offset. He says the men favour its existence, but that the operators are not favourable to outside regulation. He thinks the law is desirable. State Inspector Bell, of Idaho, thinks the eight hour law raises the cost of operating proportionately and decreases the output of the mine, but the men and most of the operators favour its existence, and he thinks such a law is desirable in mining. State Mineralogist Storms, of California, where the eight hour law has been in force since 1909, thinks it raises the operating tonnage cost and undoubtedly decreases the output. He says the men generally favour its existence, but some of the operators are opposed to it. He thinks, generally speaking, such a law is desirable in mining.

Mr. Sutherland (now Assistant Inspector of Mines in Ontario), who has had extensive practical experience in a number of the mining districts of the west, says the men and he thinks, generally, the operators favour the existence of the eight hour law where it is in force, and he thinks it does not decrease the output of the mines and that it is not injurious to the mining industry.

As to the operation and effect of the eight hour law in England, where it went into force in 1909 and 1910, all the information I have obtained has been derived from the inspectors' official reports and from information which Sir George Askwith, of the Industrial Commissioner's Department, has been kind enough to give me. It seems that owing to the customs and privileges which had grown up in different parts of the country some friction occurred at first as to a number of matters, but the law seems now to be working pretty smoothly. The comparatively short time it has been in force and the other labour disturbances that have occurred and the changes that have been made in other respects make it difficult to tell what are its effects. It does not appear to have decreased the output, but the chief inspector, while thinking there has been an increase in the working cost per ton, says it is impossible to say how far this is due to the operation of the "Eight Hours" Act. On the whole it would not appear that any very material economic effects are attributed to the operation of the law.

Independent Opinion in Ontario.

I have discussed the question of an eight hour law very fully with our own mine inspectors and other officials and with other disinterested persons familiar with mining conditions. The inspectors, whose efficiency and usefulness I found in my visits to the mines to be held in high respect both by the operators and the men, naturally and properly do not wish unduly to take part in any controversy between the two parties, but their knowledge and experience in these matters and the opportunities they have had for understanding circumstances and conditions are such that it seemed to me imperative to obtain the benefit of their knowledge and that I have consulted them; some of the information they have given me upon these is more particularly referred to in other parts of the report, but I think it is right to say here that they and the other mining officials with whom I have discussed the eight hour day do not seem to fear evil results from it, and Inspector Sutherland is very strong in the belief that a reasonable eight hour law for underground workers would be beneficial.

I think the weight of well-informed independent opinion is in favour of the law.

Review of the Matter.

From what has already been stated I think it must be concluded that foreboding of disastrous results to the mining industry if an eight hour bill is enacted are not justified. The mine managers do not produce any figures or evidence in support of their prediction that injury would result, except statements of a number of mining men who attribute their financial difficulties in whole or in part to the eight hour law, and a reference to the closing down of a number of mines in British Columbia after the eight hour bill went into effect. Other opinions, however, do not attribute these things to the reduction of the hours of labour. Inspector Sutherland and others think the trouble in British Columbia was due to other causes, and it may be pointed out that returns indicate that the past year's mining operations in British Columbia have been the most profitable in the history of the province. The strongest support I have found in favour of the contention that the mining industry would be injured is the refusal of the Commission on Hours of Labour in Nova Scotia in 1910, to recommend the eight hour day for the coal miners because they believed such a law would undoubtedly add to the cost of operating or seriously reduce wages, and because apparently they feared injury would in consequence result to the coal industry, which as they pointed out had to meet competition from other places.

In the British coal mines the average hours of labour prior to the enactment of the eight hour law were about the same as we now have in Ontario, and the Commission dealt pretty fully with the matter of reduction of output which the owners claimed would result, and arrived at the conclusion that this would not be so great as claimed though they believed some diminution of production would follow. The actual effects, as already pointed out, seem at least no worse than the Commission anticipated.

With regard to the figures as to drill time submitted by the Cobalt Mine Managers, and the contention based thereon, which is very similar to what was urged by the coal mine operators in Great Britain, I am told by independent persons having knowledge of these matters that there is no reason why the actual drill time should not be a good deal longer than the contention indicates. I am informed also that it is claimed by the managers of the mines in Ontario which are working on an eight or a nine hour basis that their costs are as low as those of ten hour mines, and western shiftbosses and mine captains working in the Ontario mines claim that they can get as much work done in eight hours as in ten. It is stated and admitted on nearly all sides that the amount of work done generally in the Ontario mines is not satisfactory for the time that is spent at it, and that in fact the efficiency of a great many of the men is not as high as it should be.

What the effect of the enactment of an eight hour law would really be on one of course can definitely say. As pointed out in the report of the Miners' Eight Hour Day Committee in Great Britain in 1907, much would likely depend on the spirit in which the law was received and the efforts made to adapt operations to the new conditions, and to minimize friction between the men and the employers. Probably upon the whole the conclusion that would be most warranted is that while results might vary in different places or under different circumstances and while there might probably, generally speaking, be some increase in cost of production, the increase which may reasonably be feared is slight.

The fact that little or no injury would likely result to the industry or that the mine owners are able to stand a diminution of profits is no ground for a change or disturbance of conditions unless other reasons warrant or require it. Neither on the other hand I think would even material decrease in output and profits be reason for refusing the law if the conditions in regard to the health and welfare of the workers were so serious as imperatively to require it.

Turning to the latter question, I am convinced that the popular idea of hardship and injuriousness of working underground is only partly right. The mines of Ontario, I believe, as a whole, are naturally as healthful as any in the world. Figures and opinions show that there is little in the assertions regarding arsenic poisoning in the Cobalt mines, though, no doubt, through infection, that does in a few instances occur. There seems, however, to be better basis for the fear of harm arising from the breathing of the dust caused by the drilling and other operations, and especially from the hammer drills where no water is used to allay the dust, and particularly in the quartz workings. Phthisis or miners' consumption is at present a disease little known in Ontario, but the time has been short for its development and it is undoubtedly a matter to be considered and as far as possible guarded against. Our inspectors are fully alive to this necessity and no doubt will do their best to minimize the evil, but I may here mention that one of their difficulties is that the men are not always as willing as they should be to co-operate in precautionary measures. It is undoubtedly true that there is a good deal of powder gas in many of our mines and that this causes considerable trouble, and is more or less harmful even where the men are not actually overcome by it and no fatality occurs thereby. I think it cannot be questioned either that underground mining though not the most hazardous of occupations, must be distinctly classed as a hazardous one. The allegation of greater frequency of accidents in the latter hours of shifts I find after very careful investigation, assisted by the hospital records and other figures produced by the managers, and especially by the data put together for me by Chief Inspector Corkill, is not borne out by the facts. The figures really show that a rather larger percentage of the accidents take place during the early hours of the shift than during the later hours. Reports and opinions do not on the other hand confirm the allegation that shorter hours and consequent speeding up would be likely to increase accidents. Hospital records do not show a large percentage of sickness among the miners. The Commissioners in the British eight hour day report already mentioned, find that the health and physique of coal miners in Great Britain compares favourably with that of other work people, although the eight hour law was in fact adopted there. The best information I have been able to get shows metalliferous mines as a class to be generally less healthful than coal mines.

The prevailing view expressed in the reports received from the inspectors and other officials of British Columbia and the Western States, is that in their opinion underground work is more injurious to the health than surface work, and that there are special reasons why underground men should have shorter hours than other workmen. The eight hour mining laws, as a rule at least, seem to be based upon that assumption, some of the United States statutes specifically so declaring. I am not unmindful in considering the above reports that officials will naturally be disposed to favour their own

law, and that the employers whose opinions they refer to in support of the law may not feel disposed to complain of what they cannot help; nor do I forget that the exigency of the situation in the United States from a constitutional point of view may have something to do with the legislative declarations as to the injuriousness and danger of underground employment. Neither do I neglect what is said by the mine managers here, which I think is to a great extent true, that men after getting used to working underground prefer that to surface work; but higher wages and a certain fascination about it, and a sense of pride or dignity in having attained to a higher or more important stage in the mining occupation, probably account largely for the preference. Whatever the reason may be such a preference is not incompatible with the statement that the occupation is in fact unhealthy and injurious.

