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Established 1882

Vol. XXI—No. VII. OTTAWA, JULY 31st, 1902. Vol. XXI—No. VII.

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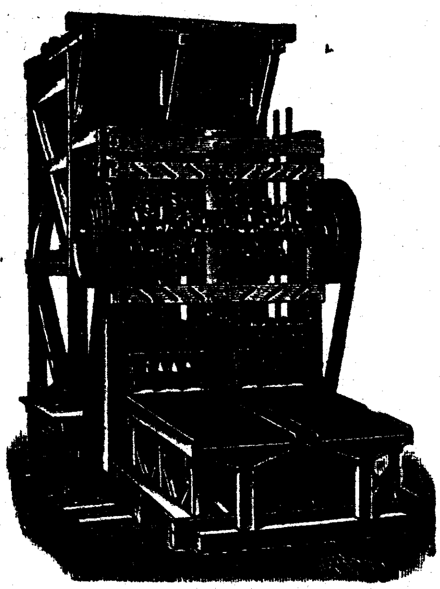

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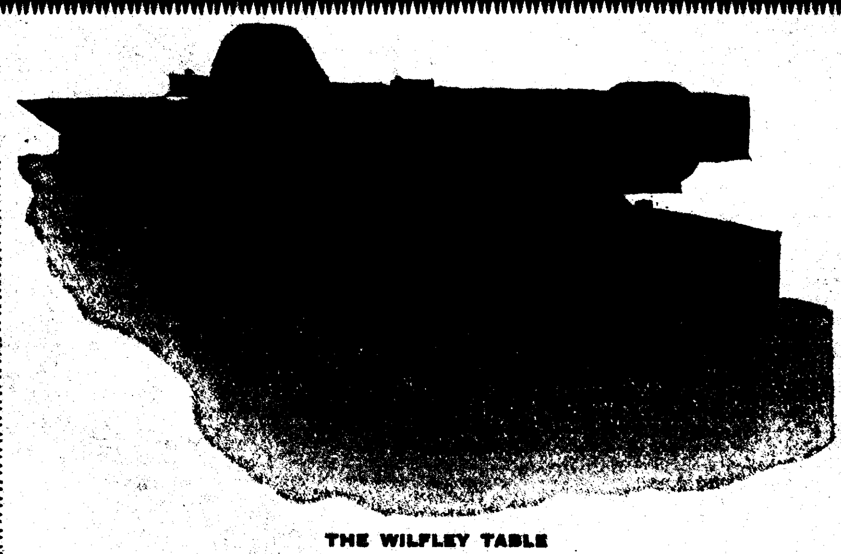

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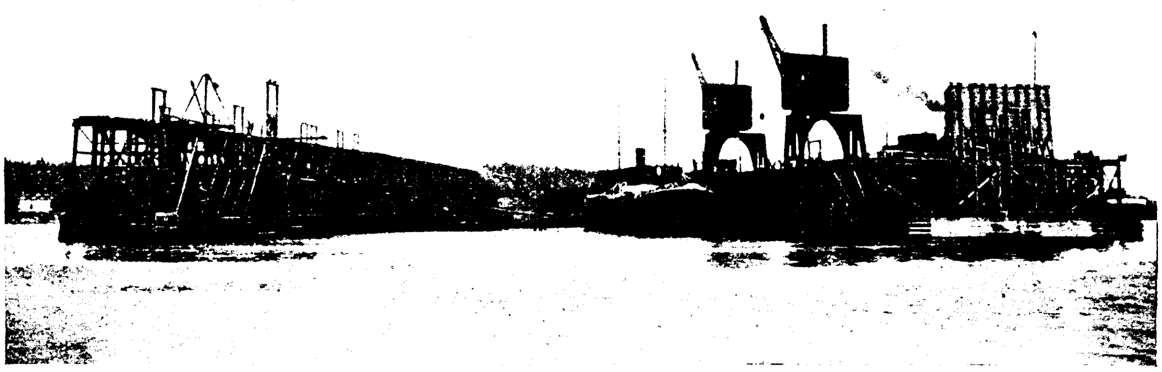

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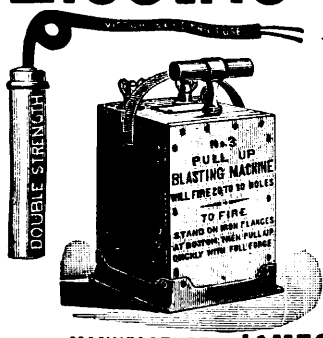

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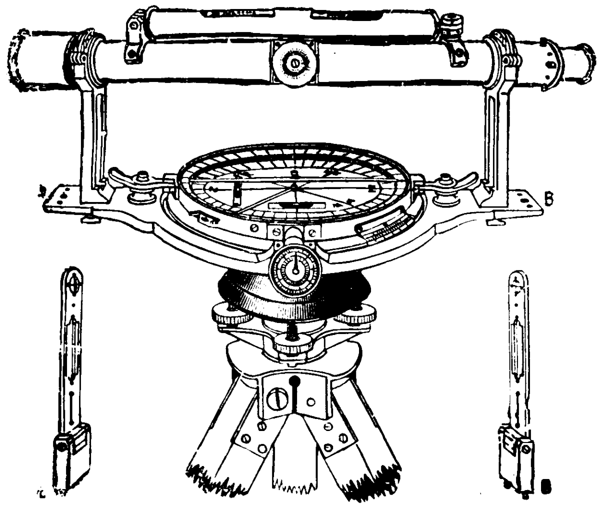

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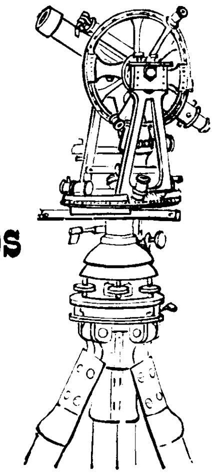

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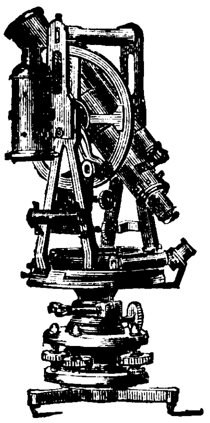

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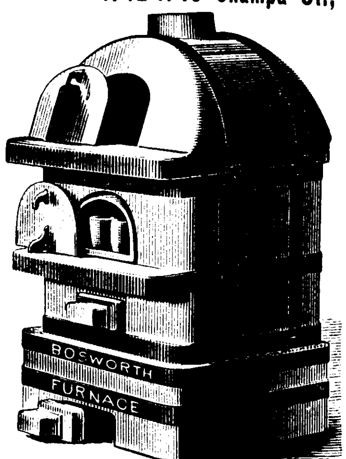

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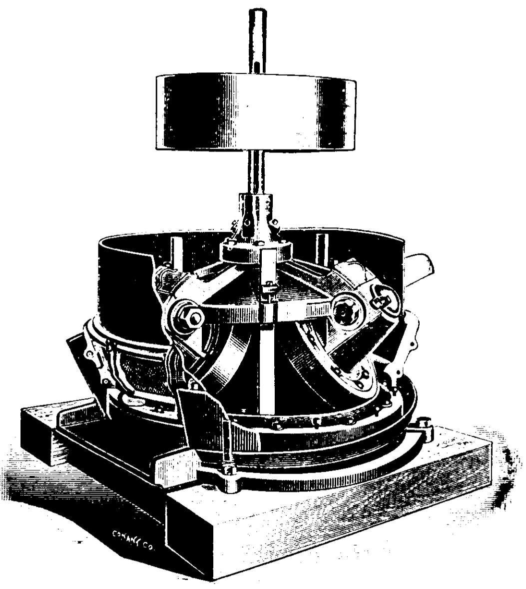

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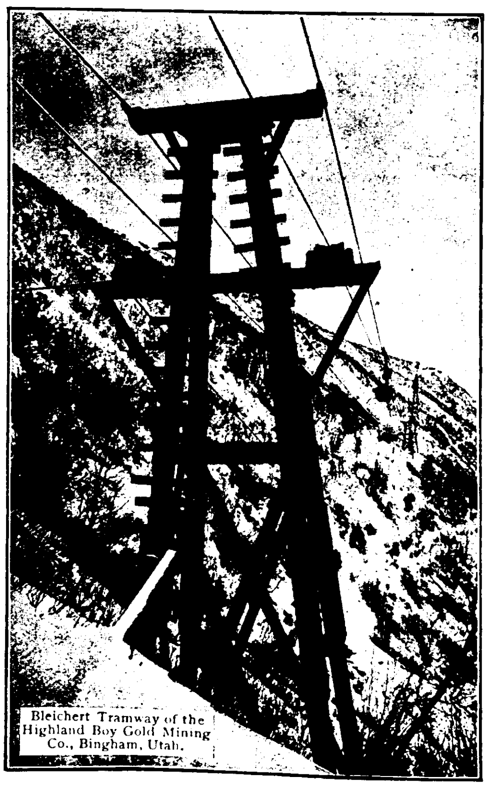

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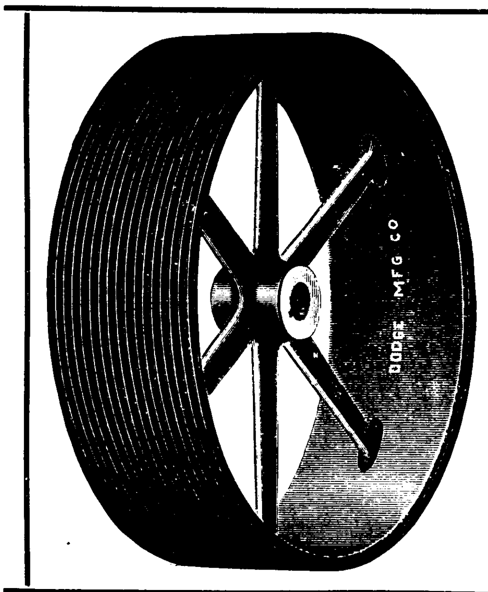

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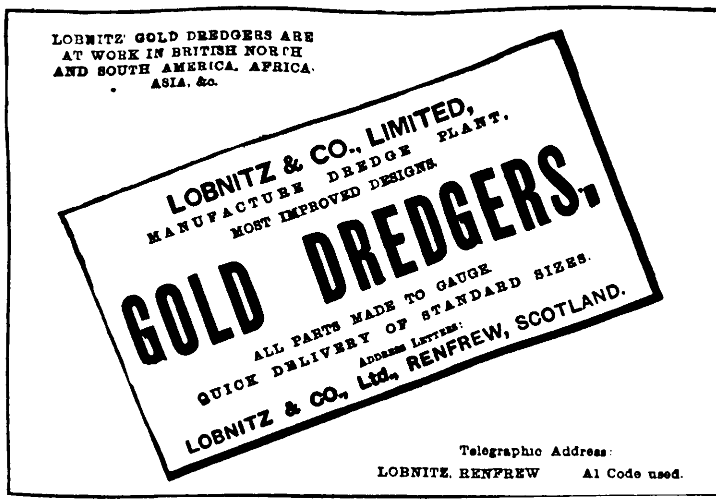

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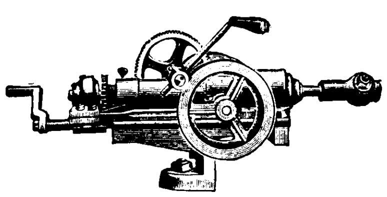

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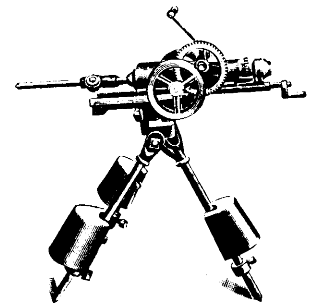

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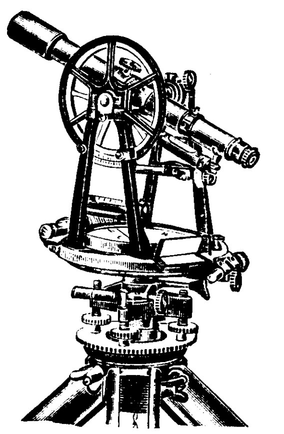

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VOL. XXI., No. 7. JULY, 1902. VOL. XXI., No. 7.

The Nickel Outlook.

—

The consolidation of several of the great nickel producing companies has led to the reduction of the working force at Copper Cliff and the various properties held by the Canadian Copper Company. It is said that this is only temporary, and has been necessitated by the reorganization of the business under the new *regime*. Whatever the cause, about eight hundred men have been laid off. Fortunately for them, mining and smelting operations are at present so active in Ontario that little difficulty has been experienced in securing employment.

Three factors may be expected to determine the direction in which the combined companies will move in supplying the nickel market, which, it should always be remembered, is at present a limited one. These factors are (1) the supply of ore, (2) the process of reduction, and (3) the government regulations.

The supply of ore in the Sudbury district seems to be very large. The Copper Clifl, the original producer, is still being worked. Ore is being taken out from several other deposits in the neighborhood of the smelters. The Stobie is at present idle, not, we are informed, from any lack of ore, but because ore of higher grade can be easily obtained. The Froode is producing and shows no signs of a falling off. But, while development and production seem to be going on somewhat slowly elsewhere, the work at the Creighton is being pushed vigorously. This deposit seems to be the largest in the district, and is at least up to the average in nickel content. The immense body of ore now visible in the open cast is sufficient in itself to supply the smelters for a long time to come. The mines of the other companies should be taken into account in estimating the factor of supply of ore. The Lake Superior Power Co. is working the Gertrude, two miles west of the Creighton, and the ore body there is stated to be large. The Elsie, belonging to the same company, is being developed. The Mond Nickel Company are getting plenty of ore from the Victoria, and are now developing the North Star, which lies in the same range as the Gertrude and the Creighton. The old Worthington has been pumped out and is being further developed. All the indications point to an unlimited supply of ore in the district. The Copper Cliff at a depth of over 1,000 feet is still producing ore, and this is presumably an index of what may be expected of a fair proportion of the other mines. At present, the ore supply is so plentiful that only the richer ore bodies are being worked. Should these fail, the smelters could doubtless be supplied by concentration of the leaner ores.

The process is a more difficult and complicated factor to estimate. In the first place, after all the experimenting, newspaper interviews and vaunting of new processes, the old roasting and smelting process as practised at Copper Cliff is the only one now in use. There may be modifications, but the roast heap, the smelter, the matte, and the Bessemerizer are to the fore wherever the ore is being reduced on a large scale. We do not mean to imply that there has been no result from all the experimenting. Far from it; but so far the results have only accentuated the complexity of our problem, and the fact that much remains to be done before the present process, cumbrous and lengthy as it is, can be replaced by a neater and less expensive one. A number of investigators have been working on magnetic separation. It has been shown to be possible to separate the copper ore from the nickeliferous pyrrhotite, and the latter into a weakly magnetic part carrying the greater part of the nickel and having a composition approximating to that of pentlandite, and a more strongly magnetic part containing little nickel. To effect this, the ore must be ground and passed through several magnetic separators with magnetic fields of different intensities. Two difficulties arise,—first, the devising of magnetic separators of practicable efficiency and capacity, and secondly the prevention of waste of the high-grade fines in the subsequent smelting operations. Experience with ground matte has already shown that the waste as flue-dust may be very serious where the blast furnace is used. Briquetting would prevent this only in part, as the briquettes are easily pulverized. Nothing is heard of the success or otherwise of the Mond nickel process. It has been stated that the only serious difficulty met with in the extraction of the nickel on the large scale as nickel carbonyl has been the deterioration of the apparatus owing to the considerable variations of temperature; but a mechanical difficulty like that is certain to be overcome, if it indeed exists. In the meantime the production of matte at Victoria mines goes on. The direct production of nickel steel from selected pyrrhotite roasted sweet, briquetted and mixed with iron ore does not seem to have been effected at Sault Ste. Marie, where experiments in this direction have been carried on. One of the difficulties in such a process is to obtain pyrrhotite low enough in copper, although we are reliably informed that a small percentage of copper is not detrimental to the quality of steel. This process is an attractive one, too, because of its allowing the sulphur dioxide to be utilized, thus avoiding the nuisance of the roast heaps, and at the same time giving valuable by-products. However, if it came into general use, a difficulty might arise in finding a market for these by products, viz., sulphuric acid and sulphites. Then, too, a process could hardly receive favorable consideration unless it provided, at some stage, for saving the gold, platinum, palladium, and other precious metals found to a greater or less extent in these ores. On the whole it would seem that the metallurgical treatment of our copper-nickel ores must necessarily be a complicated one. Nevertheless it may be possible to so improve and modify the processes at present used as to reduce the cost of production of nickel and thus extend its use.

The question of government regulations is a difficult one. While the International Nickel Company now controls about sixty per cent. of the total output of nickel, it must be remembered that the Société Le Nickel, which supplies nearly the whole of the remaining forty per cent., is an independent company. On the one hand it should be the aim of Ontario, as of every country, to manufacture its raw materials as far as possible before exporting them; but, on the other hand, discretion forbids us to unduly hamper the development of what is admittedly a difficult metallurgical problem.

The Selection of Crow's Nest Coal Lands.

The Minister of the Interior is to be congratulated on having finally made an excellent selection of coal lands, for although, as the coal company have appropriated one by one the most valuable locations and the chances of a good selection seemed to be gradually diminishing, at last a stand was made against this grabbing policy, just in time to prevent Morrissey Creek following the other possible points of vantage.

The selection finally made is the one we have openly advocated for two years past, and is the only possible one to place the Government in possession of 50,000 acres of coal land "of equal value to the other coal lands," as prescribed by the Statute. The whole of the outcrops on Coal Creek and Marten Creek are covered by these sections, and but for a surveyor's error Morrissey would have been in the same position, for, feeling secure in the possession of that location, the coal company prevailed on the Government to allow them to settle on Michel, thinking thereby to cover every available outcrop. This was permitted in 1899, but last year it was discovered that the southwest corner stake of the freehold sections at Morrissey fell short of the creek on the north side by a quarter of a mile, thus furnishing the Government with an opportunity to slip in and avail themselves of what is really the best location in the Pass.

The Government take the south side of Morrissey as far as Lodge Pole, thence east. following the course of the latter creek in line to the eastern boundary, between British Columbia and Alberta. Starting again, from a point at the junction of Morrissey and a branch creek, they draw a line due north, skirting the eastern boundary of the coal company's freehold and cutting off the coal to the deep until they reach the Marten Creek freehold. This gives the Government the best undisturbed area in the Basin, as they secure coal where it is more solid, free from faults, and regular in quality Analyses of the Fernie coals show a range of fixed carbon from 64 to 74 per cent., and ash from 5 to 10. Morrissey tests made last season yielded from 74 to 79 per cent. of fixed carbon, and from 2 to 4 of ash, the coal being both cleaner and firmer and yielding a higher grade coke.

When the official statement announcing this selection was made, —whether authorized or not we cannot say—it was declared that the Government had thus secured a property which would "pay the Dominion debt." This would seem to indicate on their part the wise intention to utilize their valuable asset and raises the one important question as to what should be done with this property.

First of all, it belongs to the country, and should be used for the public good. It is obvious that it can never pay the Dominion debt nor be of any service if it is simply to remain locked up. The same objection would hold good if it fell into the hands of the Crow's Nest Pass Coal Co., or the C.P.R., who have more than sufficient areas of their own, and who, by reason of their other interests, could not furnish any effective competition.

Is competition needed? Undoubtedly, both on the ground of supply and price. The C.N.P.C. Co. have been in operation nearly five years, and have only now reached the comparatively insignificant output of 2000 tons a day, although they have occupied five separate sites, the most favorable they could select. Two on Michel, two on coal, and one on Morrissey, and are operating six mines. They commenced work at Michel in 1898, on the outcrops of the seams, and have not yet reached 500 tons a day. A year ago they opened up five or seams at Morrissey of good quality and easy of access; up to date they have not commenced to ship coal. Meanwhile, during the major part of last year, there was a shortage of both coal and coke at British Columbia smelters. No doubt this will be remedied in the future, but the recent deplorable accident, followed as it has been by an unfortunate strike, only tends to show how nearly the whole supply may be cut off at a moment's notice, and the Provincial industries closed down for want of fuel. Under the most favorable conditions this accident involves two months' cessation of coal production, and there is no guarantee that the sad experience may not be repeated.