Undoubtedly the air in mines even under favourable conditions is not as good as ordinary air. It contains a smaller percentage of oxygen (especially where hydraulic air is used), is more or less laden with dust or small particles of rock or mineral and with powder gas—the prevalence of which, however, varies very greatly in different cases—and as natural ventilation is always poor other impurities also are pretty sure to be present. There is besides usually more or less water or dampness underground, though our inspectors say that as a class the Ontario mines would be considered dry in comparison with others. Working under these conditions, and always by artificial light, I think cannot reasonably be contended to be as good for the worker as working under ordinary conditions, and the element of danger may add something to the burden. It is estimated that 80 per cent. of the underground men are under 40 years of age and 90 per cent. under 50.

Upon consideration of everything I have been able to gather I think the conclusion must be that working underground is unhealthy and injurious, though not at all to as great an extent as is claimed by a number of the men or as is ordinarily believed by persons unfamiliar with mining conditions.

Some of the statements put forward as arguments for or against the law are not relevant. That the workmen have among them persons who favour the law upon grounds that do not commend themselves to the general community, or that they have in their ranks or in the organization to which a number of them belong, individuals who are not a credit to them, should not condemn their case if it is in fact meritorious; though I think the importance to any body of men of so controlling their members as to maintain public opinion upon their side can hardly be over-estimated. I should be sorry on the other hand to see any law put in force for no better reason than that those upon whom it may be assumed to be a burden are making large profits and are well able to bear it, even where that is the case. The prevailing idea, however, that the mine owner gets his money easily is far from being always correct. While some of the mines may return investment a hundred fold and be almost able to pay their last year's wagebill from the mere advance in the price of their product, there are many where profits are very much smaller, and some where more money goes in than ever comes out. I have sometimes felt that the mine owners of Ontario have not always had the sympathy that they should have from the rest of the population, but objections on the ground of taxation and royalties, which have no relevancy in the present inquiry and which can only be regarded as complaints against what the people of the province generally regard as just and

reasonable, can hardly be hoped to enlist public opinion in their favour. But this is beside the question.

A consideration which I think should have weight is the tendency the proposed legislation would likely have toward allaying unrest and removing friction and difficulty existing in a number of the mining camps. Taking out of the field of controversy and settling permanently what has been and will apparently likely otherwise continue to be a fruitful source of trouble between the employers and the men would of itself be a good deal gained. Sir George Askwith, speaking of the question generally, and Inspector Sutherland, speaking of conditions in Ontario particularly, are both of opinion that the eight hour day will likely come sooner or later, or will be a source of agitation until it is obtained, and they both see advantages in establishing it now. The history of the matter in Ontario supports this view. There has been a gradual reduction in the length of the day in a number of the mining districts. The newer camp at Porcupine has, on the whole, considerably shorter hours than Cobalt, and lately the shorter day has been introduced in some of the mines in the older districts. As already mentioned, it is not only the miners' organizations that are wanting the shorter day, but also the men who neither belong to the union nor live in districts where unions exist, and those working by piece work or contract, as well as those working for day wages. This desire of the men for the law, I think, is an important consideration in estimating its desirability. It cannot, of course, be hoped that the legislation would settle all difficulties and wholly prevent strikes, but it would remove one of the chief causes of trouble.

I think there is something, too, in the contention that the shorter day would tend to greater skill and efficiency of the men, and that by improving conditions it would encourage a more permanent class of residents in the mining camps and lessen the very large remittances of wages now sent out of the country by those having no established home here.

Recommendations.

Everything considered, I think the balance is in favour of enacting a reasonable eight hour law for underground workmen in the mines of Ontario.

Of the laws in force in other places, I think that in Great Britain is the most carefully devised, and that its principles should, in the main, be followed, with simplification of some of its provisions where that is possible.

Subject to proper safeguards for securing suitable means of descent and ascent, I would recommend that the law respecting metalliferous mines in British Columbia, and that in force in most of the Western United States, approximating closely in this respect to the laws of Great Britain and France, should be followed as to making the eight hours from face to face rather than from bank to bank.

The law, I think, should apply to contract and piece work, as well as work by the day, and men as well as employers should be obliged to observe it, notwithstanding any consent or agreement between them; otherwise I think the chief benefit of the law would be lost.

I think no overtime or deviation from the Act should be permitted except in emergencies where life or property is in danger and for repair work and an exception for Saturdays; but I think pumpmen and shift-bosses and persons engaged solely in surveying or measuring might properly be excepted from its provi-

sions, and I think, having in view the conditions now prevailing at a number of the mines, the time taken for dinner or lunch, not exceeding half or at most three-quarters of an hour, should be excluded, and I do not think the usefulness of the Act would be materially impaired by exempting workings where not more than six men are employed in a shift. Very strong representations have been made to me in respect of the hardship an inelastic eight hour law might entail in performance of development work, especially in out of the way districts, and I think this exemption might safely be conceded.

I would suggest that the mine managers, in order to be permitted to exclude the time taken in descending and ascending, should be required to obtain from the mine inspector a certificate that the means provided for descent and ascent are satisfactory. I think also the question as to whether a shift is in fact composed of not more than six men should, in case of dispute, be determined by the mine inspector.

In answer to a question asked, I would say I do not think it would be desirable that, instead of enacting a positive eight hour law, the fixing of the hours of labour should be left with a Board. That, I think,

would be sure to cause trouble, and would destroy one of the chief benefits I see in passing the legislation.

I can see no harm in inserting a provision such as the British and Alberta Acts contain, empowering suspension of the law by Order-in-Council in the event of great emergency or grave economic disturbance.

The provision in the British Act allowing an extra hour during periods not exceeding 60 days in the year is, I think, unnecessary here, and would only tend to cause complication.

Following the course pursued in the enactment of similar laws in a number of other places, I think, in order to permit of preparation for it, the coming into effect of the Act should be postponed for a reasonable time—not less than six months—from its passing, and, perhaps, it would be but fair to postpone it longer in respect of the mines or the district where there have recently been strikes, as it might be considered a hardship upon the mines which, according to the findings of the Arbitration Board, have not been in the wrong, to disturb conditions again after so short an interval.

Faithfully submitted,

S. PRICE.

St. Thomas, Ont., January 27, 1913.

PRINCIPLES ON MINE VALUATION.*

By James R. Finlay.

Almost all enterprise is based on valuation of some kind. Practically all transactions in mining property, whether it be in stocks, bonds, or actual ownership, are based on some kind of an appraisal of values. If you expect to be employers instead of employees you should begin at once to study the factors which give value to things. You can not buy intelligently nor sell intelligently until you know how to form an estimate of what a given property is worth to you, to the man you are dealing with, and to anyone else who might be brought in. It is only by such knowledge that one can discern a bargain or avoid a disastrous venture.

This generalization has no more application to mining than to any other form of business; but it certainly does not apply to mining less than to other forms of business. I think that no more unfortunate idea is taught to young mining engineers than that they are to consider themselves merely as professional men, like doctors or ministers. I would not speak of this if such an idea had not been cultivated in certain quarters. It is true that some mining engineers are employed to do technical work as referees between conflicting interests. Professional honesty is of course an absolute essential, but the honesty of a mining engineer is the honesty of business and of common sense. It is not in the least desirable for a mining engineer to avoid business transactions; on the contrary he should go into them as soon as possible and study the subject in every possible way. I do not see how any man can make a success of mining who does not realize that it is a strictly commercial business; that the only result to be sought is commercial success; that the only scientific and technical attainments that are worth anything are those which contribute to commercial success. Attainments of a different character are, of course, worth while; but they are valuable to a mining engineer because he is a man and a citizen, not because he is a mining engineer. They would be equally valuable in

every kind of profession. Success in business is measured in money. Technical skill is efficient only if it pays. One can judge of the value of technical excellence only if he is prepared with a knowledge of what constitutes the money value of the results of such technical excellence.