As to price, we have always been opposed to arbitrary restrictions, holding that the consumer should pay just what the article required will fetch in the open market. In the present instance, however, the absence of competition creates a monopoly, under which Canadian customers are still paying 50 cents a ton more for coal and $1 per ton more for coke than they would if there was fair competition in the Pass.

No doubt the Government intended to protect the consumer by fixing $2 as the maximum selling price, but subsequent experience has shown that it was a mistaken kindness, as Blairmore coal, equally good for steam purposes, sells for $1.50. The price of coke was not fixed in the charter, but we maintain that the $2 rate for raw coal was intended to govern it. Be that as it may, the lowest figure at which the C.N.P.C. Co. have sold coke to date is $4 at the ovens

Now is there any urgent necessity for cheaper fuel and especially coke? In view of the constantly accumulating evidence as to the real value of the low grade ores of B.C., who can doubt it? Look at the whole of the Boundary district on which the future of southern B.C. so much depends, with an ore averaging little, if any, above $4.00. Look at the Rossland Camp. How are the mighty fallen? Le Roi under $10, Centre Star and War Eagle certainly no higher. The fact is that in all the large mines rich pockets and pay chutes near the surface have been practically exhausted and the lower levels have revealed lower values; the theory that the veins would get richer as they went down has been effectually exploded and only by the strictest economy in mining and smelting can our camps continue to operate. No one can claim that freight and treatment charges are high at any Canadian smelter. We have it on the highest authority that the Granby cost is under $2, and the recent contract made by the Centre Star and War Eagle Co. with the Canadian Smelter at $4.50 for freight and treatment must be regarded as very low. All this shews the severity of the crisis which has been reached and points to the absolute necessity for the cheapest fuel obtainable.

How can this best be secured? By leasing 10,000 acres of the Government coal lands to disinterested parties, having no possible connection with either of the corporations mentioned, with such restrictions as would involve the forfeiture of the lease if its conditions were violated, This could not be compassed by a sale, as control would cease, and, however high a price might be paid, cheap fuel would not be ensured. A twenty years' lease, with a royalty to the Dominion Government of 10 cents a ton, and an initial payment of $1,000,000 for the lease, would result in an annual income of $100,000, and yet retain Government control, and for such a lease at least a dozen applicants would be forthcoming. Only in this way can effective competition and cheap fuel be secured, and any satisfactory, because permanent, contribution made to the Dominion exchequer, and we commend it to the serious and early consideration of the Government.

CORRESPONDENCE.

The Electrolytic Production of Metals, with Special Reference to Copper and Nickel.

Sir,—Again referring to Mr. Ulke's comments upon my paper, permit me to say:—

1st. I have no alterations to make concerning my communication of the 4th inst. and must refute the assertion as to my unscientific and illogical character of the classification of electro-metallurgy. In fact other metallurgists go still further.

Dr. Carl Schnabel, in his eminent work upon metallurgy in general subdivides the production of copper through electro-metallurgical means into three (3) distinct classes. What applies to copper can also to a greater or less extent be applied to other metals, viz.: nickel, cobalt zinc, etc.

The three subdivisions according to Dr. Schnabel are—

a. The production of copper from ores.

b. The production of copper from matte, etc., etc.

c. The production of copper from crude copper alloys, etc.

Process *a* coincides with the direct production of metals from solution.

Processes *b* and *c* coincide with refining process.

(See German edt., *Handbuch der Metalluittenkinde,* Dr. Carl Schnabel, Vol. 1, page 250.)

There is a great difference between refining crude metal and producing metal from solutions using insoluble anode material, *no matter what may be said to the contrary.*

3rd. Regarding the advantages of producing metals from a sulphate as against a chloride solution, this fact is certainly not decisive and should receive more consideration. I admit that the chloride process is old and has not yet attained prominence, but the sulphate method is older, and before its successful introduction had the same obstacles to contend with that are now blocking the chloride method.

In refining from a sulphate solution one kilo watt hour at a potential difference of 0.5 volts will produce 2.36 kilos of copper. From a chloride solution working at the same potential difference (0.5 volts) 4.72 kilos of copper are produced by one K. W. H. I admit that it is difficult to hold the potential difference of a chloride bath down to 0.5 volts but the same has been successfully accomplished.

The above figures may speak for themselves regarding THE SPEED OF REACTION.

The assertion of Mr. Ulke to the effect "that it is out of the question at the present time for large refiners to go to the expense of erecting a costly plant for liquifying chlorine, producing bleach, etc., WHEN IT IS CONSIDERED that the returns would be reduced to an unprofitable low figure *as soon as such methods were* GENERALLY ADOPTED," speaks for itself. (Special emphasis upon general adoption.)

7th. Concerning the obtaining of pure nickel through the electrolysis of a slightly heated ammoniacal nickel sulphate solution using lead anodes, I have only to repeat what has been said in my communication of the 4th inst.

For the benefit of those who may read these comments I wish to state without going into details regarding method that in the quantitative determination of nickel, the compound containing same is brought into the condition of a sulphate solution, the nickel is separated from other metals associated therewith, the solution made ammoniacal and this ammoniacal nickel sulphate solution subjected to electrolysis using platinum anodes and cathodes. To hasten this deposition and also to obtain a firmer plating the solution is kept slightly heated during the time that the electrolytic deposition takes place. Therefore with all due regard for patents, I will leave the decision as to whether I MADE AN ERROR OR NOT to the judgment of those who may read these comments.

Very truly yours,

WM. KOEHLER.

Cleveland, June 27th, 1902.

Power Drills.

By Mr. C. C. Hansen, Montreal.

In opening this discussion about power drills I will, with your permission, give a short description of a few of the better known types.

We find in all cases that the power drill consists of the following parts: The cylinder, piston, rotating mechanism, and valve. These constitute the working parts of the drill, and are mounted in a frame or shell, provided with means for feeding it ahead as the drilling progresses.

For work on the surface, the drill is usually supported on a tripod, which is placed over the spot where the hole is to be drilled, and when the desired depth is reached the whole apparatus is moved to the next place, usually a few feet distant. For underground work, such as shaft sinking or drifting, a column or bar is used, as several holes can be drilled from the same position of the bar, and a tripod is difficult to handle under ground where the room is confined. The drill is fastened to the mounting or support in such a way that nearly all the space can be reached and the holes drilled in any desired direction.

In the end of the piston that extends outside the cylinder, provision is made for fastening a drill steel or bit, which must be changed for an average size drill say every two feet in depth, which is the extent of the feed, or oftener, according to the time it takes to wear of the cutting edges on the drill steel.

The work of a power drill consists in the piston travelling forward and backward in the cylinder, actuated by the pressure from steam or air, according to what is available. The number of double strokes or blows will vary between 250 to 500 per minute. The forward stroke against the rack is uncushioned, that is, the drill steel fastened in the piston must take the full force of the blow, but the force of the backward stroke is taken up in a cushion by admitting the pressure into the back end of the cylinder before the backward stroke is completed. The work of the piston is controlled by the valve mechanism, which alternately admits the pressure at the top and exhaust it at the bottom.

In this valve mechanism, or the means for controlling the forward and backward strokes of the piston, we find the greatest difference in the various types of power drills, which I will show you later.

An important feature of the power drills is the rotating of the piston during the work. If the position of the drill steel remained the same during a number of blows, the consequence would be that the steel would wedge fast in a very short time, the hole would not be round, but the shape of the bit, and power wasted. It is therefore necessary to rotate the bit a small part of the circle between each blow. This is accomplished by boring out the back end of the piston to give room for a "rifle bar," which is part of the rotating mechanism. The usual thing is to place a ratchet ring in the back end of the cylinder, supported between washers, the one on the inside having a hole in the centre for the rifle bar to pass through. In the inside circumference of this ratchet ring are a number of teeth or ratchets. The head of the rifle bar contains two or more pawls that will engage the teeth or ratchet in the ring, when the rifle bar is turned in one direction, but pass over the ratchets when turned in the opposite direction. Each rifle on the bar is a screw-thread that will make a revolution in about 60" and the bar contains, usually, five or more rifles. In the end of the piston is placed a nut that fits the rifles in the bar. This mechanism is so arranged that on the forward stroke the pawls will pass over the ratchets, and allow the rifle bar to turn, but on the backward stroke the pawls will hold the rifle bar fast and the piston will turn a small part of a circle. As the stroke of an average size drill is about 6½", the piston will describe a revolution in about nine strokes, so that the force of the blow is fairly well distributed over the bottom of the hole.

side of the valve will be exhausted and the small amount of pressure that will pass by the solid part of the valve is sufficient to hold it in place, as the piston travels farther on the forward stroke the port connected with the back end of the valve will be opened to the atmosphere and the pressure on this side exhausted, which will shift the valve to the opposite position from that shown.

Here you see the cylinder which contains the ports to each end of the valve chest, the piston, consisting of the piston proper, the piston rod or shank and the chuck for clamping the drill steel. The rotating mechanism and the valve and chest.

Fig. 2.—This sketch shows another type also operated by a floating valve which is again actuated by small ports covered and uncovered by the reduced part of the piston. This sketch shows the cylinder, valve mechanism and part of piston only.

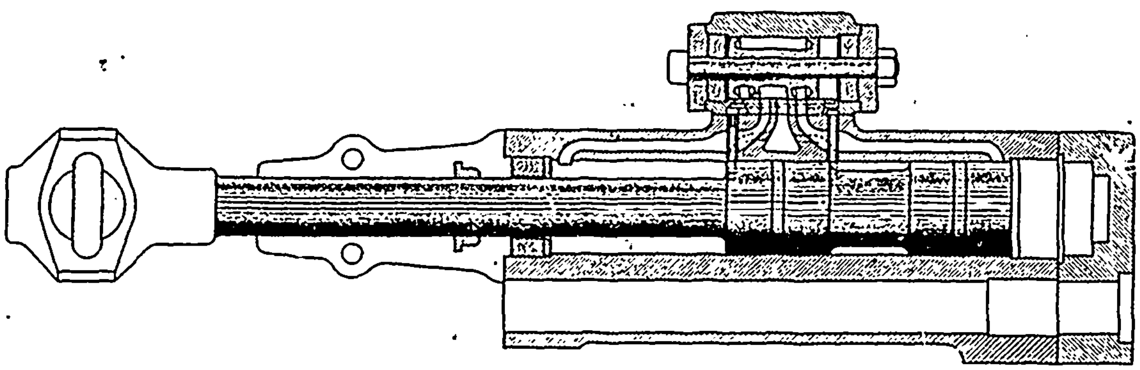


FIG. 1.

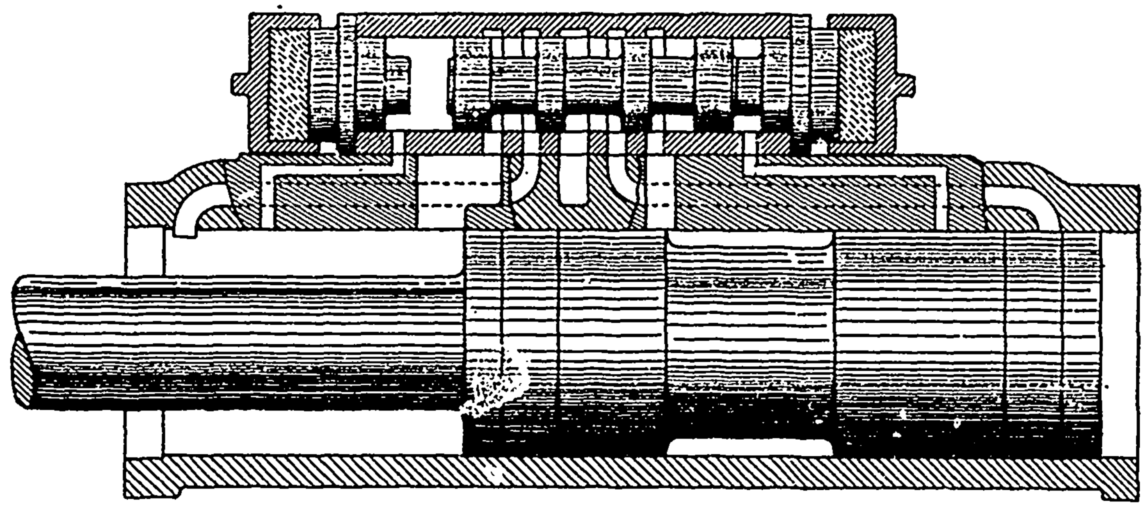


FIG. 2.

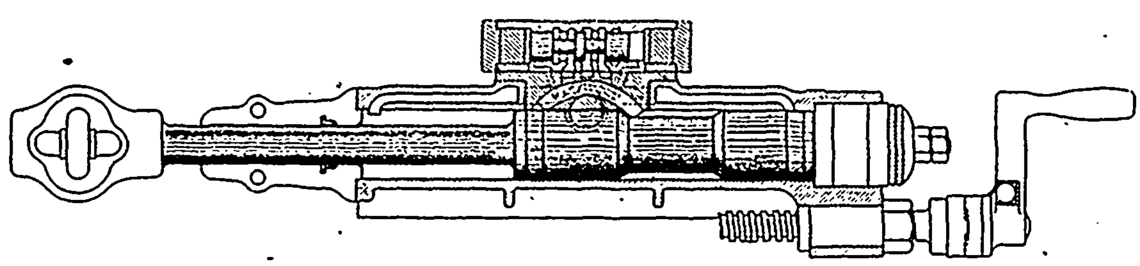


FIG. 3.

Fig. 1.—This sketch shows one type of power drill in which the valve is operated by the reduced part of the piston proper, alternately covering and uncovering two parts connected with the respective end of the valve chest. The position of the valve is for admitting pressure to the back end of the piston for the forward stroke. The space between the cylinder and the reduced part of the piston is always in connection with the atmosphere through ports leading to the exhaust. As the piston travels forward until this port is covered, all the pressure on this

Fig. 3.—This sketch shows some departure from the previous described types in regard to the valve. We find still the floating valve controlling the piston, but this valve is actuated by an auxiliary valve, which is again operated by the piston. This auxiliary valve is really nothing else but a slide valve, which alternately admits and exhausts the pressure at the respective ends of the floating valve with which it is connected by means of small ports. The auxiliary valve is made in the shape of an arc of a circle, and is moved by the reduced part of the

piston. The space between the reduced part of the piston and the cylinder walls is filled with pressure and not, as in the previous cases, open to the exhaust.

Fig. 4.—Here the result has been accomplished in a different way. The valve is a plain D slide valve, which is operated by a tappet or rocker supported on a pin that passes through the cylinder wall. The high parts of the piston will strike one or the other of the two arms and allow the other to go down in the reduced space of the piston, and the third arm will move the valve.

Fig. 5.—Here we find another "tappet" only much the same as the one previously described. The valve, you will notice, is part of an arc on the face, with the pin supporting the tappet for centre.

The amount of work done by a power drill is usually measured in lineal feet of hole drilled in a given time. This again depends on the kind of rock, the depth to which the holes are drilled, troubles that may be caused from seamy rock, when it is difficult to keep the hole straight, and last, but not least, the drill runner. Comparison is, therefore, difficult if not impossible. I know cases where twenty lineal feet drilled in eight hours would be considered good work, and other cases where from three to four times this amount would only be considered fair.

In some of the Western mining camps drilling matches are held, usually on the Fourth of July and Labor Day, the manager putting up a prize for the winner. It is useful in more ways than one, because it gives an idea of what a man can do, and has a tendency to keep up a spirit of competition between the men, for it is considered quite an honor to be the best drill runner in the camp. The drill runner is no doubt a very important factor in the amount of work that can be done with a power drill, for experience counts here as well as in most other things, but, as stated, the condition of the rock and work has a large influence. From my experience I should say that from twenty to eighty lineal feet may be drilled in a day. Sometimes this is exceeded, as proved by an instance where one man and a helper drilled 218 feet in a little over nine hours. This was done with a $3\frac{1}{2}$ inch drill mounted on tripod and in an open cut.

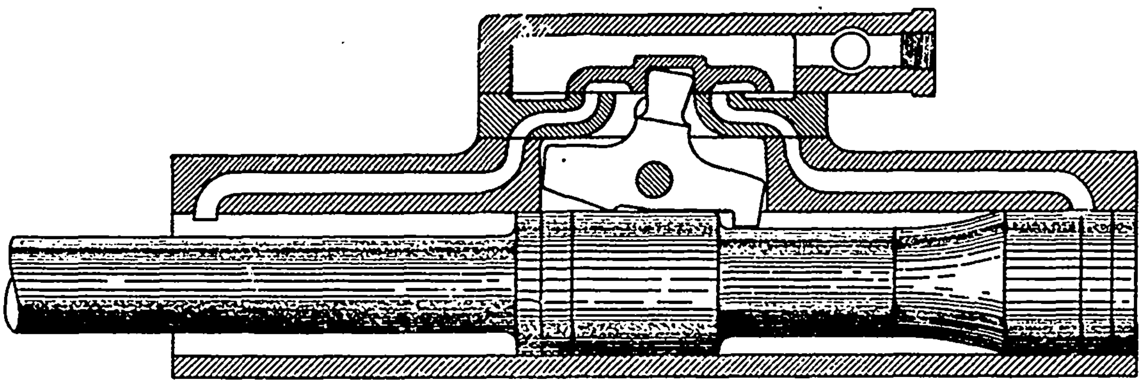


FIG. 4.

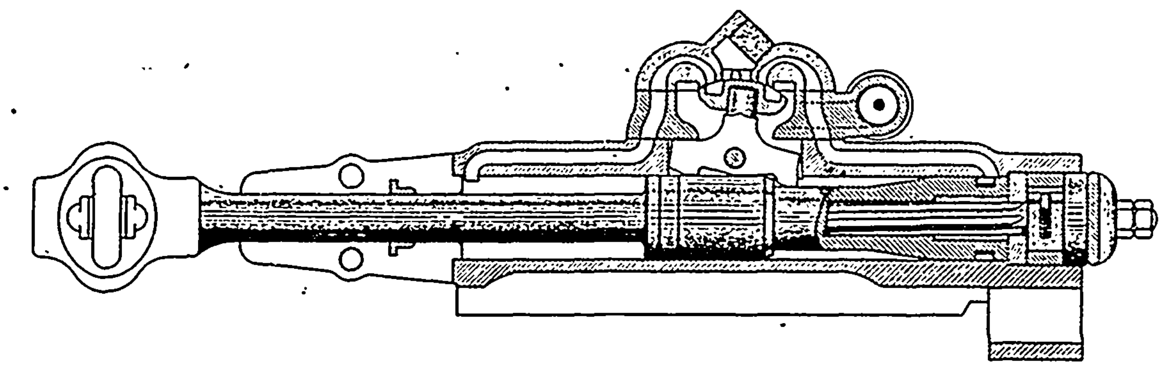


FIG. 5.

The Ore Deposits of Copper Mountain, Similkameen District, B.C.

By O. N. SCOTT, School of Mining, Kingston, Ont.

LOCATION.

Copper Mountain is about 13 miles south of Princeton on the east side of the Similkameen River, in the Similkameen sub-mining district, which embraces the great south-eastern portion of the Yale District, B C., and is drained by the Similkameen River and its tributaries.

This district contains many large deposits of low grade copper ores, some of which have been prospected considerably, but lack of transportation facilities has hindered that development which would be necessary to determine more exactly the value and extent of these deposits.

However, on Copper Mountain are to be found large surface outcrops of copper ore, and on the deposits development work has been carried on, to a limited extent, but yet more than in any other part of the district.

It is to the description and characteristics of the ore deposits of Copper Mountain (on the Sunset and H.H. Gardner mines) that I wish to draw the attention of the members of the Institute, from observations made by myself in July of last summer.

GEOLOGY OF COPPER MOUNTAIN.

Copper Mountain rises abruptly from the Similkameen valley to a height of about 2000' or 2300' above the valley, and covers several square miles.

It consists chiefly of masses of volcanic rocks, which probably are pre-tertiary, although in altitude they are found above the tertiary coal seams in the valley bottom.