Undoubtedly this view of the mining business, or profession, has been gaining ground in our universities and technical schools. Formerly, I think, education was considered to be merely a training in principles. Technical training was a discipline in the science of action (I coin the expression), an exposition of the principles of doing things. Whether it was worth while, in dollars and cents, to do a thing was to be found out later in actual business. Now I think it is recognized that, while making money is of course a matter of actual occupation in business, there are certain general principles underlying the value of things, which are well worth study. This is the study of political economy, which is largely taught in all our universities. The mining engineer sooner or later comes into contact with this subject and is bound to find it interesting and important. I shall try now to advance a few ideas about the valuation of mines, which I think are basic enough to come under the head of general principles.

The first thing to which I wish to draw your attention is the general subject of valuation. What is it that causes a price to be fixed for commodities or properties? In general, there are two methods of fixing values; one is the empirical method, and the other, the constructive. The empirical method of fixing values is simply to obtain a record of facts—of transactions. A man will assume that a town lot is worth \$100 because he finds that people have bought and sold similar lots for \$100 apiece. Nearly all commodities of a retail nature are valued in that way, and it is perfectly logical that they should be, because each actual transfer is a bargain between the buyer and the seller, the

*A lecture in the Department of Mining, Columbia University, December 2nd, 1912.

oretically at least. The man who sells for a certain price does so because he believes he can do it profitably. On the other hand, the man who buys figures the same way from his side. Consequently we find that wheat, iron and copper, as commodities, are valued empirically by merely ascertaining what sales are made; and fluctuations of price are established by supply and demand. If a commodity is anxiously sought for by more people than can be supplied, they bid up the price.

The constructive method is that which places the value of commodities in a more or less scientific manner—builds up logically an estimate of what it properly should be worth. This naturally applies to proper-

ties which are dealt in only occasionally, for which there is no precedent of an actual sale of the equivalent thing. You will easily see that mines belong to that class of property.

Hardly any two mines are exactly alike; therefore you cannot say logically that because one mine is worth one million dollars, another mine is also worth one million dollars—at least you cannot say so until you have gone through the factors which give both properties value, and have found that they are identical. It is to those factors which do give values to mines that I wish to call your attention now.

(To be continued)

PERSONAL AND GENERAL

Mr. Alex. H. Smith, of Carter & Smith, has quite recovered from the painful accident that he suffered some weeks ago in Porcupine, and has left for Arizona, after completing several examinations in Eastern Ontario.

Mr. Geo. H. Aylard, now of Victoria, B.C., under whose supervision the Standard silver-lead mine, in Four-mile camp, Slocan Lake district, was developed from a mere prospect to an important ore producer, is spending a few weeks at Silverton and New Denver, within a few miles of the Standard.

Mr. G. O. Buchanan, of Kaslo, B.C., Dominion Supervisor of Lead Bounties, has lately been fully occupied getting in returns of lead mined and smelted in British Columbia, to the close of the fiscal year ended March 31.

Mr. W. A. Carlyle, who in the nineties was actively associated with mining in British Columbia following several years as Professor of Mining and Metallurgy at McGill University, and later was general manager of the Rio Tinto copper mines, in Spain, has resigned the professorship of metallurgy in the Royal School of Mines, London. His resignation is to take effect in June, after which he will resume practice as a consulting engineer, entering into partnership with Mr. John F. Allan, a well-known consulting engineer who, beside important consulting connections, has been in the service at different periods in a managerial capacity, of the Rio Tinto Co., Mexican G. and S. Recovery Co., and Caucasus Copper Co., respectively.

Mr. A. B. Clabon, of Vancouver, B.C., who with Mr. Fred M. Wells has been actively associated during the last year or more with the development of the property on Princess Royal Island of the Surf Inlet Gold Mines Co., is arranging for a resumption of work on the Kingston property, in Hedley camp, Similkameen.

Mr. W. B. Dornberg, of Spokane, Washington, manager for the Treasure Mountain Silver-Lead Co., (which is developing a promising silver-lead property situated in Tulameen district and is distant from Otter Flat, B.C., about 20 miles), has been spending a week in Victoria.

Mr. Howard W. DuBois, of Philadelphia, Penn., managing director of the Quesnelle Hydraulic Gold Mining Co., is making preparations for the ensuing gravel washing season's hydraulicking operations at the company's placer gold mine in Quesnel mining division, Cariboo district, B.C. Mr. DuBois gave the annual

meeting of the Canadian Mining Institute at Ottawa last March an interesting account of what his company had done in Cariboo, and showed a number of lantern slides illustrative of its work.

Mr. S. S. Fowler, of Riondel, Kootenay Lake, B.C., general manager for the New Canadian Metal Co., operating the Bluebell lead mine, the first lode mine discovered in British Columbia, spent several days at Victoria about the middle of April.

Mr. Hamilton, for some time in charge of the Cerre de Pasco Mining Co.'s reduction works at La Fundicion, near Tinhauarea, Junin, Peru, has succeeded Mr. A. B. W. Hodges as general manager for the company. La Fundicion will still be his headquarters.

Mr. Lionel Hill, assistant to the manager of the mines of the le Roi No. 2, Ltd., at Rossland, has left British Columbia on a three months' trip to England.

Mr. C. Hankel, formerly with the Zinc Corporation, who for about a year had been advising Mr. M. S. Davys, managing director of the Silverton Mines, Ltd., in connection with the designing of a concentrating plant to treat silver-zinc ore, from that company's Hewitt-Lorna Doone mines, in Silverton camp, near Slocan Lake, and the erection and equipment of a concentrating mill, has left British Columbia on his return to England.

Mr. John Hopp is back in British Columbia from a business trip to Eastern Canadian and United States cities. As the hydraulicking season is approaching, he will shortly prepare for operating. The snowfall having been heavy during the 1912-1913 winter, a long and profitable gravel washing run is expected this year. Mr. Hopp has four or five hydraulic placer-gold mines, situated within a few miles of Barkerville, Cariboo district, including leases on the famous Williams creek and on tributaries of the equally well-known Lightning Creek.

Mr. P. F. Horton, superintendent of the H. B. mine on Deer Creek, near Salmo, Nelson mining division of British Columbia, has been spending a month in Victoria and other coast cities. With the breaking up of the snow road and the unsuitable conditions for heavy hauling in early spring, shipment of ore has had to be temporarily suspended, but as soon as the wagon road shall be hard enough freighting will be resumed. The output capacity of the H. B., which ships lead ore to Trail, is now about 1,000 tons a month.

Mr. H. M. Lancaster, who ten to twelve years ago was engaged in mining engineering work in Rossland camp, and who since 1903 has been connected with mining in the states of Idaho, Montana and Washington, has returned to Rossland with the intention of again giving his attention to mining in British Columbia.

Captain J. Edwards Leckie, formerly of Cobalt, but now of Vancouver, B.C., recently gave an address on "Cobalt and Northern Ontario" before the local Chamber of Mines.

Mr. Duncan McIntosh, of Greenwood, Boundary district, B.C., long connected with the development of mining properties in that district, has been in Vancouver and Victoria for several weeks.

Mr. Robert McKee, after whom McKee Creek, in Atlin camp, was named, was reported in coast newspapers to have been in Seattle early in April with about \$400 worth of placer gold from the Silver Creek diggings, situated in the northeastern part of Atlin mining division. Many placer claims have been staked on Silver and other creeks south of Teslin Lake, during the winter, and much work will be done this spring to test the value of the new diggings.

Mr. J. L. Parker, formerly manager of the Pacific Metal Mines Co., of Vancouver, B.C., is now manager of a coal mine near Diamond City, near Lethbridge, Alberta.

Mr. and Mrs. Bedford McNeil will be the guests of Mr. J. B. Tyrrell during the Toronto meeting of the International Geological Congress. Mr. McNeil is president of the Institution of Mining and Metallurgy.

Mr. Hallett R. Robbins, at one time engaged in development work on a group of mineral claims situated in Hedley camp, Similkameen, British Columbia, and afterward practising as a mining engineer, with office in Seattle, Washington, is now assistant professor of metallurgy at the State College of Washington, Pullman, Wash., in succession to the late Mr. Roswell E. Sampson, who was killed by a railway train.