The explanation of this is that these tertiary rocks occupy an original depression in which they have been protected from denundation by the surrounding more resistant rocks. They probably form part of a series which once covered the whole surface of the country, but which, owing to denudation, now appear merely as isolated remnants, resting on the older rocks.

These are comparable to the tertiary of the Kamloops district, described by Dr. Dawson,* and the tertiary outlines of the Kettle River, mentioned by Mr. R. W. Brock in the summary report of the Geological Survey in 1900.

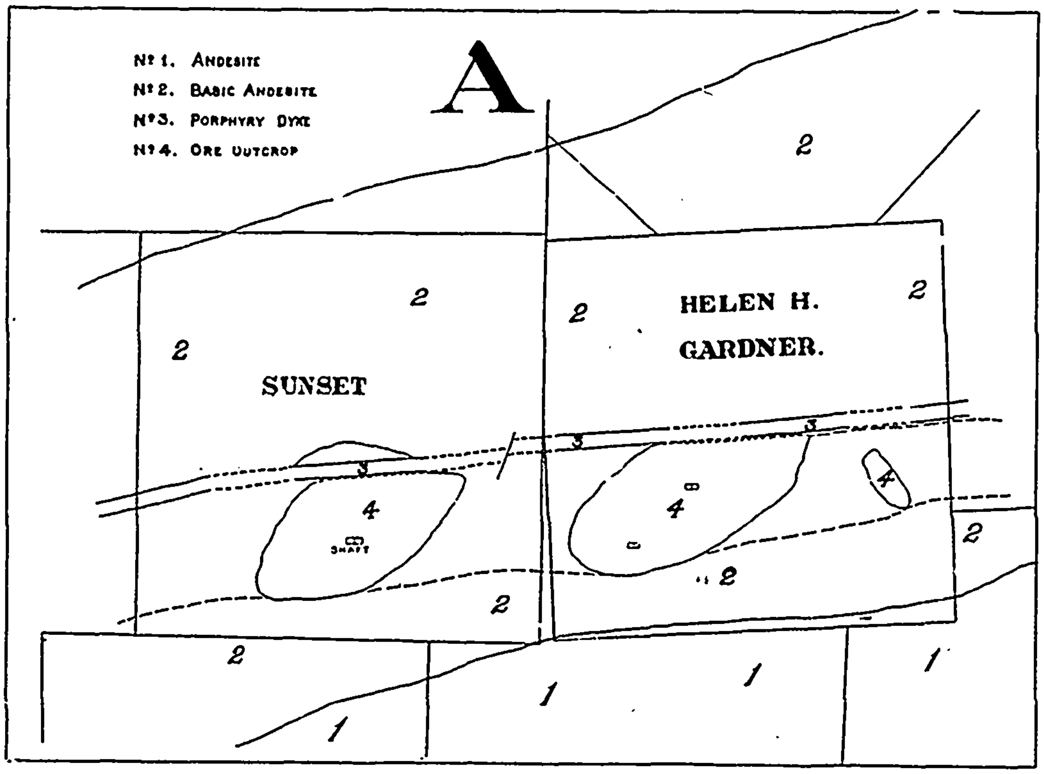
On the accompanying diagram "A" I have sketched part of the volcanic areas which are associated with the ore bodies of the "Sunset," "Helen H. Gardner," "Sunrise," and other properties lying on the summit and western slope of the mountain; a cross section of same is shown in "B."

The part colored in brown, No. 1, represents the area of fine-grained greyish-looking rock of the following composition:—

A—

SiO_2	52.33
Al_2O_3	18.80
Fe_2O_3	10.21
MnO_2	none
CaO	8.22
MgO	4.189
K_2O	3.62
Na_2O	3.842
Total	101.211

A thin section under the microscope shows its chief constituents



The green colored band (No. 2) is an area of basic volcanic rock, greenish in color, and of fine texture.

Its analysis is given in "B."

Locality	B Copper Mt.	C Japan.	D Nevada.
SiO_2	50.48	50.87	50.38
Al_2O_3	13.92	21.98	19.83
Fe_2O_3	15.04	10.94	8.05
MnO_2	.0088	1.45	.....
CaO	11.28	9.12	10.33
MgO	4.083	1.38	5.36
K_2O	.0355	.02	1.76
Na_2O	3.611	2.85	2.15
S	1.1083	.....	.....
	99.5666		
Sp. Gr.	2.8571		

Under the microscrope a thin section showed it to be considerably altered and decomposed, but consisting of plagioclase feldspar, augite, and biotite.

It also shows a microscopic brecciated structure. According to its analysis, chemical and microscopic, I have classed it as a "basic andesite," although on account of its age, following the German petrographers, we might speak of it as a "porphyrite."

In comparison with an audite andesite (C) from Japan mentioned by Rosenbusch, it shows a striking similarity in chemical composition when we group the ferro-magnesian constituents and silica content.

This basic andesite shows in chemical analysis milarity to the basalt of Richmond Mt., Eureka district, Nevada, given under "D," described in Kemp's "Handbook of Rocks."

* Geological Survey Report, 1894, part B.

to be plagioclase feldspar, also smaller quantities of orthoclase feldspar with crystals of augite and biotite. The constituents are well crystallized and do not show alteration or decomposition. I have classed this as an "augite andesite" according to the above microscopic and chemical analysis. This andesite is evidently a later intrusion in the "Basic Andesite," since a well-defined "Salband" occurs along the contact.

The pink colored parts, No. 3, represent a series of quartz porphyry and porphyry dykes that strike in an easterly and westerly direction, cutting through the basic andesite and dipping into the mountain.

The analysis of two samples ran:—

	E	F
SiO_2	72.5	71.65
Al_2O_3	11.51	14.10
Fe_2O_3	5.25	4.42
CaO	.44	.51
MgO	traces	traces
K_2O	5.252	4.542
Na_2O	6.012	6.644
MnO_2	.....	traces
	101.03	101.866
Sp. Gr.	2.571	2.510

Under the microscope, a thin section of this porphyry shows quartz of distinct crystal outline, in a ground-mass of orthoclase feldspar.

The quartz porphyry is of fine texture, and is a hard brittle rock.

"F" is an analysis of a porphyry outcrop in the "Helen H. Gardner," not showing similar characteristics in hand specimens—that is, absence of quartz crystals—but the chemical analysis is close to "E."

It is therefore probable that it belongs to the same dyke or series of faulted dykes as that which occurs on the Sunset property.

THE ORE BODY.

The ore body on the "Sunset" and "Helen H. Gardner," which are adjoining claims, is roughly defined on the north by this quartz porphyry dyke, which has a width of about 75 feet, and forms the hanging wall. Contiguous to the dyke is the copper ore, not occurring in a well-defined vein, but in the form of bornite and chalcopyrite, impregnated and disseminated through the basic andesite, forming a large deposit that can be traced in an easterly and westerly direction for over 3000′, and varying in width from 50′ up to 250′.

This mineralization of the basic andesite with copper pyrites extends from the dyke outwards, becoming less and less mineralized till the ore gradually gives way to country rock.

This country rock (the altered basic andesite), forms a contact with the coarser grained andesite on the south.

ORIGIN OF DEPOSIT.

On a careful examination of the many hand specimens which were selected from different parts of the ore belt, one is impressed with the fact that the characteristic feature of the copper is its occurrence in small veinlets and seams through the gangue (basic andesite).

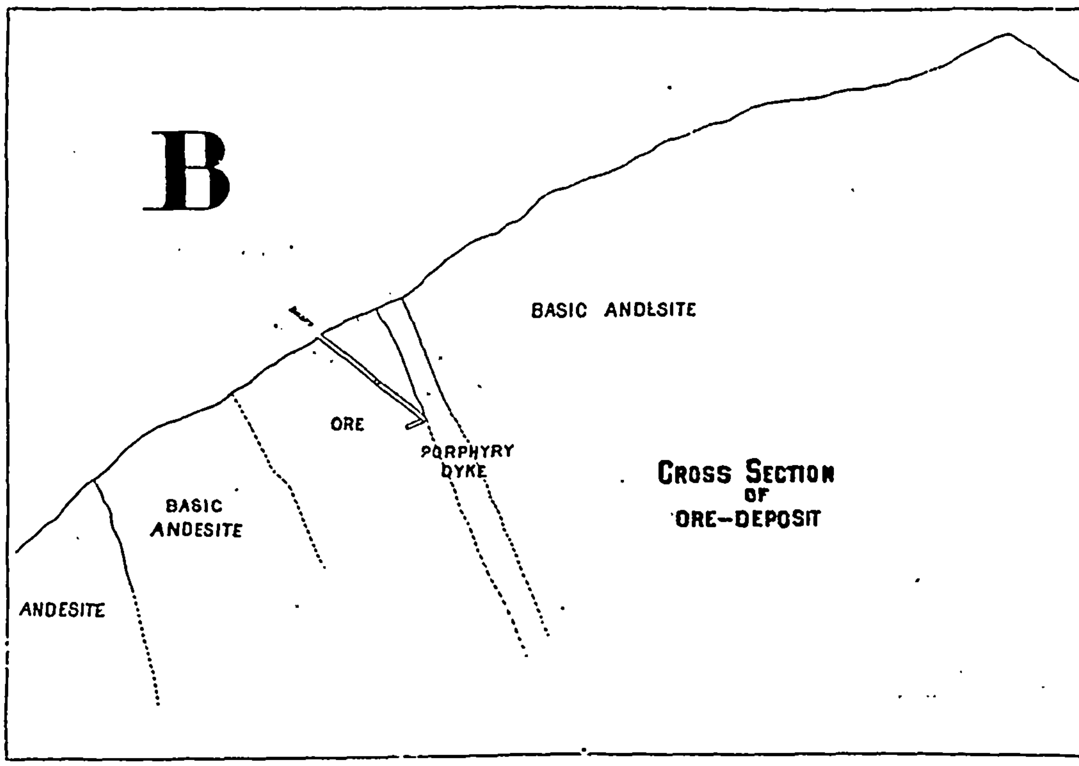
Under the hammer specimens would invariably break along these vein fractures.

That occurrence suggested to my mind that the ore deposit was of aqueous origin.

These fissures and cross-fissures would serve as channels for ascending copper-bearing solutions, which, it would seem, deposited their metallic contents in these veins.

Under the action of circulating water, the veins have been widened and adjacent country rock replaced with copper sulphides, by metasomatic action.

It is reasonable to suppose that a basic rock would undego decomposition under the influence of ascending mineral waters under pressure and probably containing CO_2, which would accelerate its solvent power.



The ore from this deposit is most interesting in its character. In appearance it resembles closely the barren basic andesite, with the exception that it is cupriferous.

The bornite and copper pyrites are at times disseminated through the gangue (basic andesite) in small veins or veinlets, which look like a highly shattered mass cemented together with copper pyrites. These veinlets are quite irregular in their course, in fact, crossing and recrossing each other in intricate confusion, forming enrichments at contacts and again widening out into seams ranging from a fraction of an inch up to 6″ or 7″ in width, of solid bornite and copper pyrites.

Associated with the sulphides of copper is calcite, as a gangue in filaments along the facets or again forming considerable seams. Very often the calcite and sulphides are intimately mixed.

By analysis I found an average sample of the ore to contain :—

G—

Cu	4.66
Au	20c. to $1.50 per ton
Ag	traces
SiO_2	42.25
Al_2O_3	9.26
Fe_2O_3	9.37
$CaCO_3$	34.74
S	1.65
	101.93
Sp. Gr.	3.0

In comparing the chemical analysis of the ore (G) to the basic andesite (B) it will be observed that the ore shows much lower percentages of ferro-magnesian and SiO_2 constituents and total absence of alkalies than the basic andesite, indicating that the augite and feldspars have yielded to a solvent.

Also under the microscope a thin section of the mineralized country rock showed the feldspar kaolinized and in places surrounding crystals of pyrites. Also, the ferro-magnesian mineral augite had undergone decomposition and was replaced in part by crystals of pyrite ; thus the microscopic and chemical analyses prove directly the replacement of the feldspar by the pyrite.

Again, the fact that calcite occurs as a gangue in these fissures in connection with the copper sulphides would indicate deposition from solution.

If we seek for an explanation of the genesis of the deposit in an igneous theory, it must be explained why the sulphides are not more or less evenly disseminated through a gangue or segregated in solid masses ; whereas quite the reverse is a case for Copper Mountain ores.

Here the bornite and chalcopyrite are deposited chiefly along fissure lines, leaving the country rock quite recognizable.

The origin of the mineral contents of the deposit was not local, that is, the material was not brought in and deposited by "lateral secretions," because the analyses show there is no concentration of the iron from the surrounding rocks, and that these rocks have not been leached, so that the material must have come from depth.

Referring to the accompanying sketch, you will notice that I have indicated the quartz porphyry dykes in pink color.

These dykes follow the general course of the ore bodies, that is, east and west, and usually form the hanging wall, although one case was found where ore occurred on both sides of the dyke.

In these rugged mountainous regions, where the process of tilting and folding has been active, eruptive dykes have caused further rupturing and fissuring of the country rock, which probably may have been accelerated later by earthquakes, etc, etc., so that I attribute the formation of the intricate fissuring which extends from the dykes outward into the country rock to the forcing of the quartz porphyry through the basic andesite. At least the later fine fissuring was due to this.

I shall further try to show that the porphyry dykes have a relation to the ore deposit, a relation which is chiefly mechanical and not chemical.

The chemical analysis of two specimens shows them to be highly siliceous rocks, so that they would be highly insoluble compared to the contiguous basic andesite.

A thin section under the microscope showed that its constituents were not altered or decomposed, indicating also its impermeability to circulating solutions. Therefore, these fine-grained acidic eruptives were impervious to ascending solutions, but acted as a barrier to horizontal circulation and directed the course of mineral-bearing solutions upward along the lines of dislocation and fissures.

In that way the permeable basic andesite was brought under the influence of ascending mineral solutions, which, by their dissolving power, would readily attack the feldspar and ferro-magnesian constituents of basic rocks, enlarging the already existing fissures in such lines of decision and depositing their metallic contents.

The augite andesite (No. 1) does not show mineralization on account of its compactness, lack of fissures, and absence of porphyry dykes.

In the Similkameen district quartz porphyry dykes should cause the prospector to thoroughly examine the contiguous rock for ore deposits or indications of such.

In the Boundary country, 150 miles east, I have noticed somewhat similar acidic dyke rock in the B.C. mine (Summit Camp) in contact with the rich Cu. sulphide ores, also at the "Rathmullen" and "Blue Bird" mines in the same camp, so that the relationship of the dyke to the ore bodies in the Similkameen may be applicable to the low grade deposits of the Boundary country, which may also owe their genesis to ascending mineral solutions.

If the genesis of the ore is attributed to ascending solutions, their source must have been deep-seated, hence a favourable indication of the continuance of the ore in depth.

SURFACE INDICATIONS.

Copper Mountain ore deposits are generally covered or partly covered with "detritus" or wash, and since the copper ore does not contain a high percentage of iron, heavy gossans (or insol. iron oxides) do not occur to indicate bodies of sulphides below.

Ar the surface of the "Sunset," "Helen H. Gardner," "Sunrise," and other Copper Mountain ore deposits, the soluble copper content has been leached out by surface waters, aided by the oxidizing action of the atmosphere changing the upper part of the deposit to a barren or lean copper ore, and in the lower regions forming enrichments.

In the upper parts of the deposits carbonates of copper form blue and green stains in the rock, the well-known surface indications of copper ores, although when no wash covers the outcrop very little carbonate stain may be left owing to its contact with the rains and atmospheric agencies.

MINING AND TREATMENT.

The Copper Mountain ores are of a type common to the whole district. The large deposits of low grade copper ore, averaging from two and a half to seven per cent. Cu, and small amounts of Au and Ag, which vary in width from 40′ to 250′ and, showing good indications of permanency in depth, are comparable to the Boundary district ores.

In the Boundary some of the large deposits are quarried, giving a large production at a low cost per ton. Copper Mountain deposits, lying on a sloping mountain side, would afford favourable conditions to cheap mining by a system of quarrying.

The Boundary ores are self fluxing and smelted at a low cost. Copper Mountain ores should offer no great difficulty in being smelted at as low, or nearly as low a figure as these. The aluminium contact is somewhat high, but not high enough to cause serious trouble in the furnace.

Within the last month, reports have come from Princeton of the discovery of a 10′ bed of bituminous coal, which is said to be of a good coking quality. It is less than ten miles from Copper Mountain ores, and should furnish a cheap fuel for the smelting of ores of the whole district.

Therefore, under competent management, and a careful development of the deposits, together with a local supply of fuel, these ore bodies bid to become valuable copper producers in the near future.

Le Roi.—Cable:—"There were shipped from the mine to the smelter during May 13,000 tons of ore, containing 7,172 ozs. gold, 10,980 ozs. silver, and 4'0,870 lbs copper. Estimated profit on this ore $60,000. Great Northern Railway have made rate second-class ore 25 cents, promise coke early next month, delivered at Northport $6.80 per ton" (Office note.—The reductions of the freight rate on second-class ore to 25 cents and of the price of coke from $9.50 to $6.80 are the outcome of lengthy negotiations, and will materially reduce the operating expenses.) (April shipments:—26,093 tons, containing 8,689 ozs. gold, 18,079 ozs. silver, and 706,224 lbs. copper.)

Enterprise (British Columbia).—Cablegram from Nelson, B.C.: "Estimates of last month's receipts, $7,190; expenses, $8,060; does not include 100 tons zinc concentrates, 70 ozs. of silver per ton of 2,000 lbs.; owing to a break-down at crusher, returns diminished."

Le Roi No. II.—Manager cables:—"Shipments last month amounted to 6,466 tons. Contents:—3,573 ozs. gold, 7,000 ozs. silver, 135 tons copper The returns from ore, after making a reduction of all smelting charges, amount to $60,000. Cost of mining may be taken at $21,000. Profit for last month, $39,000. (Equivalent sterling, £8,041.)" (April shipments:—6,375 tons. Estimated profit, £9,278.)

Nimrod Syndicate, Limited.—Mr. R. D. Fetherstonhaugh, the manager of the Atlin Mining Company, Ltd., a subsidiary of the above syndicate, cabled on the 29th May as follows:—"We have cleaned up after a run of 50 hours, recovered 130 ozs., being the proceeds of 48 ft. of sluices."

Giant.—The Hon. C. H. Mackintosh, resident director at Rossland, cables under date 4th June:—"I have made contract with smelter (Canadian Pacific Railway Company's smelter at Trail), to smelt Giant ore at 18s. (per ton), a reduction of 25 per cent. Have opened up a fine body of ore. Assay value of gold per ton is $30." (Office note.—Hitherto the rate for smelting Rossland ores has been $6 per ton, and it will, therefore, be seen that our resident director has succeeded in obtaining a reduction of 25 per cent.)

Slough Creek.—The following cablegram, dated Barkerville, B.C., the 29th ult., has been received from the company's mine manager:—"Gravel was struck at 9 o'clock this morning in vertical borehole 6 ft. above crosscut; considerable water; gravel appears firm; is in good order throughout; every precaution has been taken to ensure getting through safely." Further cablegram, dated 2nd inst., says:—"Put up secondary borehole 3 ft. 6 in. forward—5 ft to the gravel—1 ft. in the gravel—water not increasing—wash is undoubtedly auriferous—prospects are most encouraging throughout the mine."

Cariboo Goldfields.—Cablegram from the company's engineer at Barkerville, Williams Creek, British Columbia: "The flume is being lowered so as to enable us to hydraulic gravel immediately above bedrock. Large returns cannot be expected until we get into lower level. I anticipate a marked improvement within the next fortnight. Gold contents of gravel are increasing. Expect to reach bedrock in about three weeks. Water supply is plentiful. We have raised more gravel this year than during the previous three years put together. Promises to be a brilliant success as soon as opened up. Have sent to bank further small parcel of gold, 99 oz."

Mine Timbering in the Old Ironsides and Knob Hill Mines.

By H. P. De Pencier, McGill University, Montreal.

The Old Ironsides and Knob Hill mines are situated at Phœnix, in the Boundary Creek District in British Columbia, at the summit of the watershed of the Kettle River. The accompanying photograph shows the Old Ironsides head works on the left.

The ore bodies in these mines are very large, as will be seen from the accompanying blue print, which was kindly furnished me by the Superintendent, Mr. W. Y. Williams. This fact necessitates an extensive and thorough system of timbering the lower levels of these mines. The boundaries of these ore bodies have not yet been well ascertained, the ore appears to extend over 2,000 feet in length, while the width is not determined, though crosscuts from the footwall have been run for upwards of 300 feet.

The Old Ironsides has been prospected and developed by a system of shafts and drifts, showing the ore to extend down 400 feet, though work is not being carried on below the 300-ft. level. Stoping ground on the 200-ft. and 300-ft. levels has been opened up exposing blocks of ore running as high as 280 feet in width by 200 feet long; also, in an intermediate level, the 250-ft., ground 160 feet by 40 feet has been blocked out and is being stoped.

The Knob Hill is worked through a long adit tunnel, along which three blocks of ore 200 feet square are blocked out on at least three sides. On the surface, 150 feet above the level of this tunnel, an open cut or quarry is operated, and delivers ore to the tram system in the tunnel by means of shafts or shutes in the solid rock.

The foregoing brief description of these mines is merely intended to convey some idea of the immense size of the ore bodies, and hence the need for timbering when the ore is removed.

The ore in this wide mineralized zone does not form a very strong rock, though where (as in the Knob Hill) there is not much water and it has not been shattered, it forms a fairly safe roof for drifts and crosscuts.

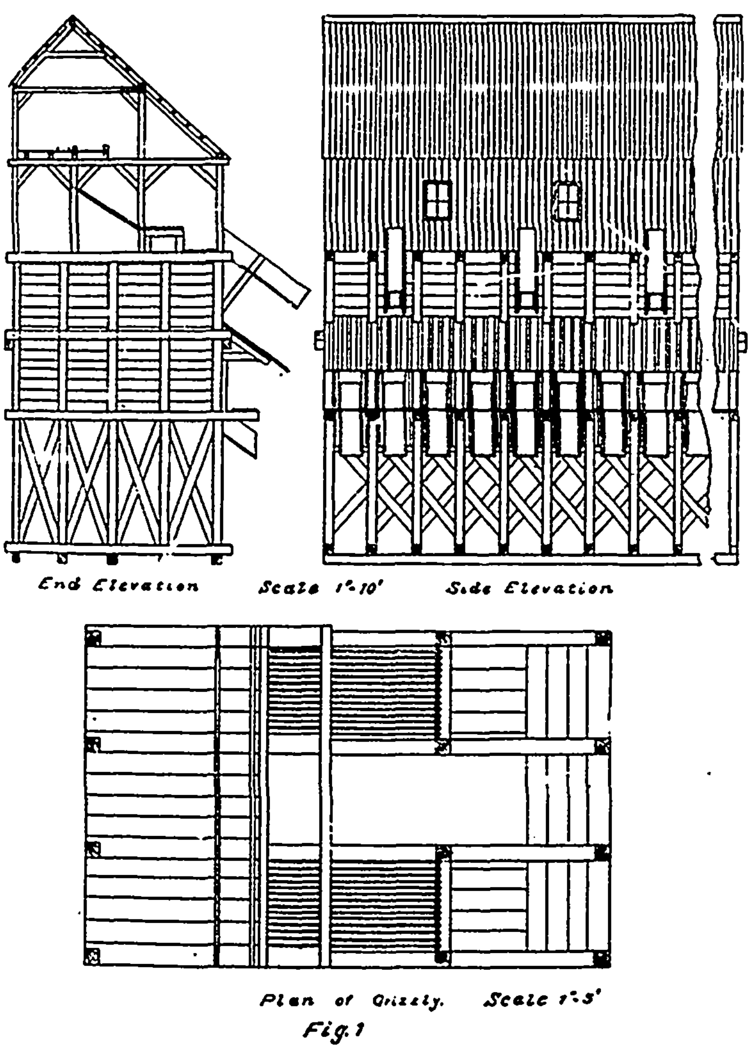
A large part of the timber used at both mines has been obtained on the claims, the country here being rather heavily wooded. The principal kinds of woods are pine, spruce, tamarac and Douglas fir; the three latter are regarded as of nearly equal value, the fir being the strongest and all three being stronger than pine, which, however, has the advantage of being softer and crushing more easily, so as to take up the load more evenly; for this reason pine is much used for making wedges.

Most of the timber on the claims has now been used and the supply for the future is being brought in by railway from outside points.

Posts and caps are cut from round timber, which has the bark peeled off to lessen the decay caused by moisture retained on the surface and below the bark when it is left on; this round timber is 10 inches and upwards in diameter, the posts being generally 15 inches up to 24 inches in diameter, while caps are smaller, the thickness across the flats at the post being 9 inches. Lagging poles are 5 to 10 inches in diameter.

Sawn timber is used in the construction of ore bins, hoists, and in the lining of shafts and shutes.

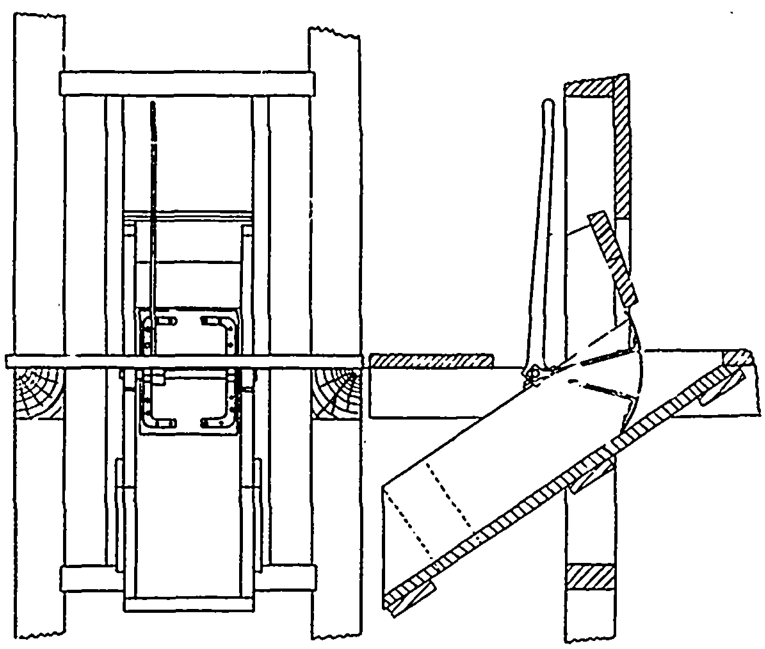
On the surface at both mines considerable timber has been used to build retaining walls to hold second grade ore and for making ground



End Elevation Scale 1" = 10' Side Elevation

Plan of Grizzly. Scale 1" = 5'

Fig. 1



Front Elevation Section through Centre

LOADING SHUTE FOR ORE BIN.
Scale 1" = 2'

Fig. 2

about the shafts and buildings. Round timber with the bark on is used for this, it is built into a wall by means of cross-pieces, forming cribs; these pieces are notched to fit the notches cut in the logs of the wall, and are run back into the bank where the weight of material resting against them holds the whole crib firmly in place.

Both mines are equipped with ore bins capable of holding from 5,000 to 10,000 tons and intended for the storage of ore and its easy delivery from the mine to the railway cars. The general arrangement of them is the same and is shown in Fig. 1. The foundation is made of 12-inch square timber made into bents and resting on mudsills of the same timber; these rest on the solid rock.

The bents run crosswise of the bin at a distance of 5 feet from centre to centre and are strongly braced, the direction of the braces being changed in successive bents, while the bents are tied together by braces crossing three bents.

The floor of the bin comes directly on top of the bents; it is flat and horizontal; the ore takes the angle necessary for its removal.

The floor and sides of the bin proper are made of 4-inch plank, spiked solidly to the 12-inch square timber frame arranged as shown in Sketch 1; also 1 inch iron tie rods are freely used in addition. Along the front side of the bin a railway track is built, and above this on the bin a platform extends from which the cars are loaded by means of a series of shutes placed 5 feet apart from centre to centre. The details of these shutes are shown in Fig. 2; the gate is made of heavy iron 26 inches wide, it is pivoted as shown on an axle and opened by a long iron lever; two movable planks above the iron gate permit the attendant to bar out large rocks if they should stick in the mouth of the shute.

Above the main bin compartment proper the grizzlies and breaking and sorting platforms are built—a plan of these is shown in the lower sketch in Fig. 1. The grizzlies are made of 25-lb. mine rails cut to the desired length and strung, bottom upwards, on iron rods at each end, pieces of pipe placed between them on the rods make the desired space between them, about 2¼ inches. There are two such grizzlies, each 5 feet wide, with an open space between them, in each 15 feet of the length of the bin. This open space is used for dumping ore directly

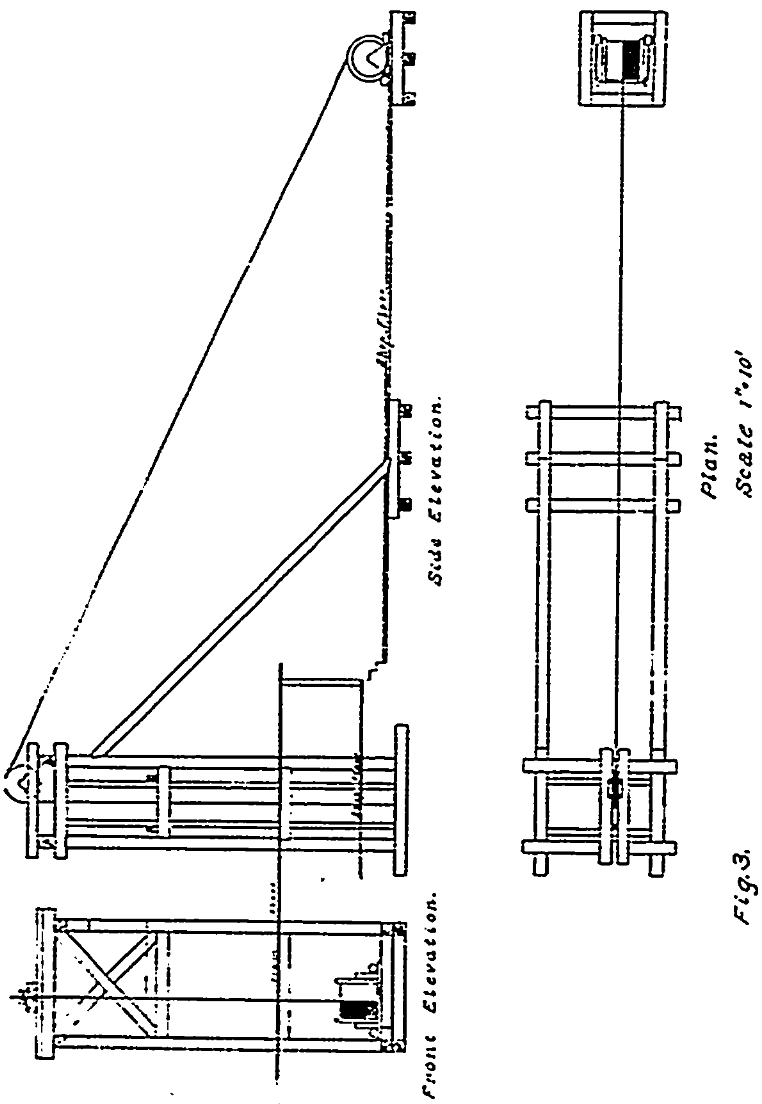


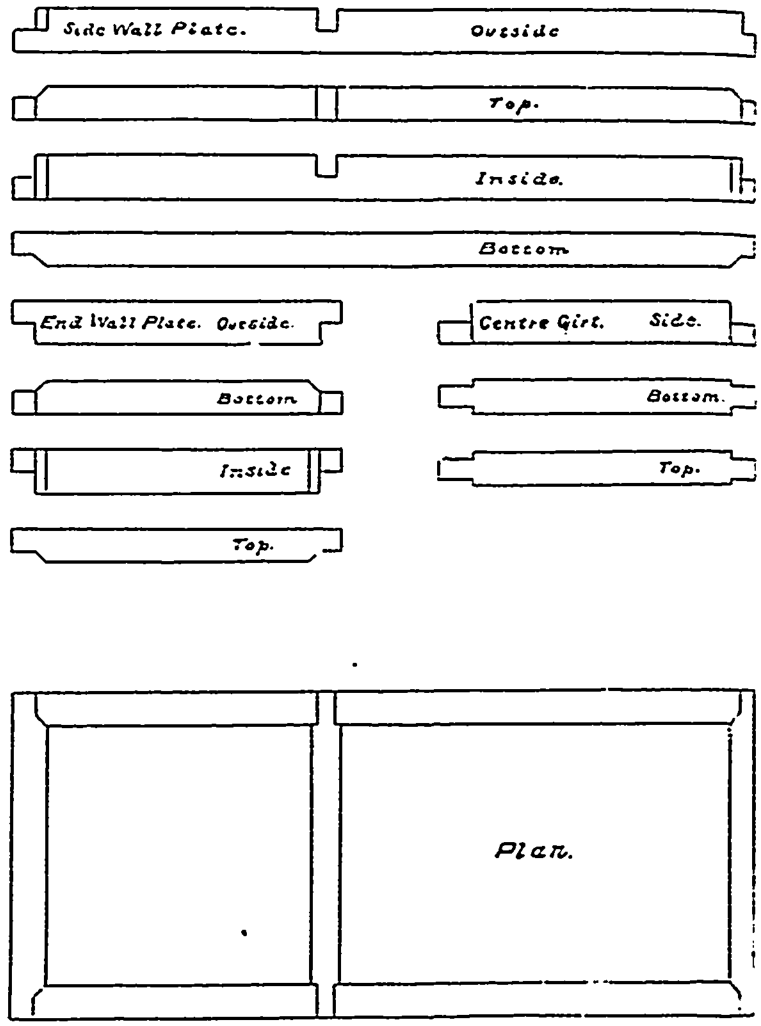
Fig. 3.

into bin when it does not require sorting or breaking; or by means of a shute a low-grade ore can be thrown out of bin at the back.

Above the grizzlies is the tram car level; the cars come from the shafts to the centre of the bins and turn either way on a steel turn-plate and are run to the desired compartment and dumped. A beam 4 inches square, running parallel to the track, about 2 feet from it, prevents the cars being overturned into the bin.

The whole structure is roofed with 1 inch boards to keep out rain and snow, which are abundant in this locality. The bin sketched is a small one with a capacity of about 18,000 cubic feet if full, or say 1,000 tons. There are in addition two others of much greater capacity.

The shafts in operation on the Old Ironsides are the original prospecting shafts and the "gallows frames" are not elaborate. Fig. 3 shows the plan and elevations of the one at No. 1 shaft. It is built of 12 inch square fir timber arranged as shown. Men and timber are taken on the cage at the shop floor level, while ore or waste is hoisted



Scale 2"=1'.

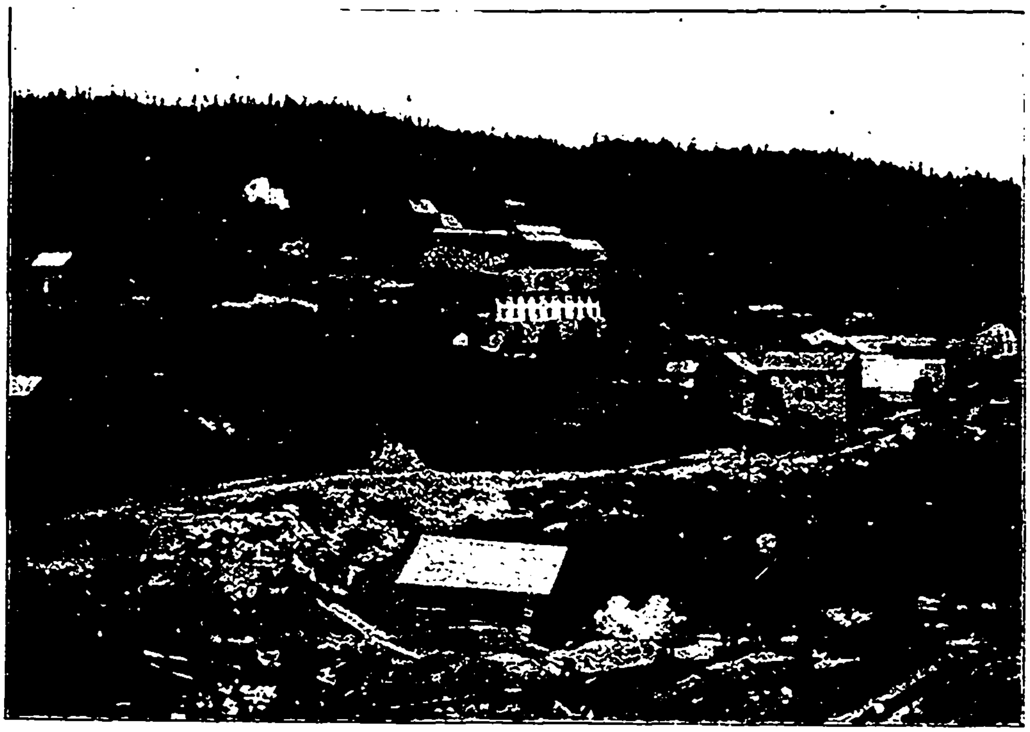
Fig. 4.

to the tram floor level to be taken to the ore bin or waste dump. As the hoisting engine is quite small, an elaborate hoisting frame is not required. The frame at No. 2 shaft is somewhat similar.

Both shafts have two compartments, one being for hoisting ore, &c., and the other for ladders, pipes, &c. Owing to the fact that they are lagged inside with 2-inch plank, I have not got full details of the timber in them.

Shaft No. 1 is cribbed for a part of the way down and Fig. 4 shows a method of framing timber for cribbing which is employed in British Columbia; it is a halved joint combined with a bevelled hitch on the inside to resist lateral pressure; it is improved if side and end plates are made to break joints so as to prevent one set slipping over the next.

The lower part of No. 1 shaft and all of No. 2 shaft is timbered with square shaft sets. Fig. 5 shows timbers cut for this purpose, with a halved joint and bevelled hitch, and the posts resting at top and bottom in a hitch to prevent them being forced inwards. The centre girt or divider is supported by a tenon and mortice joint; and centre posts are provided. The lagging in bad ground is placed outside of the timber and is supported on strips spiked to the plates; in safe ground the lagging is placed on the inside, being intended to prevent small rocks from falling in.



General View of the Knob Hill and Old Ironsides Mines, Boundary District, B.C.

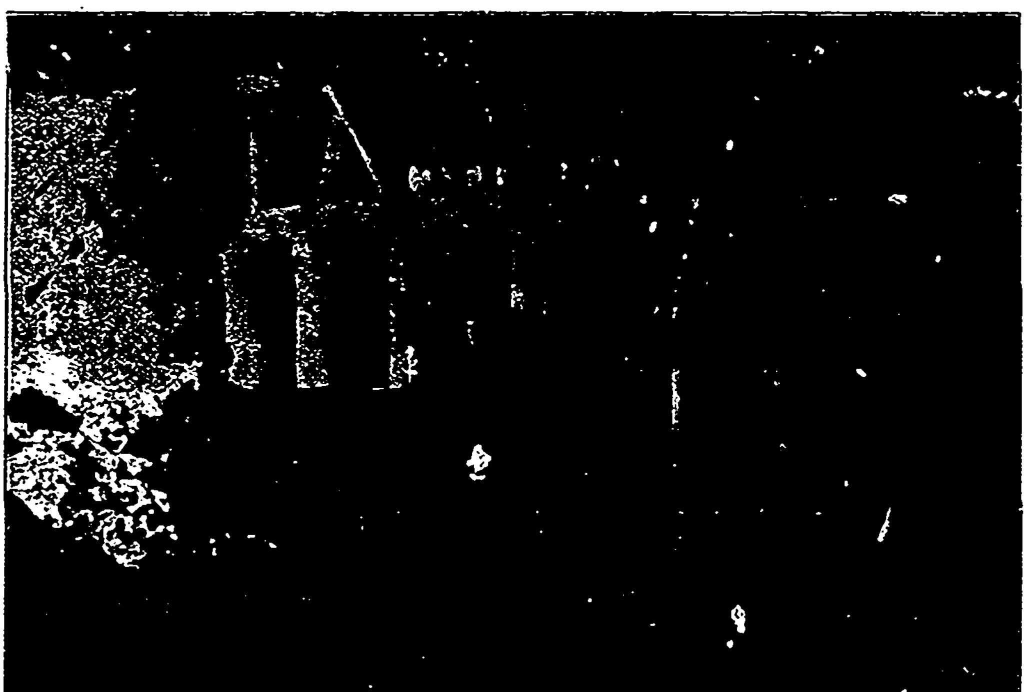


Photo showing arrangement of the Bottom Square Sets and Spragging at the Knob Hill and Old Ironsides Mines, B.C.