Mr. T. A. Rickard, of London, editor of The Mining

Magazine, has been elected a corresponding member of The Canadian Mining Institute.

Mr. J. M. Ruffner, manager of the North Columbia Gold Mining Co., which is the largest operator of hydraulic placer-gold mines in Atlin camp, British Columbia, has returned to that province after having spent the latter part of the winter at his home in Cincinnati, Ohio.

Mr. W. J. Watson, of Ladysmith, Vancouver Island, B.C., manager for the Tye Copper Co., has gone to England to confer with the directors of the company relative to a possible sale of the Tye smelting works at Ladysmith, there not being at present a sufficiently large supply of custom ore obtainable to make it probable the company will soon be in a position to resume smelting operations at the works.

Mr. E. H. Webster, assistant manager for the Motherlode Sheep Creek Mining Co., operating a gold mine and 10-stamp mill in Sheep Creek camp, Nelson mining division, B.C., has resigned that position to return to Los Angeles, California.

Mr. Fred M. Wells returned to Vancouver, B.C., on April 14 from Surf Inlet, Princess Royal Island, where he had been developing a gold mine.

Mr. Walter A. Bell, of St. Thomas, has won the Dana Fellowship in geology at Yale University. Mr. Bell is a graduate of Queen's University, where he studied under Professor M. B. Baker.

Mr. S. N. Graham, manager of Peterson Lake mine, recently visited Kingston, Ont.

Mr. Charles Heys, of Thos. Heys and Sons, has returned from a long visit to Nicaragua.

Mr. George R. Rogers, manager of the Mann mine, Gowganda, has returned to the mine after spending some time in Toronto.

Dr. A. Strachan, accompanied by Mrs. Strachan, will attend the meetings of the International Geological Congress as official representative of the British Government. Dr. Strachan is Assistant-Director of the Geological Survey of Great Britain.

SPECIAL CORRESPONDENCE

NOVA SCOTIA ST. LAWRENCE NAVIGATION.

The opening of navigation for St. Lawrence ports will be unusually early this year. Up to the fifteenth of April the Dominion Coal Company had sent three steamers with coal to Quebec, and shipments should continue regularly from this on. This is at least three weeks earlier than the first shipments in 1912, and the lead gained should be of great assistance in sending the necessary quantity of coal to St. Lawrence ports during the coming summer. It may be confidently expected that shipments up the river during the ensuing season will be greater than in any previous season. The mines have worked without interruption throughout the winter months, and the stockpiles are unusually heavy.

Some recent remarks of Prof. Barnes, of McGill University, have set people thinking as to whether all is being done that it is possible to do to lengthen the per-

iod of open navigation in the St. Lawrence River. The question is one which interests the coal trade of Cape Breton more than any other single industry, as probably the greatest problem at the Cape Breton mines is to equalize summer and winter conditions. Prof. Barnes states his belief that a proper service of ice-breakers, such as are used in the Baltic, could keep open a passage from Anticosti to Quebec during the greater portion of the winter, and that with the provision of anchorages for use at night and in snowstorms it would be possible to send vessels to Quebec from the ocean all through the winter. It is certain that in the winter just passed navigation to Quebec was possible until some time in January. The real hindrance to Cape Breton shipping comes in the drift ice season, which covers the months of March and April, and in late springs, even the month of May. The thickness and compactness of the drift icefields varies with the prevailing winds, and sometimes the icefields blockade the Newfoundland shore, and sometimes the Cape

Breton shore. Until the icefields commence to come down from the north there is no hindrance to shipping from Cape Breton ports except the inclemency of the weather and the storms of winter, and it must be said that these are not allowed to interfere very much with business in Cape Breton. If it were possible to bring about the conditions which Prof. Barnes thinks are not impossible then it would enable the Cape Breton mines to ship coal to Quebec all the year round, with the exception of the drift ice period. It must, of course, be borne in mind that the winter of 1912-1913 was a phenomenal one in many respects, and that the temperature in the River St. Lawrence falls extremely low in January and February. Long continued and blinding snow storms have also to be reckoned with.

DOMINION COAL OUTPUTS.

The output of the Glace Bay mines for March was 370,916 tons, making a total for the first quarter of 1,092,196 tons, compared with 964,525 tons for the first quarter of 1912. The Springhill production was 36,000 tons, the total for the first quarter being 98,579 tons, compared with 107,420 tons for the same period of last year. The reduction in output at Springhill is, of course, due to the fire in the mine which took place around New Years. This difficulty has been overcome, the March output being about 3,000 tons in excess of last March. The net increase from the Dominion Company's mines for the first quarter compared with last year amounts to 118,830 tons. In April the Glace Bay mines will likely produce around 405,000 tons, or 25,000 more than last April. Shipments will not be quite so heavy in this month as last year, when it will be remembered the Cape Breton mines were sending many cargoes of coal to replace English orders because of the English coal strike.

The Emery seam at No. 3 Colliery was pumped out towards the end of March, and a small daily output is now being obtained, which will rapidly increase to two or three hundred tons per day before the end of the summer. This mine is to be known as No. 11 Colliery. It is situated quite near to the surface works of No. 3 Colliery, a mine on the Phalen Seam approaching exhaustion. The opening of the Emery Seam will enable the company to utilize the existing plant and workmen's houses. It may be expected that this procedure will eventually be followed at all the company's mines on the upper seams. Up to the present, with the exception of two openings on the Emery Seam, the lower seams have been left untouched. Below the Phalen Seam are the Emery and Gardiner Seams, each of them averaging between four and five feet of good coal, and with roof conditions eminently suited for the longwall method of extraction. Below these two seams are several others, not yet thought of as very attractive seams, but destined some day to be valuable. There are seams of coal in the Sydney Coalfield, as yet despised and disregarded which placed in some of the more exhausted coalfields of the world would be highly thought of. The coal from the Emery Seam it may be remarked is an excellent steam coal. It is a rather dull coal in appearance, having a long "reed" and is fairly strong in texture. It contains a rather larger percentage of ash than the Phalen Seam, but in burning the coal does not clinker and the ash residue is light in texture and does not clog the draft. The sulphur percentage is low, and the heat units approach those of the Phalen seam. The volatile is comparatively low, and in every respect the Emery coal fulfills the requirements of a steam

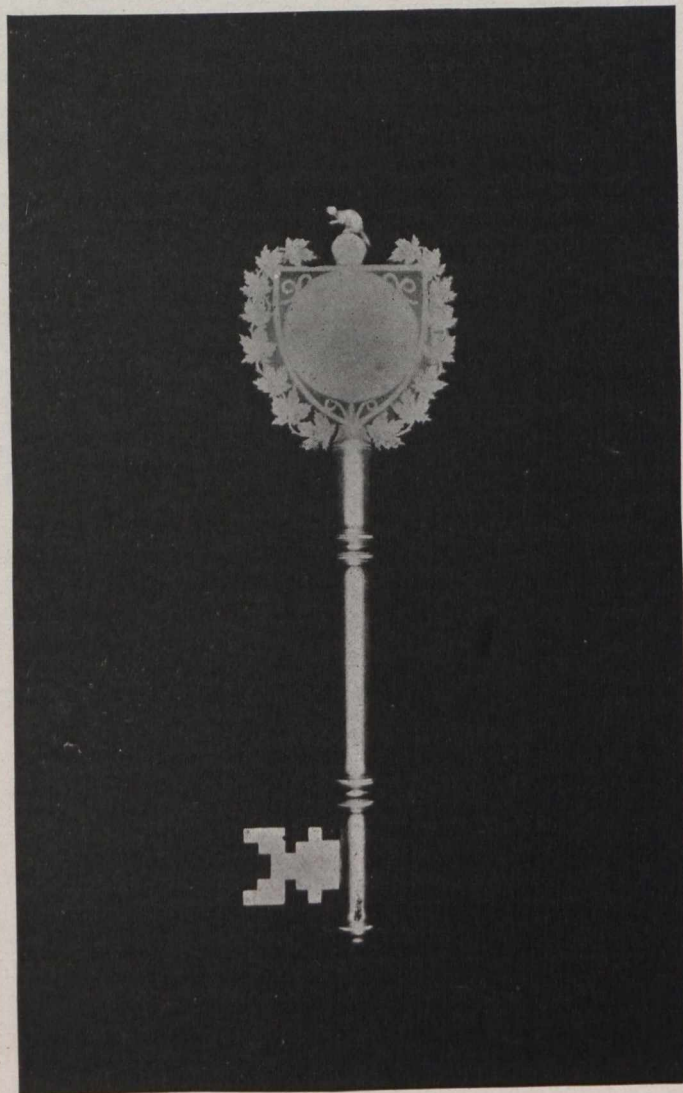
coal, and for this purpose it will steadily grow in favour when its merits come to be realized.