As the shafts are only prospecting ones the level stations are simple. Posts about 15 feet long are put in the shaft at the station and the upper end wall plates are run across the station a distance of about 20 ft., with suitable supporting posts and dividers or cap pieces; the lower end plates are also extended to form part of the sills for carrying the floor and steel turn-table plates.

Both mines are equipped with a track system. The rails are carried on wooden ties placed about 18 inches apart; these ties are flat on two sides and are 3 in. x 4 in., and 30 inches long.

The main haulage roads are lighted with incandescent lights; the wires are carried on small round timbers about 4 inches thick, wedged

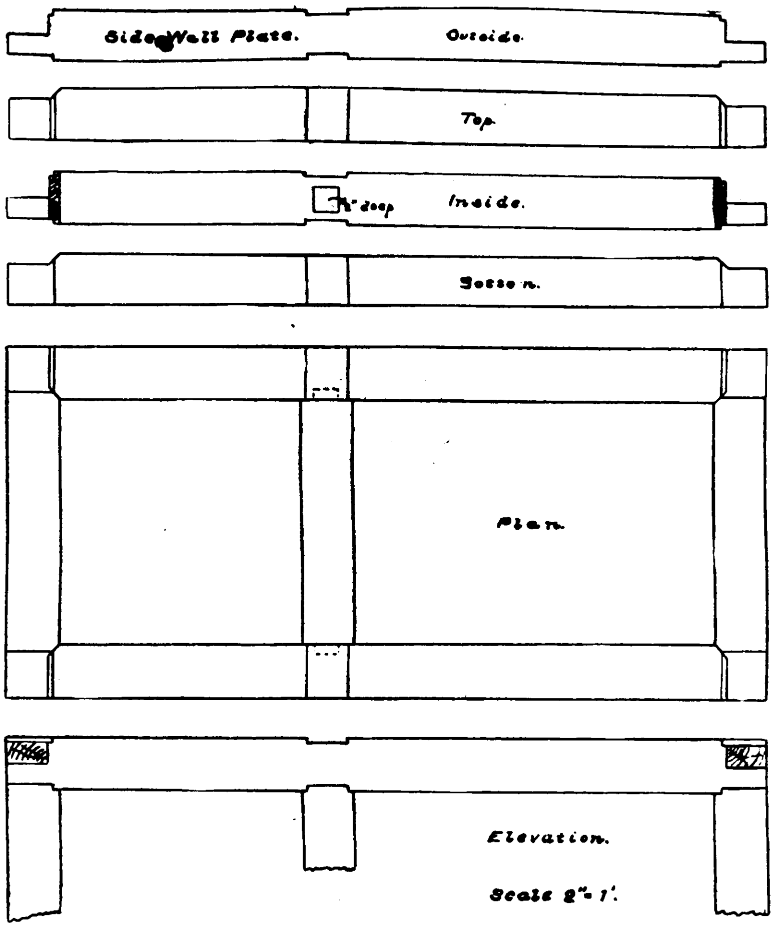


Fig. 5.

across the top of the drifts like a horizontal stull. Where there are tunnel or stope sets they are used to carry the wires.

The method of mining the ore in the Old Ironsides may be briefly said to be by overhand stoping. The stopes thus formed are filled with square sets of timber, and this timbering constitutes the most important item in the timbering of the mine.

The square sets are of round timber 8 feet in height placed 5 feet apart with cap pieces to hold them in their relative positions laterally. These posts and caps are securely wedged into place to carry any pressure resulting from settling or breaking loose of rock. Fig. 6 shows the shapes of the timbers; they are all round timbers except the bottom sills in each stope, which are 6 in. x 12 in. sawn timber. The sketches at the top of Fig. 7 shows the method of framing joints; in the drawing square timber is used for convenience in drawing. The lower drawing in Fig. 7 shows a number of sets put together; in it the posts are represented as being too small to allow of cutting the small shoulder for catching up the whole cap. This occurs sometimes with the round timber.

It will be noted that the framing of this timber is especially designed to carry vertical pressures,—the tenon on the end of the posts ensuring the position of the posts in the different floors of the stopes being directly above the corresponding post in the floor below.

It will also be noted that this system of timbering is very elastic and can be applied to ore deposits of almost any shape and size.

This timber is all framed on the surface by special carpenters. Fig. 8 shows the framing platform which is situated in a convenient place above the shafts and below a spur of the railway from which the timber can be unloaded and rolled direct onto the platform, framed, and rolled off onto piles near the shafts.

It is cut up into caps and posts to the best advantage. Fig. 6, *a*, *b*, *c*, show templates, straight edges and squares used by the framing carpenters. All timber should be marked off and measured from a centre line. It may be mentioned that this method is about to be abandoned at this mine and the timber framed by machinery.

The timber is transported to the shafts on a 30 inch gauge track and lowered into the mine by the "muckers" of the night shift; and stored in convenient places near the shaft stations. In this connection it may be noted that it is advisable to store it in as dry a place as possible, as the drier and lighter it is the more easily and expeditiously the heavy pieces can be handled.

From the stores underground the men of the day timber crew take it as required to the various parts of the mine on small timber trucks running on the ordinary mine tracks.

If the timber is being put in on the bottom of the stope, the first operation is to get the 6 x 12 inch sill accurately in place. This may

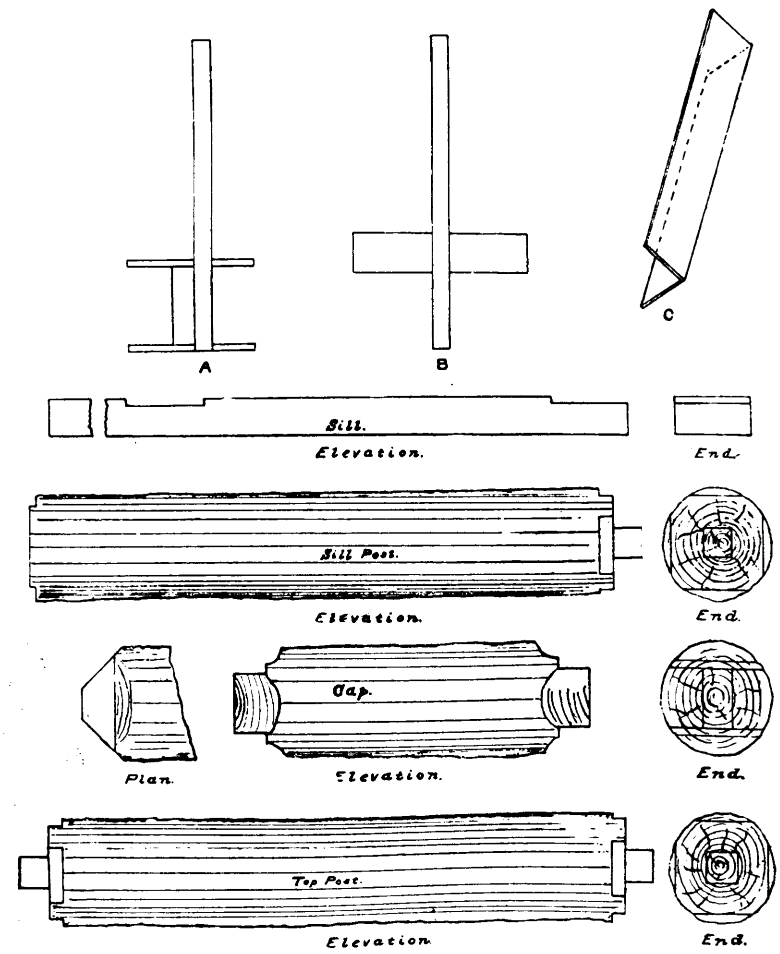


Fig. 6. Scale 3" = 4'.

be done by the engineer giving level and location with his instrument, or it may be placed by reference to the adjacent timber, if there is any, by levelling and measuring across from the sills. When the sill is tamped accurately to its true position the sill posts are set in position in the open mortices in the sill, then the caps are put on and the whole is "spragged," or braced and wedged securely in place. It is usual to brace and wedge caps and posts from the adjacent walls, and the roof also in the case of the caps by a large vertical sprag set on top of the caps meeting at a post. The accompanying photograph gives some idea of the arrangement of the bottom square sets and the spragging. The secure bracing of the timber requires both judgment and experience, and is a good test of the timberman's ability.

Next the lagging of round poles is laid on top of the caps, the lagging poles are from 4 to 10 inches in diameter, 10 feet long and have the bark left on. Not more than four square sets of lagging is

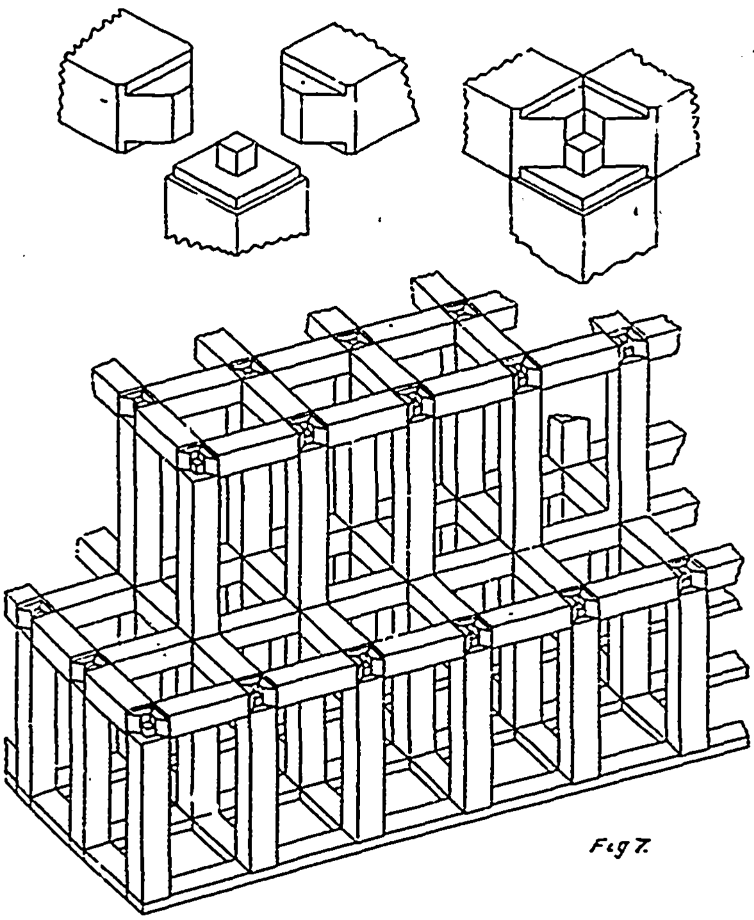


Fig 7.

laid in the same direction, *i.e.*, a square 10 feet on the side; the adjacent lagging is laid at right angles to this to give a better support to the ends.

If the timber is to be used on floors above the track level it must be hoisted from the level; to do this shutes are built through the lower floors—they are made either of plank spiked to the lagging, or of lagging, the top being spiked to the cap and the bottom ends resting on the next lower floor behind the caps so as to be out of the way of the timber being hoisted.

The hoisting engine used is shown in Fig. 9, a photograph from the maker's catalogue; it is driven by compressed air from the mine mains. This engine is in common use in British Columbia for this purpose. It is made in two sizes with double cylinders 5 and 6 inches in diameter, and drums 12 x 21 inches and 14 x 24 inches respectively. The 5 inch engine is said to be capable of lifting 1,400 lbs. 100 feet per minute. The pistons are of the trunk type, there being no crosshead or slides; the crank discs are carried on the small shaft at the top; this shaft is geared to the larger shaft on which the drum is loose and is connected by a V friction between the drum and the large gear when running. This engine is mounted on nine car wheels for transportation underground and braced securely to walls and timber when used. Each engine should be equipped with air hose, wrench, and oil can.

One inch manilla rope is used on the drum, with a single pulley block fastened to the timber of the upper floor, the end of the rope is fitted with a pair of steel hooks for hoisting caps and posts; lagging is tied together and hoisted in lots.

Timber is moved about the upper floors by means of a pair of steel tongs like ice tongs.

As yet no reinforcing sets have been used. Heavy ground is held by putting in diagonal braces, or by extra spragging and cribbing with solid timber cribs built in between the rock and the regular sets to prevent a fall beginning.

In the centre of the large stopes cribs filled with waste rock or, in some cases, with ore are carried from the bottom level up with the timber; this is intended to steady the timbering in the stope. This filling pillar is usually 15 or 20 feet square and is retained by large lagging split and placed behind the posts.

Where a turntable is put in the track in the bottoms of stopes a post is left out at opposite corners to allow of long timbers being turned; an 8 x 8 inch upright is bedded on rock beside the adjacent posts and a 12 inch square timber on top of these supports the regular caps.

On the bottom of the stopes shutes for drawing the ore from the floor above to the mine cars are built in every 15 or 20 feet along the tracks; they are built of 6 inch plank, the mouth is 5 feet above the track and is 26 inches wide.

Very little timber is used in drifts and crosscuts, only a few square tunnel sets resting on sills and measuring 4 x 7½ feet are used.

In winzes and raises stulls are placed across in the usual way to support the platforms and ladders. Ladders are 10 feet long, sides 3 x 4 inches, rungs 4 x 1½ inches, 18 inches long, and 14 inches apart.

Fig. 10 shows the head frame used in sinking an inclined winze

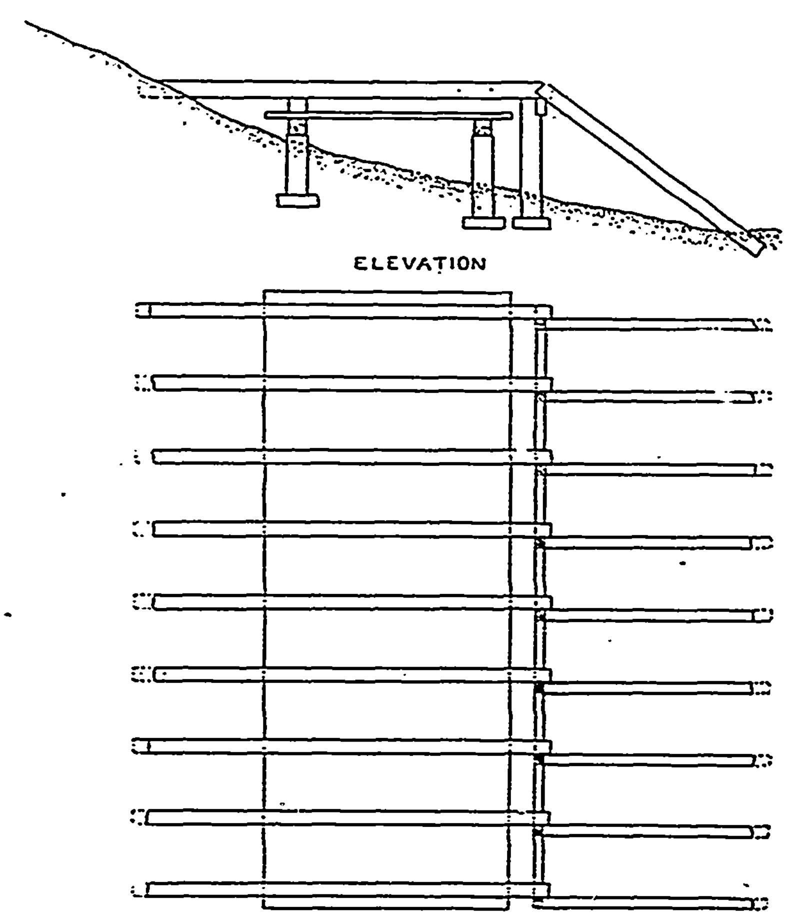


Fig. 8. PLAN Scale 1" = 5'

with a bucket, the posts are wedged solid to the rock so that no bracing is required.

Fig. 11 shows a very strong shute placed on the 300-ft. level to draw ore from the 250-ft. level stopes. Similar shutes are used in the Knob Hill at the bottom of the shafts from the surface quarry.

Fig. 12 shows a plan and elevation of an underground station in the Knob Hill from which a vertical shaft over 200 feet deep has been sunk. The frame is made made of 8 x 8 inch and round timber; the posts of the gallows frame are 12 inch square timber, no braces are required as the tops rest against the rock. The station is lagged with

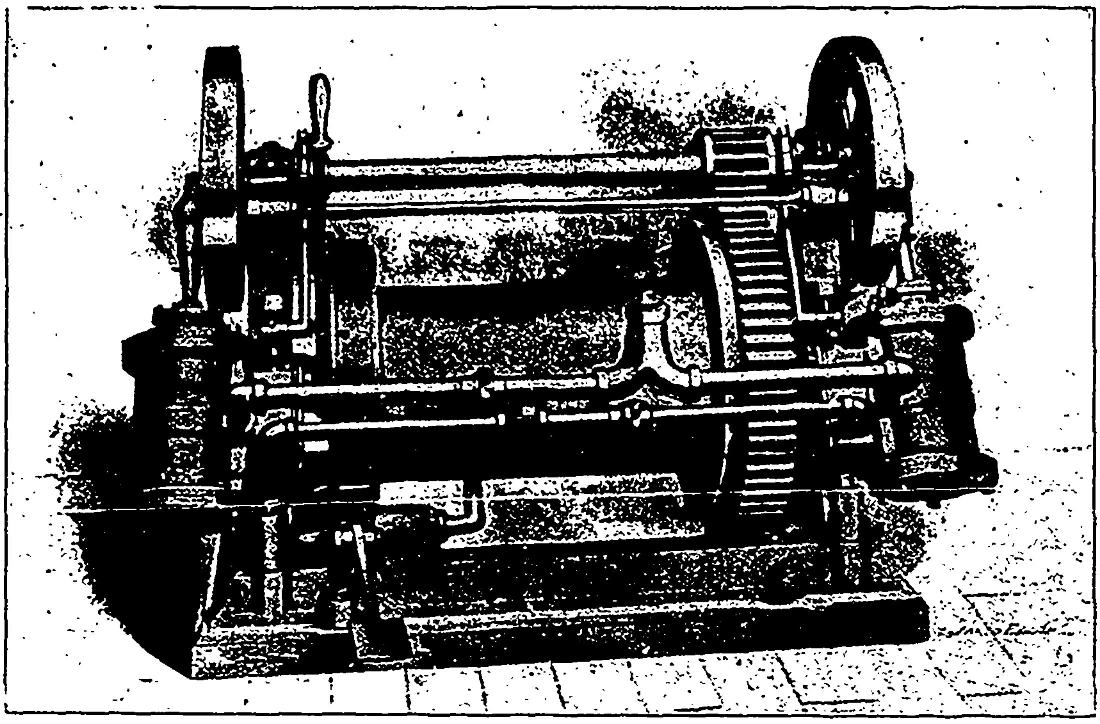


FIG 9—Type of Hoisting Engine in service at the Knob Hill and Ironsides Mines, B.C.