The unwatering of No. 17 Colliery is proceeding as quickly as possible. The railway connection will be put through during the coming summer, but it is not likely that any output will be obtained until late in the autumn. For the shipping season of 1914 this mine should prove an important producer.

ONTARIO

COBALT, SOUTH LORRAIN, GOWGANDA, AND ELK LAKE.

The last obstacle to the pumping out of Kerr Lake has been removed in the sale of the Drummond mine to Mr. David Fasken, and through him it is understood to other parties. One of the stipulations in that sale was that the riparian rights of Kerr Lake should be



Gold Key presented to Mr. Englehart, Chairman T.N.O. Ry., on the completion of the Elk Lake Branch.

sold to the Crown Reserve and the Kerr Lake for \$250,000 so that cuts down the net price of the old mine to \$250,000, which in the greatly improved condition of it is considered not too high, as there is no small amount of ore actually blocked out.

It is probable that Kerr Lake will be pumped out. All that is necessary now under the new clause in the mining act is for the companies to apply to the Mining Commissioner and get his permission to go ahead with the work after he has given his decision.

Plans are being quickly matured also to drain Cobalt Lake, bought from the government five years ago for over a million dollars. The company has twice driven into an open seam and been obliged to seal up for years some of their richest ore. Now they are rapidly preparing to put electric pumps on scows which will drain off the water into Farr Creek and into Lake Temiskaming. The lake is about three-quarters of a mile long and will probably average fifty feet deep so that the task will be of considerable duration. It is in fact estimated that it will take from four to five months steady pumping to lower the water to its required level. At the south or McKinley-Darragh end of the lake a dam will be thrown across the small creek leading into Little Lake and so into Bass Lake and Mud Lake. Enough water can be stored in this way to maintain the requirements of all the steam plants on the lake, it is anticipated. The task is naturally arousing considerable curiosity in the camp.

During the month of March the Nipissing mined ore of an estimated net value of \$234,530, and shipped ore of an estimated net value of \$204,910. At 63 shaft, which was put down on the old Meyer vein the most favourable development during the month was on the Little Silver vein. The raise was started from the 145-foot level to connect with the bottom of the old workings a hundred feet deep. The location of this raise was at a barren place in the vein, but after raising twenty feet ore was encountered which has averaged three thousand ounces over a width of two inches for forty feet. At a height of fifty feet the vein has become low grade. As soon as the ventilation is obtained by connecting with the Little Silver shaft other raises will be started on and also connect with vein 67, which shows one inch of two thousand ounce ore for sixty feet at the sixty-foot level. At No. 8 shaft cross-cutting at the 125-foot level has encountered several small seams of no value. Drifting on one of these which runs in the direction of the surface open cut has now been commenced. This open cut produced a small tonnage of high grade ore from a vein which averaged eight inches wide. This formation both at the surface and at the level is lamprohyre, a keewatin rock. This is the first work done in the formation. The high grade mill treated 113 tons of ore and shipped 313,318 ounces of fine silver. The low grade mill treated 6,233 tons during the month.

The Trethewey production for the first quarter of the year was 150,000 ounces. This was a falling off in comparison with previous quarters due to the fact that during one week in February the mill was closed down on account of repairs which lessened the production. Had not the work at the mill delayed work the silver ounces would have been increased by upwards of 10,000 ounces. During the month of March the output was over 60,000 ounces of silver.

The McKinley-Darragh-Savage production for the first quarter of the year was 430,923 ounces. Of this the Savage contributed but 50,000 ounces. The Savage by months has only been from 17,000 to 25,000 ounces owing to the fact that no more ore is being thrown on the dump than is possible until the addition to the mill at the McKinley-Darragh mill has been completed. Then the low grade will go direct over aerial tram-

way to it and the production of the Savage will be doubled at once.

The figures for the Cobalt Townsite Mining Company for the first half of April are 80,900 ounces. For the week ending April 12 the amount of silver ounces produced was 40,400 ounces. This compares with 40,500 ounces for the previous week.

A strike of importance to the camp in general and to the mines in South-Eastern Coleman in particular was made at the Beaver Consolidated at the 700-foot level recently. The vein entirely in the diabase is three inches wide and of very high grade ore. Previously to the striking of high grade the Beaver had high grade ore on 600 feet, the deepest point attained in the camp at that time. The main vein at the 700-foot level was encountered a few weeks ago, but in the first twenty-five feet of drifting on it the vein failed to show any high values. It was not until the round fired last week that the ore shoot was encountered. The Temiskaming has also now a hundred feet of high grade ore below the Keewatin on their bottom level. It is significant that the vein systems in the diabase are new and not continuations of those mined in the keewatin above.

An interesting transfer of property was made by the Wallace syndicate, a number of Cobalt business men, to the Cobalt Aladdin Mining Company. Some time ago the Wallace syndicate bought both the Right of Way and the old Silver Queen dumps for a nominal price. They have shipped several cars of ore and declare to have made a good profit. It is certain that the ore in the old Silver Queen dump did run surprisingly high. The Wallace syndicate had a contract with the Nipissing Reduction mill to run their ore, and the Cobalt Aladdin wanted it to treat Chambers-Ferland low grade. The Cobalt Aladdin has now bought the two dumps and also taken over on a lease the Nipissing reduction mill.

PORCUPINE SWASTIKA AND KIRKLAND LAKE.

The disaster at the Waiwaiten Falls plant will seriously incommode many mining companies in the Porcupine camp though its seriousness is relieved by the fact that the Sandy Falls plant is still working and most of the companies have steam plants of their own; both penstocks were broken, and some of the masonry under them swept away. It is hoped to have the damage repaired in upwards of a months time.

The effects of the strike have now almost disappeared and nearly every company desiring to operate at once is working. The Jupiter is using its own steam plant.

The Foley-O'Brien is to be operated again by a Bufalso syndicate, who have purchased the control. The Moneta is being diamond drilled. The Three Nations has all its mill machinery on the ground, the Hughes is operating its small stamp mill, and the Schumacher is now installing a big compressor plant with the plan of commencing development on a considerable scale. Mr. Joe Houston cut two veins, both promising with his diamond drill and is now going underground. The camp is very busy and experts to be still busier. The Dome and the Hollinger are now on a steady producing basis.

The strife between union and non-union men was stirred up again by a drunken brawl at Timmins when a non-union man shot at a striker for insulting him, but the Provincial police were in strong force and no disorder followed. The merchants are gradually recovering from the effects of the strike, though they have suffered most.

Practically all the foot loose prospectors in Northern Ontario are in or near Kirkland Lake. The surprising richness of the Foster Tough vein and the fact that it has endured to a depth of over a hundred feet has aroused surprisingly little excitement outside. The Foster Tough property has paid from the grass roots down and it now is looking remarkably well. There is no doubt whatever that in a few months, perhaps weeks, the public will be taken into the confidence of many syndicates and importuned for their own good, their own health and happiness, to make a hundred per cent. by financing some prospect. There are all the earmarks of a boom.

There appears to be no doubt of the promise of the district. The veins, though quite narrow, are much richer (that is they have been demonstrated so on two or three properties) than in Porcupine, and the operator is not plagued by the faults that makes the mine manager's life in the older gold camp a burden. The western engineers who have visited Kirkland Lake declare that conditions appear more familiar to them than at any other point in Northern Ontario, and they are certainly fore favourably impressed with it than any technical man who valued his reputation was with Porcupine at the same stage of development. Quite a number of deals have been negotiated though for no every large sums. The Great Northern Silver Mines have taken over the control of the Hughes, the second property in the section, and it is understood that it will be mined under the capable direction of Mr. John Redington. The Cobalt Aladdin, before exclusively busied with silver in the North, has rushed in and purchased the Burnside and is showing no tardiness in developing. A plant has been ordered already and a gang of men have been put to work at once. So far the development of the camp has been singularly healthy and free from inflation and boosting, but it is scarcely to be expected that it will remain so long. Swastika will probably remain the centre of settlement, and it is now quite busy after many lean years. At Swastika itself the Swastika mill is now making a little money for the pioneer company of the camp, and the mill at the Lucky Cross should be running soon. It is reported that the development at the Lucky Cross has been quite satisfactory lately.

BRITISH COLUMBIA

The near approach of the time at which, under existing provisions therefor, the payment of bounty on lead mined and smelted in Canada will cease, is causing concern among lead-mine owners as to the intentions of the Federal Government with regard to the future. While it is generally believed that Government assistance will be continued in some form or other nothing definite has yet been publicly made known, so that there is uncertainty in the matter. While a considerable proportion (nearly one-third of the total to each, of the amount paid during the last calendar year was earned by two companies, there were at least twenty owners in West Kootenay district who also benefited, though in varying degree. In connection with this question, the following reference to lead production, taken from the Kaslo Kootenaian, is of interest: "Mr. G. O. Buchanan, Supervisor of Lead Bounties, states that the lead production in the month of February was about the largest in any month in the history of lead mining in the Dominion, a total of about 3,000 tons of lead having been produced by the mines and smelters during that period. The greater part

of this came from Ainsworth and Slocan mining divisions."

Nelson.—On March 13, according to The Daily News, a meeting of members of the Nelson board of trade passed a resolution as follows: "That this board feels assured, from the proofs submitted of the existence in this district of platinum and regrets the publication of the opinions of Mr. W. Fleet Robertson and Mr. E. Jacobs to the contrary until the matter has been more thoroughly investigated, and that a committee of three be appointed to act with the secretary in writing to the Minister of Mines and calling his attention to the damage being done to the mining industry of this district by such statements as have recently appeared." The committee appointed consist of Mr. C. R. Hamilton, barrister; Mr. R. W. Hinton, mechanical engineer; and Mr. J. O. Patenaude, jeweler. One of the men most prominent in the discussion that took place was Mr. Fred A. Starkey, formerly a grocer and provision merchant, now a "mining broker" and real estate agent, who was reported by The Daily News, in part as follows: "Mr. Starkey declared that the report should never have got beyond the office of the Minister of Mines; that it was a 'disgrace to the country,' because it 'slandered this section of British Columbia.' He asserted that Mr. Robertson as a scientific man was not in any way the equal of Mr. A. Gordon French, who announced the discovery of platinum in this district."

(Incidentally, it may be mentioned that E. Jacobs did not publish any of his "opinions," but only the official report. Further, there was not at the meeting a mining engineer or mine manager of recognized good standing.)

On April 11 The Daily News published, under the heading "Platinum Report is Favorable," the following: "Board of Trade Committee Believes Metal Exists Here, but Cannot Say as to Quantities. Having received 22 copies of platinum assays of rock taken from the Nelson district in which values in platinum and other metals of that group were shown the special committee, consisting of C. R. Hamilton, K.C., R. W. Hinton, and J. O. Patenaude, appointed by the board of trade, reported last night stating there was every reason to believe that the metals existed here. The committee stated that it could not, of course, state if the metals were in commercial quantities, but suggested that a letter should be sent to the Minister of Mines regretting the publicity given to statements by W. Fleet Robertson, provincial mineralogist, and E. Jacobs, and asking for a further investigation. Fred A. Starkey stated last night that eight of nine assays had recently been received in the city from Philadelphia giving returns as high as \$18 in platinum, in addition to gold. R. W. Hinton remarked that the high values did not necessarily prove the existence of the metal in commercial quantities, unless a careful sampling of a lead had been made. They were, nevertheless, an encouragement toward investigation."

Rossland.—The following editorial comment was published in the March number of The Mining Magazine, London: "The law of extra-lateral right, though founded on justice to the original discoverer of an ore deposit is apt to act preferentially toward the lawyers and the expert witnesses. The very mention of the name evokes visions of interminable lawsuits. We have, therefore, nothing but the sincerest congratulations to offer to the Le Roi No. 2 and the Consolidated Mining and Smelting Company of Canada for their wisdom in effecting a compromise in connection with the conflicting rights arising from their adjoining groups of claims at Ross-

land, British Columbia. The disputed ground lay in the Le Roi No. 2 property and it was claimed to belong to the Le Roi property, purchased a year ago by the Canadian company. The necessity for some such readjustment of interests was fully known to the directors before the Le Roi property was sold to the Canadian company, and the directors of the Le Roi No. 2 were therefore not unprepared. Le Roi No. 2 transfers portions of the No. 1 and Josie claims, together with certain underground rights to the Consolidated, and in return acquires the Moneta claim. The possession of the latter ground will greatly facilitate the development of ore bodies in the northern end of the Le Roi No. 2 property."

The quantity of ore produced from Rossland mines during the three months ended March 31 was approximately 63,000 tons. With the exception of less than 200 tons from several small shippers, the mines of The Consolidated M. and S. Co. and Le Roi No. 2, Ltd., made this production in about the following proportions: Consolidated Co.'s Centre Star-War Eagle group, 37,000 tons; Le Roi mine, 15,500 tons; total 52,500 tons. Le Roi No. 2's mines: Ore shipped, crude and concentrate, 5,500 tons; ore concentrated, 5,000 tons; total 10,500 tons. Mining operations in connection with the smaller properties continue to be comparatively unimportant. The Blue Bird has not been a producer for several months, and the Phoenix and Nickel Plate have shipped only small quantities of ore. It has been announced that the Richmond Consolidated intends to work its property, situated in the South Belt, also that it is intended to develop the San Francisco on a small scale under lease.

Boundary District.—The following is part of a long report published in this district, stated to have been taken from the annual report of the British Columbia Copper Co., this covering a period of thirteen months, to the end of 1912: At the company's smeltery at Greenwood, Boundary district, there was treated 740,589 tons of ore, of which 443,022 tons was from the company's mines, while the remainder was custom ore. The metals produced were 11,146,811 lbs. of copper, 142,025 oz. of silver, and 25,862 oz. of gold, these having an aggregate value of \$2,483,663. The yield of copper, gold and silver, was less per ton than for any previous year, while the cost per ton for handling, etc., was lower than in any other year. Notwithstanding this low cost of handling the ore, the cost of producing copper was 12.85 cents per pound, the low yield of metals being accountable for this comparatively high cost. The net financial result of operations was a profit of \$425,885.40 (the largest in the history of the company) from which amount there were paid during the period covered by the report two dividends, these aggregating \$177,512. During the fiscal year the company paid on account of new properties, and for exploration and development work done on them, \$229,489. This expenditure was made because of the great importance of supplementing the company's ore reserves. In addition, there was added to the company's holding of New Dominion Copper Co. securities, bonds of the par value of \$238,675, these having cost \$122,249.25.

Ore production during the three expired months of the year has been about 290,000 tons from the Granby Consolidated Co.'s mines at Phoenix, and 145,000 tons from the British Columbia Copper Co.'s Mother Lode and Rawhide mines. Small quantities were produced by several other properties, including about 700 tons

from the Consolidated M. and S. Co.'s No. 7 mine, but these were unimportant about 3,000 tons in all.

Early in April the annual meeting of the Boundary Mining and Exploration Co. was held at Midway. Shareholders were informed that development work is resulting satisfactorily. Fourteen men are employed, machinery is being installed, and an incline shaft is being sunk from No. 2 tunnel to the coal.