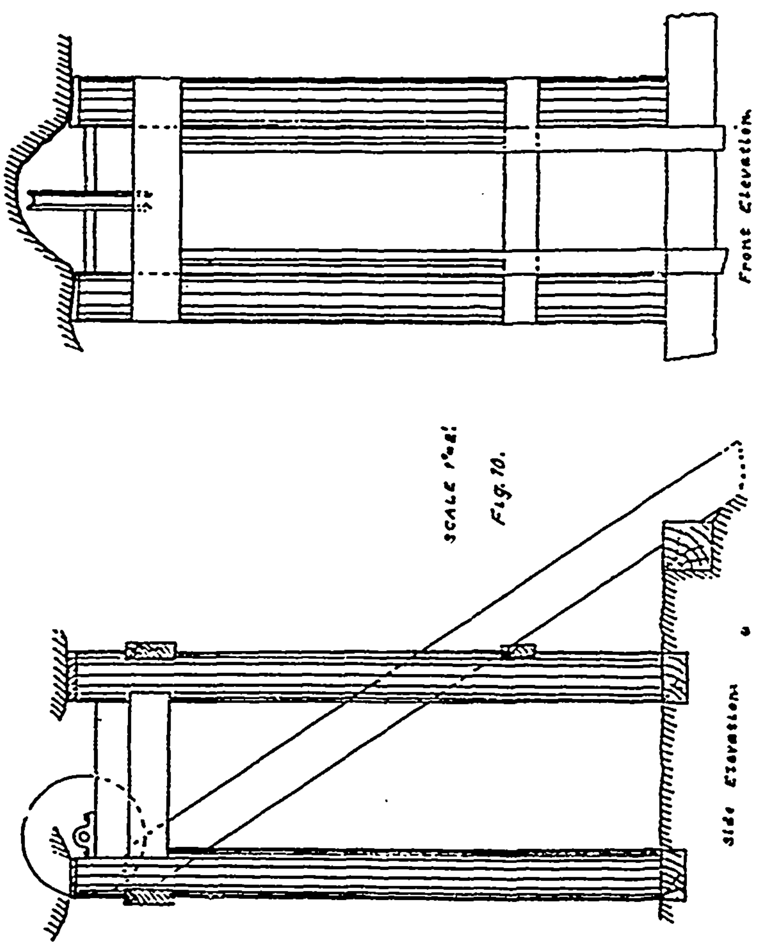
2 x 12 inch plank. The foundations are mudsills with two long sills beneath the hoist. The chamber is dry and no better roof is required.

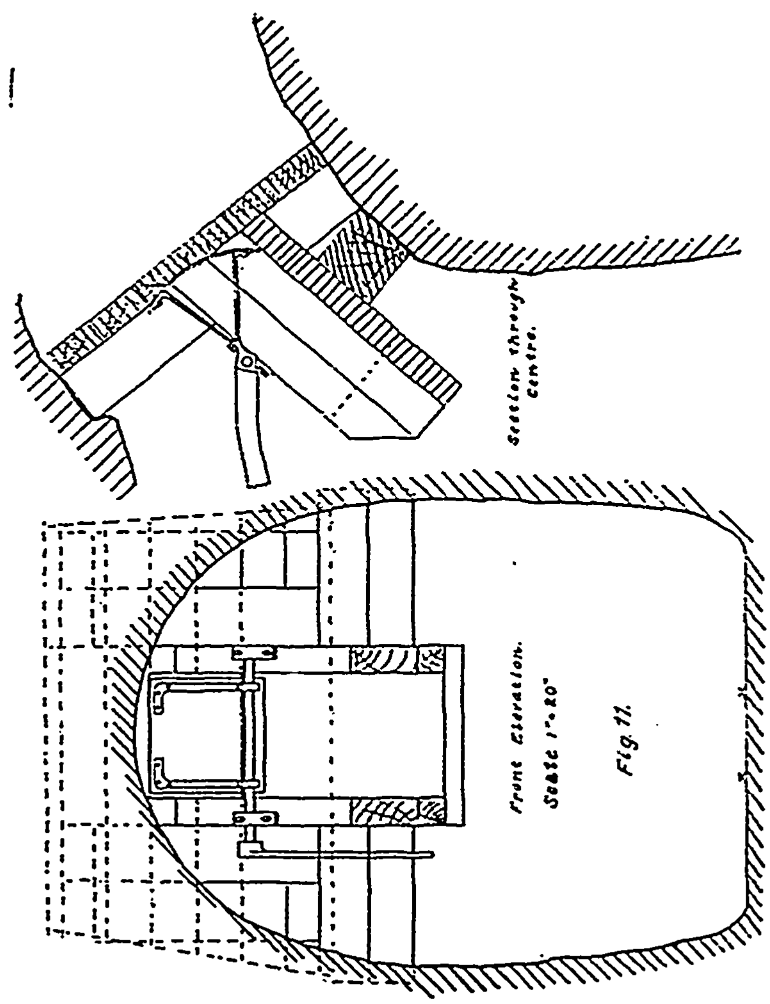
Fig. 13 shows a hoisting arrangement used on the surface of Knob Hill for loading ore into the railway cars direct from the surface.

A small car is used running on a 30 inch gauge track, and a small hoist run by air pulls it up the incline, when at the proper place it dumps its load automatically into the moveable shute below which throws it into the railway car standing alongside. The whole hoist rests on mudsills and can be turned to face different parts of the bank from which the ore is being taken. It is steadied by guy ropes reaching from the top to any convenient anchor.

On the whole very little timber is used in the Knob Hill, a few tunnel sets being practically all outside of the winzes, shutes and underground station. The tunnel sets are 10 feet wide by 7½ feet high, California sets..

Timber used in the Knob Hill may be used repeatedly until worn out; but the life of timber in the Old Ironsides is not expected to be





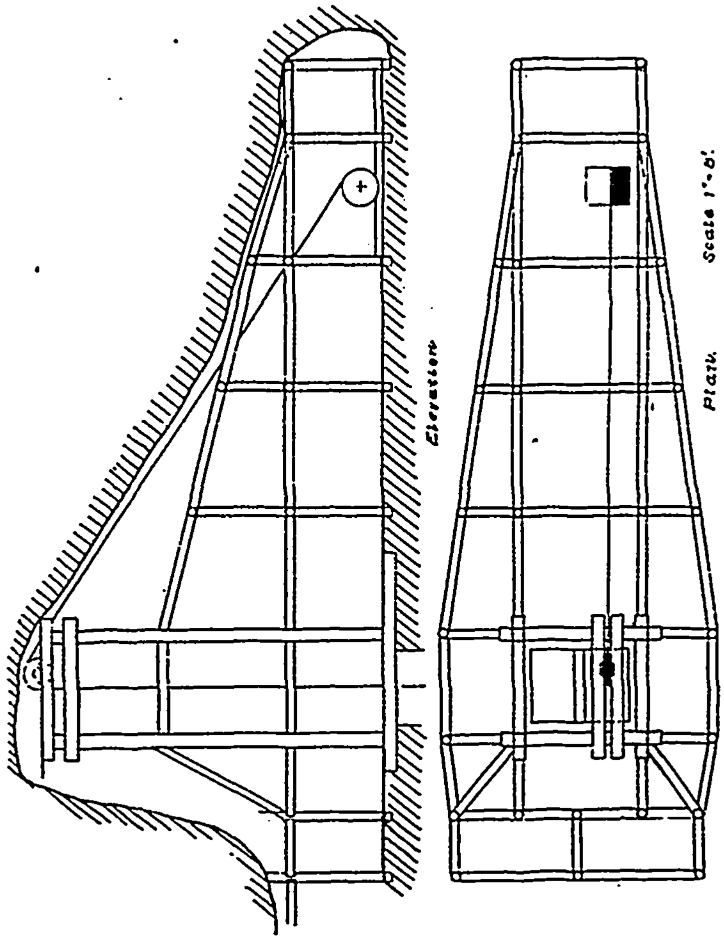


Fig. 12.

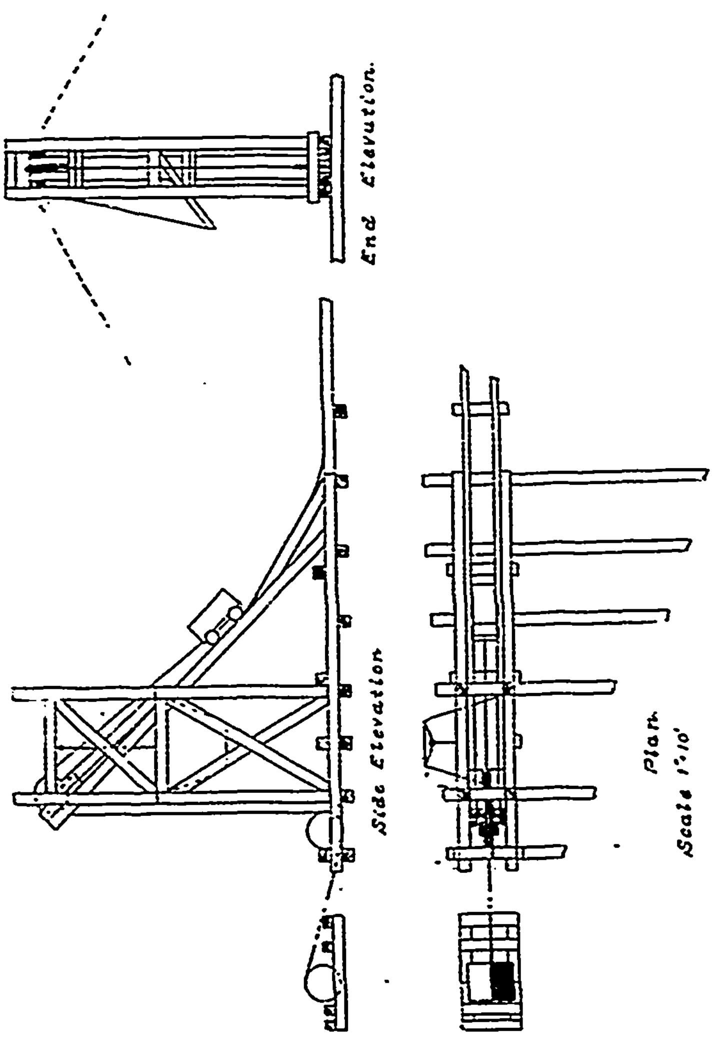


Fig. 13.

more than three or four years on account of the water and great quantities of powder smoke.

A timber crew in the Old Ironsides consists of four men, of whom two at least should be experienced men, the others may be laborers, but more expeditious work can be done if they also have had some experience. The speed of erecting stope timbers depends on the location and the condition of the place where they are being put up, if far from the timber stores or near, and whether there is much rock in the way or not. Generally from 6 to 12 square sets of three pieces are put up by each crew in 8 hours.

Tools required by a crew consist of: 2 sharp axes, 2 older axes, 6-ft. crosscut saw, hooks, crowbars, hammers, picks, shovels, spirit level, straight edge, and a few drills, besides tools used about hoisting engine.

The framing carpenters on the surface require cant-hooks, 8-ft. crosscut saws, hand saws, adzes, axes, squares, templates, straight edges, plumb bobs, chalk lines, grindstone and whetstone. As a rule the underground tools are sent to the surface to be sharpened.

The regular timbermen get $3.50 for 8 hours shift, laborers $3.00; and the foreman who looks after all the crews gets $4.00. The framing carpenters get $4 00 per day, but work 10 hours per day.

Figures of the cost of mining have not been made public. Any attempt to figure the cost of timbering in a mine must be made from figures got during a period when the conditions have been very nearly the same; as this has not been the case here owing to changes in the labor and in the source from which the timber has been got the figures would be of little use.

The drawings of timber from which the accompanying photographs were taken were made by the writer from measurements and notes taken by him at the mine.

The paper refers to the state of affairs at these mines in June, 1901.

Mining in the Rossland District.

By C. M. Campbell, McGill University, Montreal.

This paper will deal chiefly with the mining practice in the Rossland district. The history of the district will be briefly sketched and its geology noted at some length. The larger part of the information herein contained I gathered last summer, in Rossland and the surrounding country, during the stay of the McGill Summer School in that district; and later, while engaged as pipeman's helper and as machine man in the Centre Star and Le Roi mines. In addition to this I have drawn on an article by Mr. Brinsmeade, B.S., M.E., in "Mines and Minerals" for March, 1901, for much additional information. For the geology of the district I am indebted to a geological excursion with the McGill party under Dr. Adams, to the Government reports, and also to the expert evidence of Mr. Clarence King in the Centre Star–Iron Mask law suit. The negatives from which the micro photos were taken were kindly loaned by Mr. O. E. Le Roy, B.A., of the McGill Geological Department. The remaining photos I took while in Rossland, and they represent the condition of affairs at that time. The Toronto "Globe" of Feb. 8th, 1896, is my authority for the historical sketch.

By the Rossland district is meant a piece of territory on both sides of Trail creek, about three miles wide and eight long. Trail Creek is an average sized mountain stream which flows into the Columbia River from the west, six miles north of the International Boundary. The creek was known to placer miners in the early sixties, as the celebrated Dewdney trail followed its course from mouth to source, but it is not known whether these early pioneers ever found evidences of the richness of the camp or not. In 1889 a French Canadian named Bordeau made the first location, some distance south of Red Mountain, and next summer two men, Moris and Bourgeois, staked out the Le Roi, War Eagle, Centre Star, Iron Mask, and Virginius claims. Every one of these claims has since been made a mine except Virginius, upon which little or no work has been done. Things went slowly until 1895, when there were only a few dozen log cabins in the camp. Then the boom struck the place, and the population went up to 2,500 in the course of a year. Since then the growth has been steady, and Rossland has now a population of over 7000. It is entirely a mining town, the people being completely dependent on the mines.

GEOLOGY. (SEE MAP.)

Many ore deposits, such as the famous Cripple Creek deposits, are situated on deeply eroded volcanoes. At Rossland we have another example of this. Here we have an igneous core, on the sides of which we find piles of ashes and lavas, all very much compacted.

The rocks of the igneous core are of different types. One, which forms the greater proportion of the mass, and is the country rock of most of the mines, is a dark, greenish or gray, tough, fine or coarse grained rock consisting of black augite crystals and light colored orthoclase and plagioclase feldspars, with usually a little biotite and often magnetite and pyrites. It is an augite diorite, and is the variety known as mongonite. Photo I shows a thin section of this rock magnified. The large crystal is augite, and the dark zone about the edge shows where it is altering to hornblende. The opaque inclusions are magnetite, while the crystal to the left of the augite one is biotite. At the Iron Horse is a darker series of rocks, similar to the above, but without the orthoclase. This rock is gabbro, and in this locality shows a somewhat banded structure, due to the dissolving out of the dark augite or hornblende constituents, and the deposition of silica in their place. This is shown in Photo V, the upper lighter portion of the photo being the silicified part, while the lower half consists of the original mineral. A still further type of rock is that known as augite syenite, and an exposure is to be found at the big cutting at the west end of Columbia Avenue.

Outside this igneous core is the zone of fragmental and volcanic rocks. The fragmental ash rock is a greyish, fine grained, quartzitic looking material, showing a stratified structure due to different depositions of ashes. These features are brought out in Photo II. The volcanic rocks are those known as augite and uralite porphyrites. The passage irom the porphyrites to the gabbros is nowhere sharply defined, and the two rocks have apparently originated from the same magma, but have cooled under different conditions. The gabbros and bordering porphyrites are important from an economic standpoint as most of the ore bodies at present being worked are situated either on or close to their line of junction. Photo III represents a specimen of augite porphyrite taken from this junction. It shows where the dark gray hornblende has been dissolved, and its place taken by the black opaque pyrrhotite. Photo IV shows another section of the same rock as it appears under polarized light. Several twinned augite and feldspar crystals are noticeable.

Beds of impure limestone on Sophie Mountain containing corals and ashes interstratified have been found, and indicate a carboniferous age for the volcano. The whole district is underlain by granites containing beds of limestone and known as the Shuswap series.

The mineral bearing veins are characteristic fissure veins and some of the larger are known as "shear zone" fissures. Instead of being an indefinite amount of parallel fissures extending into the country an undiscoverable distance it is always a zone of a discoverable and limited collection. The mineral deposit may lie on one plane, or they may eat up the rock between the planes and deposit another in its place, or they may occupy the whole zone, or mineralize one particular fissure and travel on that, and so on. The exterior boundary is assignable if you crosscut. These veins are of enormous extent in some places, such as 100 or 200 ft. in width in the shattered mineralized zone.

The ores consist principally of sulphides of various metals. Of these pyrrhotite is by far the most abundant. It is found as a rule in a massive condition, ranging in texture from a fine to medium grain, but is also disseminated through the country rock. The massive variety usually holds blebs of quartz and grains and irregular patches of other sulphides. The pyrrhotite contains gold and silver in varying quantities, a small percentage of nickel, and traces of cobalt. The gold contents are exceedingly irregular ranging from traces up to several ounces to the ton, and the silver from traces to four or five ounces to the ton.

The pyrrhotite is usually accompanied by a certain amount of copper pyrites, intimately commingled with it. The copper pyrites is extremely irregular in its distribution, in some places constituting a considerable portion of the ore body, and in others occurring only as isolated and occasional grains and patches. It is nowhere seen in large masses. It is auriferous, and holds apparently about the same percentage of gold as the enclosing pyrrhotite.

Molybdenite, galena, and blende also occur in some places in small quantities, while iron pyrite is met with in greater or less quantities nearly everywhere. The ores are usually oxidized on the surface, but the alteration seldom extends downward for more than a few feet.

DEVELOPMENT.

The mines have been developed by running inclines along the dip of the vein, and from these inclines driving horizontal drifts at 100 foot intervals along the strike and usually within the walls of the vein. These drifts are afterwards enlarged, sill floors put in, timbered, and the ore in this way worked out to the next higher level.

DIAMOND DRILLING.

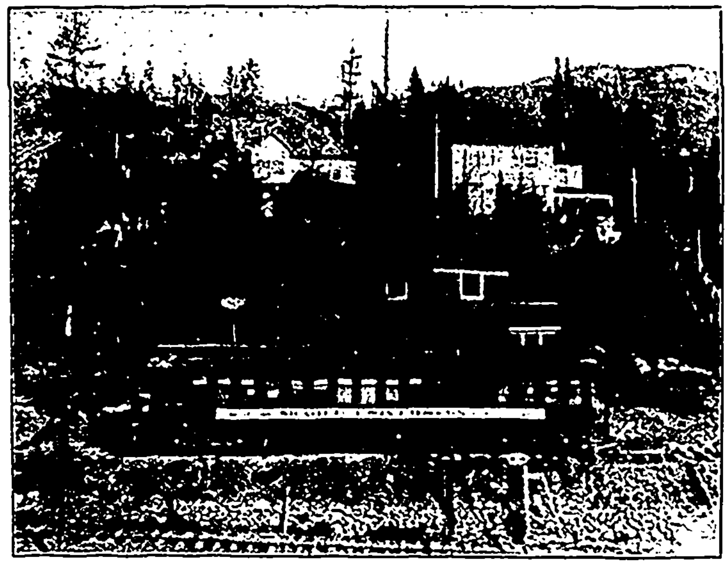
In the big mine diamond drill outfits are constantly kept at work exposing the deposit. Two sizes of drills are used, one with a bit of 2⅛ in. outside and 1⅜ in. inside diameter, and the other with 1½ in. outside and 15/16 in. inside diameter. In starting the drill, especially from those drifts in which tramming is being pursued, a short crosscut is first made by the percussion drills to give a space for the machine and the proper handling of the rods. The rods are square threaded at the ends and come in five foot lengths. They are pulled in lengths of 5 to 20 feet, according to the space available behind the drill.

The holes are cored throughout. The core barrel is 5 feet long, and the frequent slips and small seams in the country rock, permit the cores procured to be easily broken off by the usual choker device. The average length of the pieces of core is 5 to 8 inches. In careful sampling the core barrel is sometimes pulled out for every six inches advanced. The drilling engines are screw fed, and fitted for 300, 700, and 1000 revolutions per inch of advance. Their ordinary speed is 300 revolutions per minute. The water is pumped through the drill rod by a small independent pump run by compressed air. The average progress is 8 feet in an eight hour shift, with a record of 18 ft. 9 in. The core is broken up and assayed, after a careful examination by the mine superintendent. While drilling in ore, sludge samples are taken by running the discharged water for a fraction of the time into a tin pail, in which the sludge settles out.