Coast District—In the lower coast district metal mining operations are confined largely to three or four properties. In Vancouver mining division an organization known as the Lynn Creek Zinc Mines, Ltd., has for some time been developing a group of claims situated in the vicinity of Lynn Creek and distant about ten miles from Vancouver City. At the Britannia, in the same mining division, such further good progress has been made that since April 1st full time has been worked in all departments, excepting in the long cross-cut adit in which last two shifts, instead of three, are employed. The output of ore is being regularly maintained up to the treatment capacity of the concentrating plant, and shipments to the smeltery are again normal. Having sufficient men for development in addition to mining, that work has been resumed throughout the Britannia company's extensive property. Good progress is being made with the various improvements in hand, these including provision for the development of more hydro-electric power, construction of a railway from the face of the new tunnel down to Britannia Beach (about four miles of track), erection of new buildings in both the Beach and Tunnel camps, and the completion and equipment of a new concentrating mill.

No information has been received lately relative to the Tacoma Steel Co.'s Marble Bay mine, near Van Anda, Texada Island, but last advices were to the effect that only development work in the lower levels was being done, ore-production having been temporarily stopped.

On Vancouver Island, the situation is being gradually improved at the coal mines of the Canadian Collieries (Dunsmuir) Limited. Figures published at the beginning of April showed that during the week ended March 28 the output of coal from the company's Union Colliery mines, Cumberland district, was 8,891 tons. Miners have been arriving at Cumberland from various parts, including some from Great Britain, and matters generally are steadily approaching a position similar, as regards operation of the mines and production of coal, to that existing prior to the strike declared about seven months ago. A beginning has been made at the company's Extension colliery, as well, and it is stated that about 200 men are now at work there.

COMPANY NOTES

CROW'S NEST PASS.

The report of the Crow's Nest Pass Coal Company has been distributed. The net profits were \$471,454 and, deducting from this a debit of \$52,030 brought forward from the previous year, leaves a profit and loss surplus of \$419,424.

The net profits were at the rate of 7.58 per cent. on the paid-up capital stock.

Coal mined during the year was 1,064,791 tons, compared with 359,456 tons in 1911; while coke produced in 1912 was 245,229 tons, against 60,659 tons in 1911. During 1911 the mines were closed down for eight months on account of the strike of miners.

Balance Sheet.

The balance sheet and profit and loss account follow:

	1912	1911
Balance.	*\$ 52,030	\$210,734
Dividends received	786	10,484
Profits.	470,668	52,094
	\$419,424	\$273,312
Loss on operation.		263,232
	\$419,424	\$10,080
Dividends paid.		62,110
	\$419,424	\$52,030
Surplus.		\$52,030
*Debit balance.		
Liabilities.		
	1912	1911
Capital stock	\$6,212,666	\$6,212,666
Profit and loss	419,424	. . . . .
Insurance fund	26,072	. . . . .
Bills payable	1,212,437	1,634,612
	\$7,870,599	\$7,847,278
Assets.		
	1912	1911
Mines, etc.	\$6,478,705	\$6,720,340
Securities.	776,753	815,160
Accounts receivable	347,861	256,302
Cash.	113,703	3,446
Profit and loss . . . . .	. . . . .	52,030
Inventories.	153,577	. . . . .
	\$7,870,599	\$7,847,278

During the year the amount spent on improvements charged to capital account was \$19,976.31, and the amount spent on development charged to capital account was \$18,418.58.

The Crow's Nest Pass Electric Light and Power Company, Limited, carried forward to the credit of profit and loss account, last year, \$1,134.73. The profits for the year 1912 amounted to \$5,863.81, making the total amount at the credit of profit and loss account of that company, December 31st, 1912, \$6,998.54.

The Morrissey, Fernie & Michel Railway Company carried forward a loss last year of \$7,002.31. That loss has been made up during the year, and there is now \$25,078.49 at the credit of profit and loss account, or a total profit of all companies for the year 1912 of \$509,398.77.

President Rogers points out that during the year the indebtedness to the banks had been reduced to \$568,099. At the end of the year it stood at \$795,000, and since the end of the year the company has paid \$70,000 more to the First National Bank, leaving the indebtedness now standing at \$725,000.

ANNUAL MEETING MARITIME COAL.

At the annual general meeting of the shareholders of the Maritime Coal, Railway and Power Company, Limited, April 22nd, the following were elected directors for the ensuing year: Wm. Hanson, A. E. Dymont, Alex McLaurin, Wm. Ewing, G. Ratcliffe Hume, W. L. Madgen, Hon. Senator Wm. Mitchell, and Hon. Senator N. Curry.

The president reported that the negotiations for the sale of a considerable block of the company's securities had been successful, and it was contemplated to carry out, during the ensuing year, large extensions to the power plant at Joggins' Mines, to cope with increasing demand for coal and electric power.

Wm. Hanson was elected president; A. E. Dymont, vice-president, and R. Wilson, secretary.

GRANBY'S MARCH FIGURES.

Granby's operations at Phoenix and Grand Forks for the month of March showed a profit of \$87,770, and for the nine months of the fiscal year \$990,255. The yield of metals has been fully maintained, and the cost of copper for March slightly reduced, but current profits for a portion of this period were interfered with by the decline in the price of metal. All figures are now based on 4½, copper, and on the 31st of March we had on hand 1,935 tons taken in at that figure. Reports from the development work of the old properties indicate that ore reserves there have been fully maintained.

BEAVER CON.

At the annual meeting of the Beaver Consolidated Mines, held in Toronto on April 22nd, it was pointed out that the finances of the company at present did not warrant the declaration of an April dividend, owing to the large amount of money being spent in development work. It was stated, however, that the directors expected to be able to declare as many dividends as in 1912.

STATISTICS AND RETURNS

COBALT ORE SHIPMENTS.

Week Ending April 19.

The shipments for the week, in pounds, are:

Mine.	High	Pounds
O'Brien.	1	78,668
Right of Way	1	62,136
Coniagas.	2	102,971
McKinley-Darragh.	2	121,884
Dominion Reduction	1	83,612
	7	439,271

The bullion shipment for the week was:

Mine	Bars	Ounces	Value
Nipissing.	107	130,357.74	\$78,214.64

The bullion shipments to date are:

Mine	Ounces	Value
Nipissing.	1,437,906.21	\$840,486.98
Buffalo.	464,422.50	282,308.76
Crown Reserve	108,891.00	72,394.00
Temiskaming.	4,000.00	2,228.00
O'Brien.	42,547.77	24,914.40
Wettlaufer.	4,715.00	2,925.00
Miscellaneous.	2,298.00	1,650.00
Miller Lake	1,734.20	970.15
Colonial.	635.00	374.00

Trethewey	5,007.00	3,223.00
Townsite	6,770.00	4,209.00
Casey Cobalt	2,394.00	1,520.00
Kerr Lake	7,300.71	4,894.35
Dominion Reduction ..	125,591.40	68,992.35
	<u>2,214,212.79</u>	<u>\$1,311,089.99</u>

The shipments from the Cobalt mines to date, are:

Mine	High	Low	Tons
Beaver	4	..	99.75
Townsite	16	..	579.08
Crown Reserve	5	..	249.95
Chambers-Ferland	1	4	159.20
Colonial	1	..	21.56
Coniagas	17	..	538.32
Cobalt Lake	7	..	109.72
Penn Canadian	1	..	32.06
Drummond	7	..	189.39
General Mines . . . . .	..	0	8.80
Hudson Bay	5	..	157.65
Kerr Lake	6	..	234.79
La Rose	20	..	813.11
McKinley-Darragh	21	..	727.99
Nipissing	2	15	587.37
O'Brien	4	..	156.75
Peterson Lake (Seneca Sup.)	2	3	188.42
Silver Queen . . . . .	..	..	60.34
Temiskaming	7	1	228.76
Trethewey	2	1	182.15
Bailey	3	1	182.15
Casey Cobalt	3	..	109.72
Right of Way . . . . .	..	2	62.19
Dominion Reduction	5	..	138.19
Brewer Bros.	1	..	20.00
City of Cobalt	3	..	109.50
	<u>142</u>	<u>30</u>	<u>11,842.66</u>

COBALT ORE SHIPMENTS.

Week Ending April 26.

The shipments for the week, in pounds, are:

Mine	High	Low	Pounds
Townsite	2	..	151,704
La Rose	3	1	320,661
Nipissing . . . . .	..	4	256,856
Peterson Lake (Seneca-Superior Lease)	1	..	63,962
Temiskaming	1	..	83,717
McKinley	2	..	125,567
Dominion Reduction	1	..	87,950
Beaver	1	..	72,460
	<u>11</u>	<u>5</u>	<u>1,162,877</u>

The shipments from the Cobalt mines to date, are:

Mine	High	Low	Tons
Beaver	5	..	135.98
Townsite	18	..	654.93
La Rose	23	1	973.44
Nipissing	2	19	715.79
Peterson Lake (Seneca-Sup.)	3	3	220.40
Temiskaming	8	1	278.61
McKinley-Darragh	23	..	790.77
Dominion Reduction	6	..	182.16
Crown Reserve	5	..	249.95
Chambers-Ferland	1	4	159.20

Colonial	1	..	21.56
Coniagas	17	..	538.32
Cobalt Lake	7	..	109.72
Penn Canadian	1	..	32.06
Drummond	7	..	189.39
General Mines . . . . .	..	0	8.80
Hudson Bay	5	..	157.65
Kerr Lake	6	..	234.79
O'Brien	4	..	156.75
Silver Queen . . . . .	..	..	60.34
Trethewey	2	1	182.15
Bailey	3	1	182.15
Casey Cobalt	3	..	109.72
Right of Way . . . . .	..	2	62.19
City of Cobalt	3	..	109.50
Silver Bar	1	..	20.00
	<u>152</u>	<u>35</u>	<u>6,528.32</u>

The bullion shippers this week were:

Mine.	Bars	Ounces	Value
Nipissing	121	148,264.52	\$88,588.05
Buffalo	71	73,264.09	44,000.00
Dom. Reduction	44	49,760.00	29,858.40
Total	<u>236</u>	<u>271,292.61</u>	<u>\$162,446.45</u>

The bullion shipments to date are:

Mine	Ounces	Value
Nipissing	1,586,170.73	\$929,075.03
Buffalo	537,686.59	326,308.76
Dom. Reduction	175,351.40	98,850.75
Crown Reserve	108,891.00	72,394.00
Temiskaming	4,000.00	2,228.00
O'Brien	42,547.77	24,914.40
Wettlaufer	4,715.00	2,925.00
Miscellaneous	2,298.00	1,650.00
Miller Lake	1,734.20	970.15
Colonial	635.00	374.00
Trethewey	5,007.00	3,223.00
Townsite	6,770.00	4,209.00
Casey Cobalt	2,394.00	1,520.00
Kerr Lake	7,300.71	4,894.35
Total	<u>2,485,501.40</u>	<u>\$1,473,536.34</u>

B. C. ORE SHIPMENTS.

Ore production in the Kootenay and Boundary districts for the week ending April 12th, totalled 51,586 tons, making a total for the year to date 733,308 tons. Smelter receipts last week were 45,386 tons and for the year to date 634,346. Production in detail was:

Slocan and Ainsworth.

	Week	Year
Standard, milled	500	7,500
Van Roil, milled	1,100	16,600
Bleubell, milled	1,200	17,800
Kilo, milled	100	1,500
Rambler-Cariboo, milled	300	4,500
Richmond-Eureka	63	286
Standard	562	4,533
Bluebell	228	2,648
Eastmount	27	117
Silver Hoard	44	147
Hope	26	371
No. 1	42	390

Neepawa.....	25	25
Other mines		1,898
Total.....	4,217	58,406

Boundary. 4

Nickle Plate, milled	1,500	22,500
Granby.....	23,897	335,367
Mother Lode	7,268	97,366
Rawhide.....	6,055	74,618
Napoleon.....	781	10,999
Queen Victoria	530	8,188
Unnamed.....	108	1,623
Ben Hur	238	2,804
United Copper	66	1,400
No. 7.....	128	1,116
Lone Pine	276	895
Other mines		3,174
Total.....	40,847	560,030

Rossland.

Le Roi, No. 2, milled.....	350	5,250
Inland Empire, milled	100	1,500
Centre Star	2,525	42,060
Le Roi	912	18,708
Le Roi No. 2	301	6,380
Nickle Plate	19	77
Other mines		102
Total.....	4,207	74,077

East Kootenay.

Sullivan.....	932	10,956
St. Eugene	94	488
Total.....	1,026	11,444

Nelson.

Queen Victoria	530	8,188
Mother Lode, milled	500	7,500
Second Relief, milled	200	3,000
Yankee Girl	39	1,520
Other mines		9,281
Total.....	1,289	28,489

Lardeau.

Other mines		137
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B. C. Copper Co.'s Receipts.

Greenwood, B.C.

Mother Lode	7,268	97,366
Rawhide.....	6,055	74,618
Napoleon.....	781	10,999
Queen Victoria	530	8,188
Unnamed.....	108	1,623
Total.....	14,742	192,794

Consolidated Co.'s Receipts.

Trail, B. C.

Centre Star	2,525	42,060
Le Roi	912	18,708
Le Roi No. 2	301	6,380
Nickle Plate	19	77
Sullivan.....	932	10,956
St. Eugene	94	488
Yankee Girl	39	1,520

Richmond-Eureka.....	63	286
Standard.....	562	4,533
Bluebell.....	228	2,648
Eastmount.....	27	117
Silver Hoard	44	147
Hope.....	26	371
No. 1	42	390
Neepawa.....	25	25
Ben Hur	238	2,804
United Copper	66	1,400
No. 7.....	128	1,116
Lone Pine	276	895
Other mines		11,254
Total.....	6,747	106,185

Granby Smelter Receipts.

Grand Forks, B.C.

Granby.....	23,897	335,367
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TORONTO MARKETS.

April 28th.—Pig Iron (Quotations rom Drummond, McCall & Co., Toronto).

Summerlee No. 1, \$26.00 (f.o.b. Toronto).

Summerlee No. 2, \$25.00 (f.o.b. Toronto).

Midland No. 1, \$20.50 to \$21.00 (f.o.b. Toronto).

Midland No. 2, \$20.50 to \$21.00 (f.o.b. Toronto).

GENERAL MARKETS.

Coal, anthracite, \$5.50 to \$6.75 per ton.

Coal, bituminous, \$3.50 to \$4.50 for 1¼-inch lump.

Coke.

April 25th—Connellsville Coke (f.o.b. ovens).

Furnace coke, prompt, \$2.00 to \$2.25 per ton.

Foundry coke, prompt, \$3.00 to \$3.50 per ton.

April 25th—Tin, Straits, 49.75 cents.

Copper, Prime Lake, 15.60 to 15.70 cents.

Electrolytic copper, 15.55 to 15.65 cents.

Copper wire, 16.75 cents.

Lead, 4.50 cents.

Spelter, 5.60 to 5.70 cents.

Sheet zinc (f.o.b. smelter), 7.75 cents.

Antimony, Cookson's, 9.00 cents.

Aluminium, 26.75 to 27.00 cents.

Nickel, 40.00 to 45.00 cents.

Platinum, ordinary, \$46.00 per ounce.

Platinum, hard, \$51.00 per ounce.

Bismuth, \$1.75 to \$2.00 per pound.

Quicksilver, \$39.00 to \$40.00 per 75-lb. flask.

SILVER PRICES.

		New York	London
		cents.	pence.
April 10.....		60¼	27¾
“ 11.....		60	27½
“ 12.....		60	27¼
“ 14.....		59¾	27¼
“ 15.....		59¾	27¼
“ 16.....		59½	27¼
“ 17.....		59½	27¼
“ 18.....		59¾	27¼
“ 19.....		59½	27½
“ 21.....		59¾	27¼
“ 22.....		60	27¼
“ 23.....		60½	27¾
“ 24.....		60½	27¾
“ 25.....		60¾	27¾