The Rossland rock is very hard on diamonds. The War Eagle and Centre Star companies employ a skilled bit setter to keep the bits in running order. For the smaller sized bits eight diamonds are used, six on the face and two on the outside. Those on the face are set so that half of them have a cutting edge extending to the outside of the face, while the other half cut the inside clearance for the core to pass up. Whenever the drill is withdrawn from the hole the bit is always carefully examined, and if any of the diamonds are found to be loose

Le Roi. Gertrude. War Eagle. Centre Star.

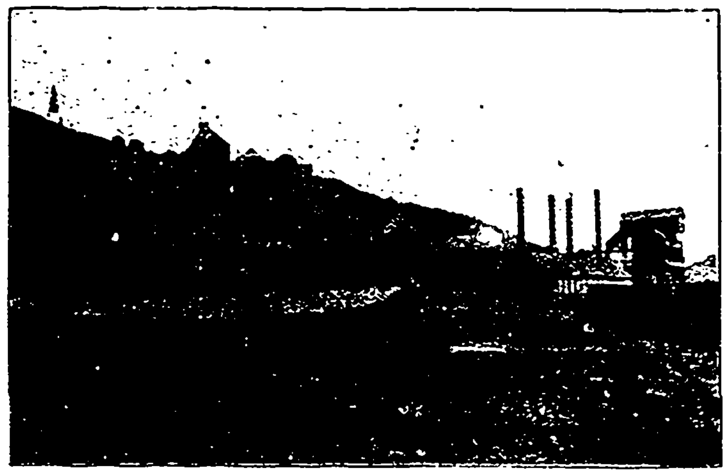
Rossland.



War Eagle Tram. Manager's Residence. Reservoir. W.E. and C.S. Offices

Offices War Eagle and Centre Star.

Rossland from O.K. Mountain.



Shaft House. Engine House. Air Compressors. Aerial Tramway. Black Bear Tunnel. Boiler House. Bins. Ore Cars.

Surface Plant Le Roi.

Le Roi Offices.

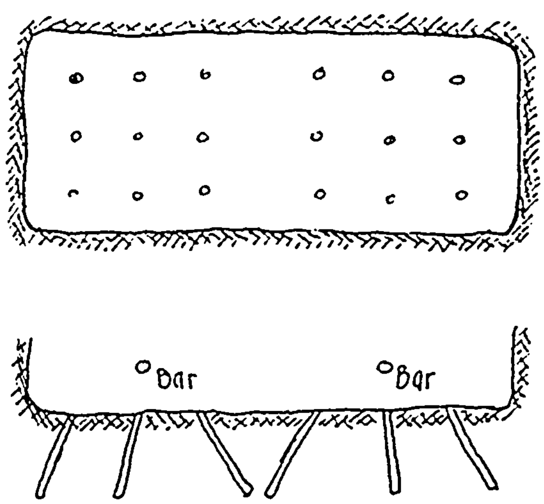
Le Roi Ore Bins.

or the metal worn away, the metal is recaulked around them. When the bit is so badly worn that the diamonds are greatly exposed, they are cut out and reset in a new metal blank.

The wear of carbons is somewhat less than 1/64 karat per foot of hole drilled. Each bit will only drill about 12 feet before resetting. To remove a bit that has been broken off in the hole, it is sometimes necessary, if other devices fail, to ream out the whole with a new bit, large enough to enclose the stuck bit and recover it in the core barrel.

SHAFT SINKING.

The Centre Star shaft is 18 ft. 4 in. x 7 ft., outside to outside of timbers, and is on an incline of nearly 70°. The accompanying figure shows the position of the drill holes for sinking. The whole round is drilled before any blasting is done, the machine drills being set up as shown by the location of the two bars. Four men work the two machines, and it usually takes two shifts to drill the round of 18 holes.



The machine men do their own loading and blasting, as it is impracticable to have a separate gang for blasting in the shaft as in the stopes and drifts.

In the Centre Star shaft the rock is hoisted, during sinking, by a bucket let down from a sheave in the ladder compartment by a small Ottumwa Ironworks Company's friction hoist in the station above. An iron bucket is used, 42 in. long and 36 in. greatest diameter. The bale is made of 1 in. round iron with a loop for the clamp hook. A couple of lugs of 1 in. round iron, spread out at the end into a square plate, are riveted to opposite sides of the bucket near the bottom. The bucket runs on skids about 20 in. to 24 in apart, on which strips of greased strap iron are nailed with the flat side tangent to the bucket at point of contact.

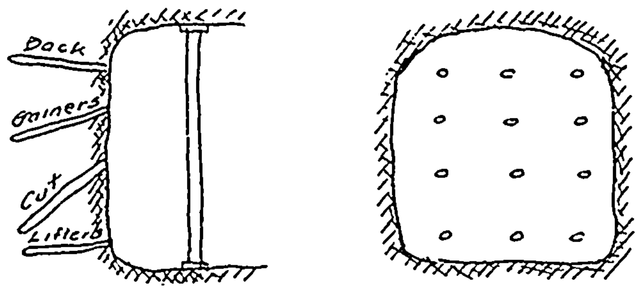
Near the point of dumping two outside skids are placed a little farther apart than the diameter of the bucket, and take the place of the other skids. These catch the lugs on the bucket and straighten it up. At the point of dumping two depressions are made in the skids and the bucl is only hoisted high enough for the lugs to catch in the depressions. The engine is reversed, lowering the top of the bucket, which falls backward and dumps. The bucket is then hoisted a foot or so above the depressions, and is lowered, the lugs catching on swinging irons which swing forward by the weight of the bucket, carrying the lugs over the depression. The bucket is then lowered to the bottom and refilled. The plan of the 600 level shows the position of the hoist and the shaft. The bucket is dumped backward into a car standing on the track behind the shaft. Two bucket loads fill the car, which is then wheeled around to the front of the shaft, and the contents dumped into a skip.

The old rock bulkhead method has been abandoned in favor of the timber bulkhead. By this method the timbering goes on contemporaneously with the sinking, sufficient space being left to keep the lowest set from being injured by the heavy blasts. This clearance is usually 20 to 23 feet.

The shaft sets are of sawed pine, framed on the surface, and are placed 5 ft. apart, being separated by posts. The way in which the different parts fit together is shown in the timber drawings. Hangers are employed to support the sets as the work progresses, the posts serving to keep the sets properly spaced, while the hangers keep the sets tight against the posts. They are not left on permanently, but are removed after several sets have been completed and properly wedged in position.

DRIFTING.

Where possible the drifts are driven along the hanging wall so as to have one free face to break from. The sketch shows the position of drill holes in drifting. The advance per round of holes is about 3½ feet. The powder used is 60% dynamite for primer cartridges and 50 for the balance of the explosive ; 40% is used if soft rock is struck.



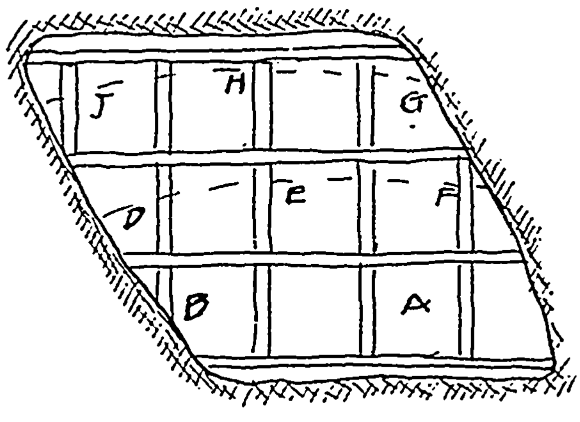
Ten and a half pounds of powder was the average consumption for one foot advance for a recent period. In Rossland the muckers and trammers receive $2 50 per day, and the machine men $3.50, when working by the day. It is, therefore, more economical to keep the machine men constantly drilling, and leave the loading and tramming to the muckers, and this arrangement is followed out.

RAISING.

The raises are put in at irregular intervals. In the Centre Star there are not half a dozen, all told. They usually have two compartments, one a man-way and the other a chute.

TIMBERING.

The square set method has been adopted, and is worked as shown in the sketch. The drift A having been driven, the breast stope A-B is then completed to the height of the curve D-E-F. Sills and then square sets, framed on the surface, are put in and floored over by four

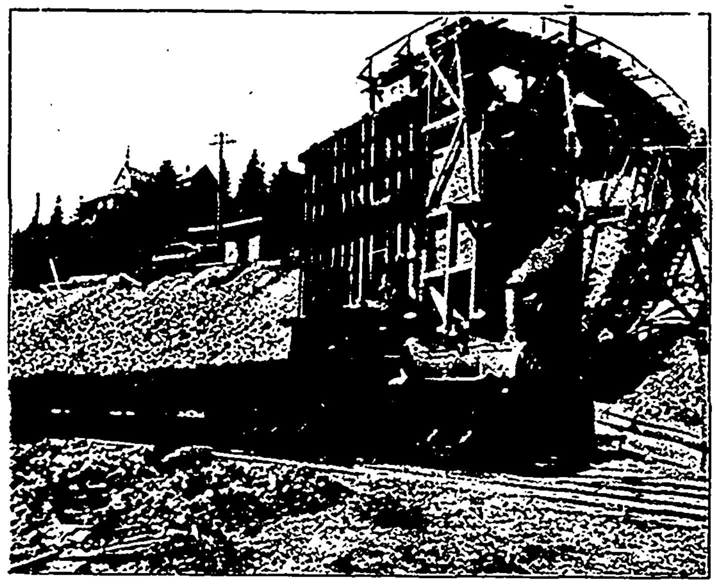


inch plank. This timbering is shown in detail in the drawing. The drill columns are then set up and stoping is pursued to the curve J.H.G. when the next floor of square set timbers are inserted. Enough space is always first excavated above last floor put in to give room for drilling. The broken rock is taken by wheelbarrows to chutes boxed in among the sets at 50 foot intervals along the foot wall. The method of timbering a tunnel is shown in the photo of the abandoned Mugwump mine.

War Eagle. Josie. Le Roi.
Looking East from Le Roi Flume.

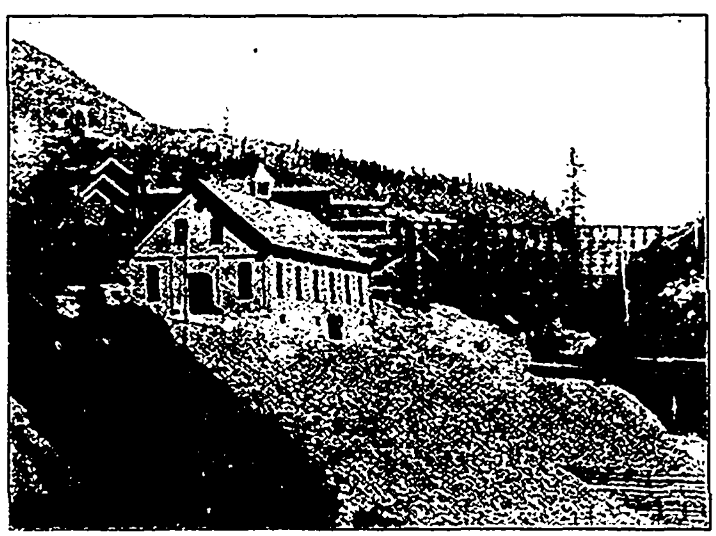
Old Surface Works Centre Star.

Roast Heap Trail Smelter.



Shay Locomotive at War Eagle Bins.

Lumber Yard. Bins. Carpenter Shop. Boiler House. Shaft House. W.E. Tram.
Surface Plant Centre Star.



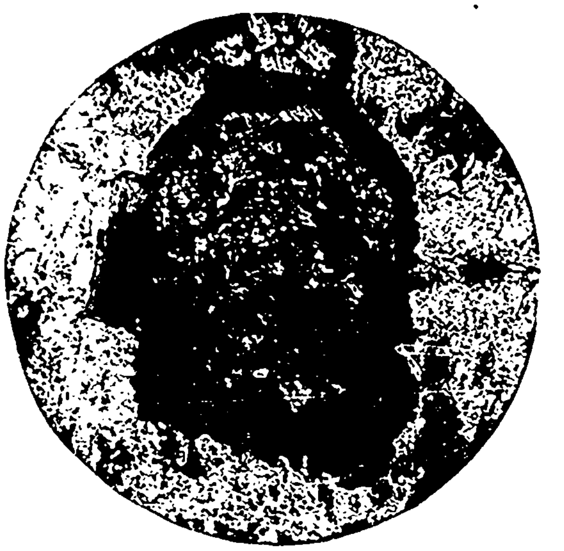
Shaft House. Air Compressor. Iron Mask Gulch.
Nickel Plate Mine.

BLASTING.

For cleaning out downward drill holes for loading, a straight blow-pipe made of one inch pipe is used. This pipe is connected to the air supply, and thus makes an efficient tool. Powder is kept in a powder house near at hand A thawing temperature is maintained by hot water pipes heated by a stove in an adjoining cabin. A powder man watches the powder-house and keeps account of the powder distribution In the mine workings above the lowest tunnel it is, in winter, nearly as cold as on the surface, and the powder, if left long before firing, would soon freeze again.

TRAMMING.

Three types of stations are in use (See drawings of shaft stations). One with a shaft bin, one with a chute which discharges the ore directly into the skip, and one where the cars are dumped directly into the skip. The wooden hopper used in this case usually prevents



Phenocryst of Augite in Monzonite from boulder near War Eagle Stairs.

the rock from falling outside the skip when dumping the car. A lessening of the number of cars required for tramming is one of the benefits gained by the installation of the station bins. This method is used altogether at the Le Roi and works very satisfactorily. Here the bins are much larger than those at the Centre Star, the one on the 700 level holding 350 tons of ore. The gates of these bins are worked by compressed air cylinders. By this method the skips can be loaded much faster and less dangerously.

The tracks are 15 lbs. per yard, and are spiked, in the drifts, to ties 2½ feet apart. Various types of switches, in and about the mine, are shown in the sketches.

The mine car in use in the chief mines is 2 ft. 11½ in. from track to top of body, and has a capacity of 16 cubic feet of rock. The turn-table on the truck allows it to be dumped in any direction.

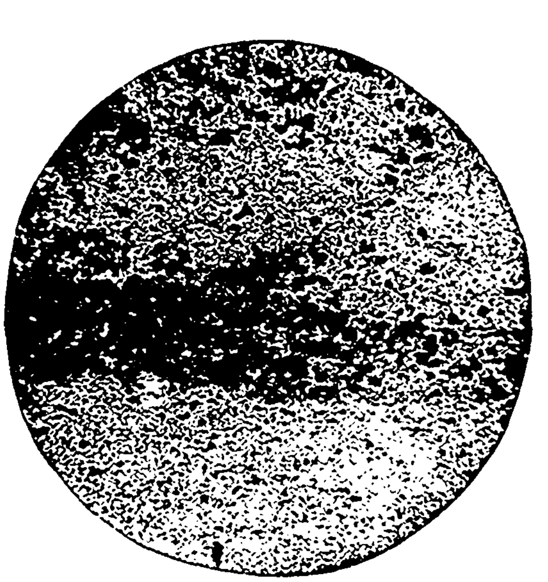
The axles are of the Anaconda type. In this type the axle is divided in the centre, mainly to allow for variation of travel in passing around curves, also to enable the wheels to be pressed separately on each half axle. This construction simplifies repairs, does away with nuts and caps on the outside, and necessitates oiling only once in three or four weeks.

HOISTING.

At the Centre Star shaft there is installed a steam hoist made by Webster Camp and Lane, of Akron, Ohio, with two drums, each 6 ft. x 3 ft., with a capacity of 1700 ft of rope of ⅞ in. diameter. The average winding speed is 800 ft. per minute, with a maximum of 1200 ft. All the motions are controlled by hand levers except the steam drum brake. This consists of a governor which is connected with the shaft. When the wheel goes too fast, the governor allows compressed air to enter a cylinder, which causes a brake to press on the wheel. When the speed passes 900 ft. per minute this mechanism comes into play The engines are 14 in. x 18 in. stroke, with a Stevenson reversing gear. A Lane friction clutch permits of either drum being run independently of the other, a necessary thing when there are several levels from which hoisting is done. The War Eagle has a duplicate of this engine in its main shaft. The round rope is prevented from cutting the foot wall shaft timbers by rollers on the wall plate at long intervals.

The skip used in the Centre Star and War Eagle Mines is detailed in the drawing, and is also shown in the photo of the Centre Star shaft at the surface. It runs on a 30 lb. per yard steel track spiked to the footwall plates in the shaft. The shaft guides are chiefly for safety purposes, for the skip dogs will grip them in case of accident to the rope. The guides also serve to keep the skip steady, as the skip body is only fastened to the frame on the rear axle. The weight of the skip is 2,400 lbs, and as it carries a load of 4,600 lbs. the total weight of the loaded skip, without the rope, is 7000 lbs. It is proposed to increase the hoisting capacity when it becomes necessary by attaching a cage under the skip. The skips in these mines are equipped with a Humber safety clutch, the working of which is seen on reference to the drawing. The clutch is designed to prevent accident due to overwinding of hoisting rope, which may occur from carelessness of the engineer or derangement of the engine. Without this hook the cage may be drawn up to the head sheave, causing the rope and possibly the sheave to break. Figure 1 of this drawing shows the hook closed at the top, as it would enter the stationery safety-stop when overwinding occurs. Figure 2 illustrates the action. Having, by overwinding the hoisting rope, come in contact with the safety stop, the spreading plates, one of which is shaded in the drawing, close at bottom, causing their upper portions to open like scissors, releasing the rope. At the same moment the plates spreading at the top, drop, and rest on the safety stop, thus suspending the cage until the runaway rope is again attached.

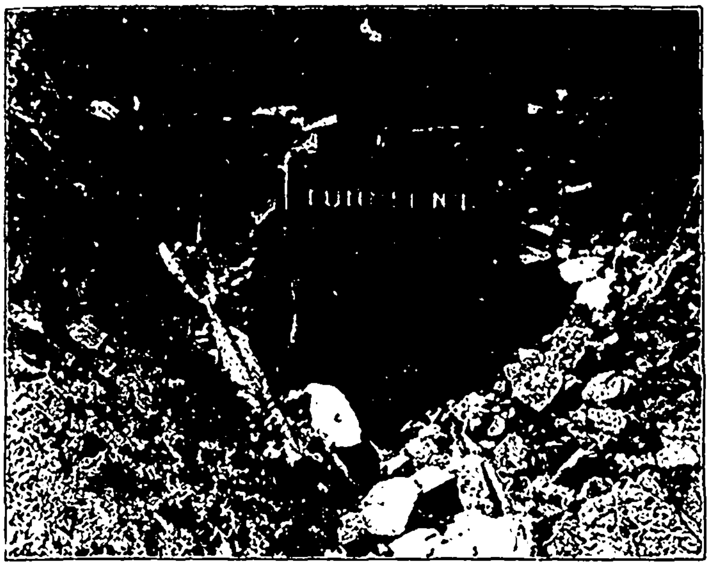
The War Eagle steam hoist replaced a 300-h.p. electric hoist run by the current brought from Bonnington Falls, 30 miles away. The



Ash Rock from California Mine.

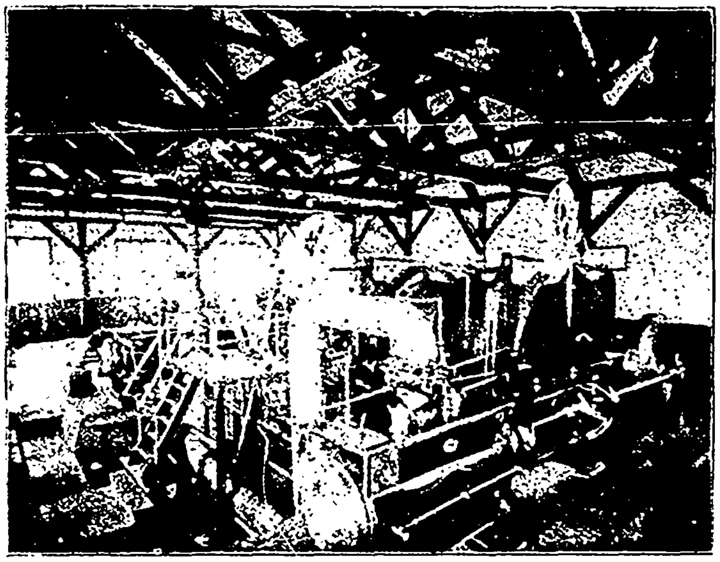
electric hoist was a failure, owing to bad design and faulty construction. A good example, however, to show that an electric hoist of correct construction will work acceptably, is the one recently installed at the Josie shaft, made by the Denver Engineering Co. It is a 150-h.p. machine, with an average consumption for counterbalanced hoisting of 60 h.p. It works at a potential of 250 volts with a three phase motor; and has two drums, each holding 1000 feet of rope.

In the Le Roi five compartment shaft two of the compartments are

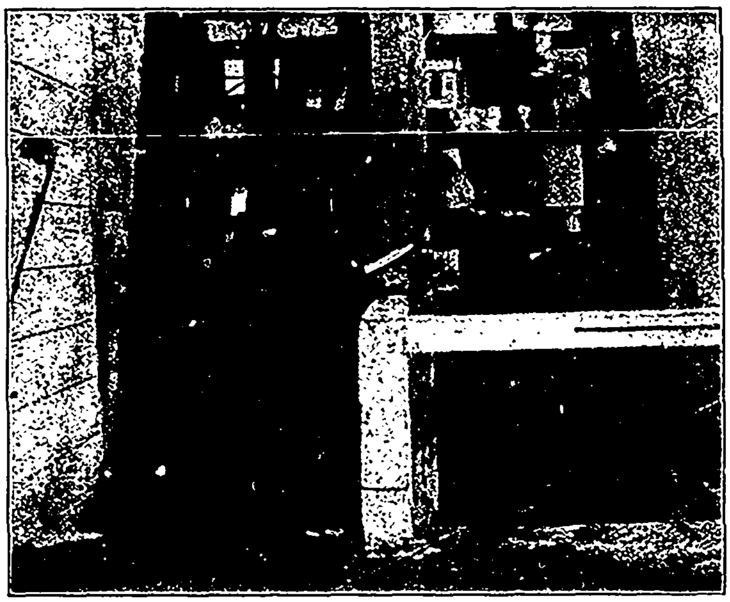


Mugwump Tunnel (abandoned).

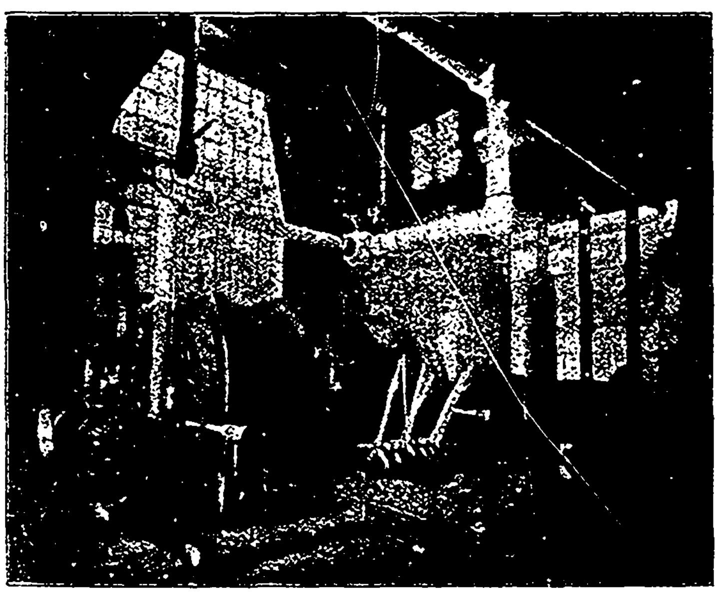
Shaft at Surface, Centre Star.



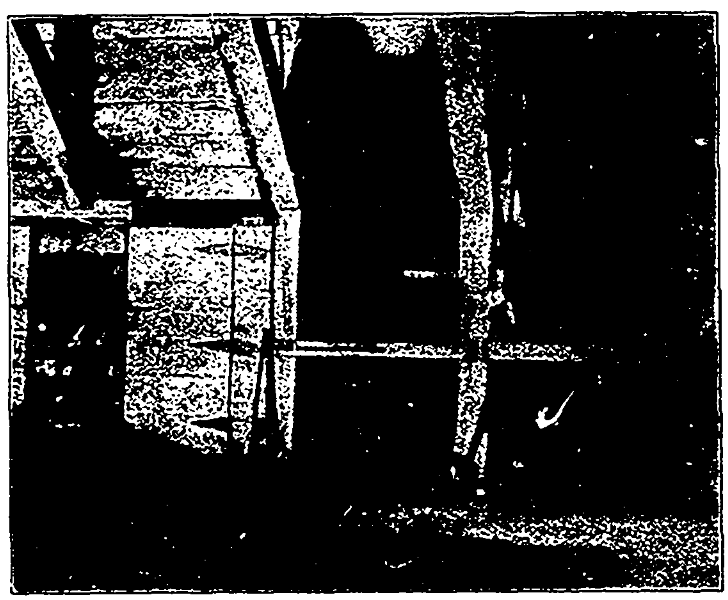
Hoisting Engines, Le Roi.



Shaft at Surface, Le Roi.



Hoisting Engine, Centre Star.



Shaft at Black Bear Tunnel, Le Roi.

used for hoisting ore. The skips in use are much the same as above described, but as men are not hoisted in them the bonnet has been omitted. Below the surface these two compartments are boarded in. Cages, with two decks, are used for hoisting the men, and these run in two other compartments, the fifth compartment being the ladder way. Before long, cages with three decks will be used. One of these is shown in a photo. It is lying outside the entrance to the Black Bear tunnel, prior to being mounted in shaft. Separate engines are used for the ore and man skips. The hoisting signals are a combination of pull rope and electric bell.

In most of the large mines there is a telephone connection at each level with the surface. This is found to be a very great convenience.

VENTILATION.

This is chiefly natural. In long drifts ventilation is produced by means of a Root blower. This is on the surface, is usually worked by a motor and blows a positive current down a main set in the ladder-way of the shaft. This main is round, of galvanized steel, and is riveted and soldered with telescopic joints. Branches of smaller piping are taken off at each level where necessary and led into the working faces.

PUMPING.

As yet the water encountered in most of the mines is insignificant. In the Centre Star the water which accumulates on the 200 level is run out of the tunnel on this level. The water of the 300 and 400 levels runs into the sump on the 500 level, and from there an overflow pipe takes it to the 600 level, from where it is pumped by a Cameron sinking pump to the 200 and from there runs out the tunnel.

BLACKSMITHING.

There is no hand drilling, except by the timbermen to cut hitches for placing stulls, or by the pipemen when a hole is needed in the

Augite Porphyrite from War Eagle, showing replacement of Hornblende by Pyrrhotite.

rock for a hanger to support pipes. The hardness of the rocks renders picks of little use. There remains little to be sharpened but machine bits, which are made by welding a star steel point to an octagon steel shank. Each machine drill uses from 20 to 30 bits in eight hours.

LIGHTING.

Tunnels and stations are lit with 16-candle-power lamps, furnished with horizontal tin reflectors painted white inside. At the working faces candles are used.

HEAD FRAMES.

At the War Eagle is a large structural steel headframe, very expensive, as it was imported from Eastern United States, necessitating heavy freightage and duty. Hence the new frames at the Centre Star and Le Roi are built of timber, the native woods being peculiarly adapted for this purpose. In the Centre Star the hoisting engine is set on the hang wall side of the inclined shaft; this simplifies the head frame, as the posts in the direction of the shaft act as back braces for the frame.

The Le Roi head frame is much larger than either the War Eagle or Centre Star. This is due to the fact that the Le Roi has a larger shaft, and that the building is used for other purposes. The ore from

Augite Porphyrite from War Eagle crossed Nicols.

the skip passes over a large grizzly to a large sized Comet crusher. From this it is discharged on an iron travelling picking belt. The useless rock is thrown into the chutes along the side of the belt, while the good ore goes to the bin beside the loading end of the tramway.

SURFACE TRAMS.

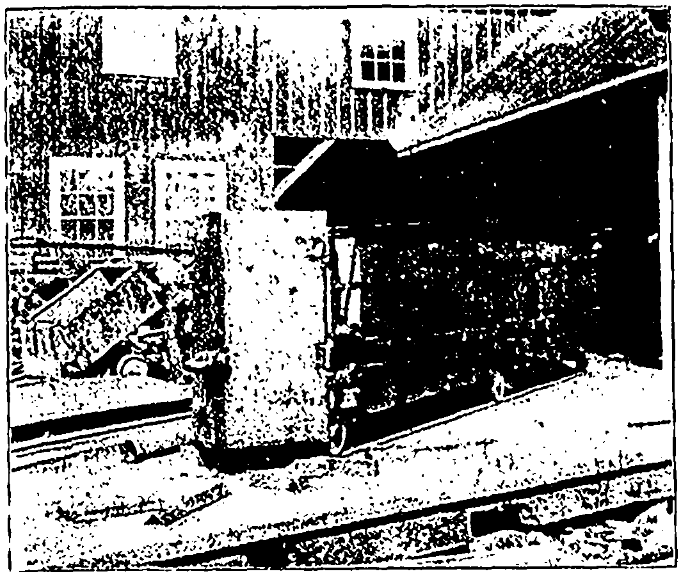
To transport the ore from the main shaft to the shipping bins at the railroad, the War Eagle employs a double track gravity tram. This tram is set for nearly its whole length on a trestle, not to save grading, but to escape the snowfall. The tram has a fall of 350 feet in a total length of 1300 feet, and in profile has a concave and convex curve. The rope is kept down on the concave side by a pulley in an overhead frame, and kept up on the convex curve by a sheave of 4 ft. diameter set between the tracks. The tram car holds five tons of ore, and is dumped automatically at the lower end of the tram. This end of the tramway is moveable, and can be so swung that the end is over the bin into which the ore should be dumped.

The tramway at the Le Roi is an aerial one, about 2000 feet long. One man only is employed at the loading end. At the other end the buckets drop their ore into the bins automatically. From the bins the ore runs into the cars below through iron chutes, the gates of which are worked by compressed air cylinders.

In the Centre Star the ore is trammed in the ordinary manner from the bins in the head frame to the bins along the railroad track, through a covered double tracked passage way a distance of 200 ft. This arrangement is temporary, as it is expected that a concentrator will be erected in the rear of the present head frame, when other loading arrangements will be made.

THE WAR EAGLE STEAM LINE.

Steam is transmitted through a six inch pipe from the boiler house of the Centre Star up the slope of the hill to the War Eagle shaft house. A section of the wood box enclosing the pipe is shown in a drawing. The pipe is set well above the bottom, to allow for drainage and packing. The packing used is dry coal ashes. When on the



Three Deck Cage, Le Roi.

Dry Room, Le Roi.

Picking Belt, Le Roi.

Dry Room, Centre Star.

Mt. Roberts. Le Roi Flume.

Carpenter Shop, Centre Star.

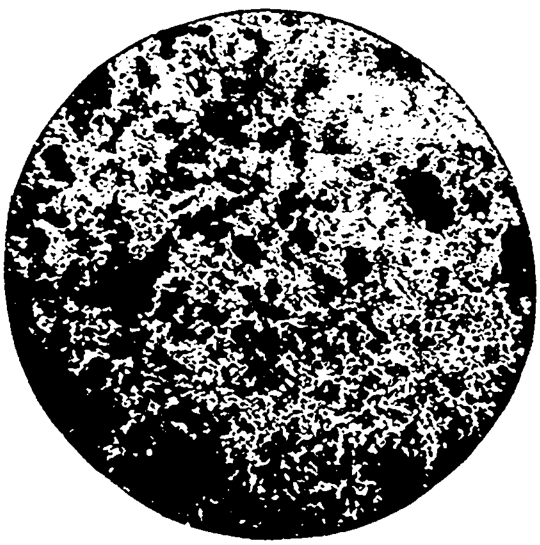
surface the box is naked; but for part of its length it lies underground, and is there enclosed in a wooden conduit large enough to permit the free entrance of a man. Considerable steam is no doubt wasted in this length of pipe, but it is certainly cheaper than the difficult transportation of coal to a separate boiler plant.

STEAM PIPES IN BLACK BEAR TUNNEL.

In this tunnel two pipes, 8 in. and 6 in. diameter, convey the steam 3000 ft. from the boiler-house to the Le Roi head works above. The temperature of the steam inside is 480°, but the insulation is so good that the outside is only warm. To bring this about several layers of packing were used—first, air cell asbestos covering, with air cells running lengthwise, then ½in. strips of wood set at right angles. This gives an air space of ½in. Then same type of covering as first, except that air cells run around the pipe, and finally, a thorough coat of lime whitewash to close the pores. As expansion and contraction amount to considerable in a pipe line like this, siphon joints are inserted every 200 feet. These are well packed, and will allow a lengthening of 14 in.. though only about one-third of that is ever used.

SURFACE PLANT.

A short description of the Centre Star surface plant might be introduced here. The chief difference between the one at the Centre



Altered Wall Rock from Iron Horse.

Star and the one at the Le Roi is that the latter is slightly larger, otherwise they are very similar. As for the War Eagle, most of the surface work required is done in the Centre Star shops.

CARPENTER SHOP.

To the east of the shaft house is the carpenter shop. This building is equipped with a 40 inch swinging cut-off saw, run by a 30 h.p. electric motor placed overhead on the turntable from which the saw hangs. It is arranged to turn by a pinion and gear, and to cut bevels of any angle so that timbers do not need to be moved. A speed of 1800 revolutions per minute is obtained by using the motor. Below the saw is a roller table which runs to a carriage. This takes the timber past four saws which cut a tenon on each end. This machine is driven off a counter shaft, and will cut up 100 sets of timber per day, the work of 50 carpenters by the old method. Square 10 in. x 10 in. timber is used. Some of it is obtained from Nelson, and some from a mill four miles distant. Wedges are cut from 4 in. plank by a solid-toothed buzz saw 24 in. diameter, running 1800 r.p m. This saw will cut 2200 wedges in 4½ hours. Formerly $25 per thousand was paid for them. Sixty horse-power is used for the shop. Adjoining is a lumber yard, where a well ordered supply of timber is kept on hand.

MACHINE SHOP.

This building is west of the shaft house, and is equipped with a large planer 29 ft. x 24 in., two large 14 ft. 28 in. lathes, and one of smaller dimensions, a Barnet drill and a radial drill with a 6 ft. arm. A travelling crane of 3 tons capacity commands the shop. The master mechanic's office with a drafting table, and the engine room, adjoin the shop. Partitioned off in another corner is the drill and air hose repair shop. This is also a supply room for drills, bars, and drill parts.

BOILER HOUSE.

Eight boilers are installed here. Four are of 80 h.p. each, and have separate smoke stacks. The remaining and somewhat larger boilers have a smokestack for each pair. Crow's Nest coal costing $5 per ton is used.

AIR COMPRESSORS.

One end of the boiler house is used for air compressors. Here five compressors of 7 drill capacity each are stored. They were in use before the large new compressor was bought, and are still used in emergencies.

The new compressor is a Rand compound condensing machine. It is a 200 h.p. 40-drill compressor, and can be run either with electricity or steam. At present it is run by steam. The air is compressed to 35 lbs. in the low pressure cylinder, passed through an intercooler, and then to the high pressure cylinder, where it is further compressed to 90 lbs. The water from the intercooler is passed over a cooling tower, which consists of a series of horizontal troughs (of wood and galvanized steel) that expose the water in thin sheets for partial evaporation in the atmosphere, by which the residue is cooled. This takes the water at 212° and cools it to 90°. Twenty-five gallons per minute are cooled, and the tower is used on account of the scarcity of water.

LE ROI WATER SUPPLY.

The Le Roi Company have a supply of their own. The east fork of Little Sheep Creek has been inverted near the Jumbo Mine by means of a dam and flume, and the water thus taken to the mine is used for the required purposes and then turned into Trail Creek at its head quarters on the Black Bear mineral claim.

DRY ROOMS.

Here the men change their clothes before going in, and when coming out of, the mine. In the Centre Star dry room the trough containing the washing water has a steam pipe running along the bottom. Apertures in this allow the steam to escape and warm the water.

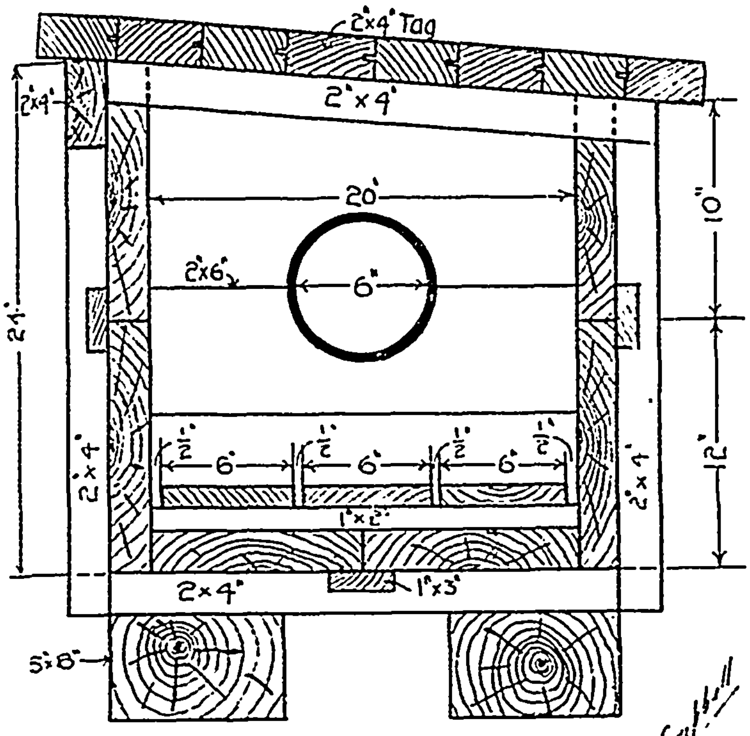
The Le Roi building is somewhat more pretentious. Hot water is supplied in large quantity, and each man can have a wash basin of of his own. The room has a cement floor, and a small stream of water runs along a trough in the floor, carrying off all impurities. Each pair of men can have an apartment to themselves.

BUILDINGS.

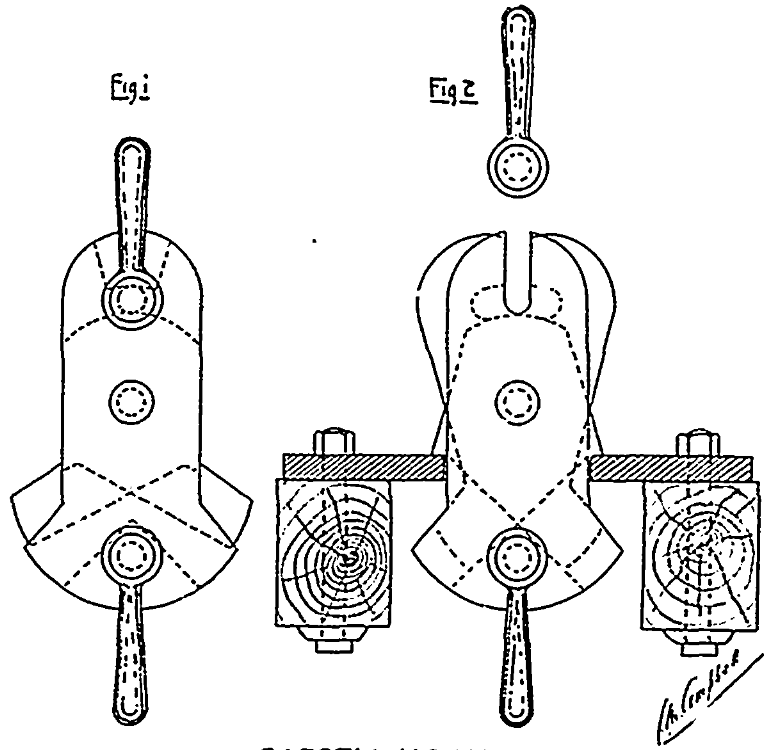
The head offices and other buildings of the mining companies are very tastefully built and are surrounded by well kept gronnds. This is rather the exception in mining camps, and deserves favorable comment.

WORKING COSTS.

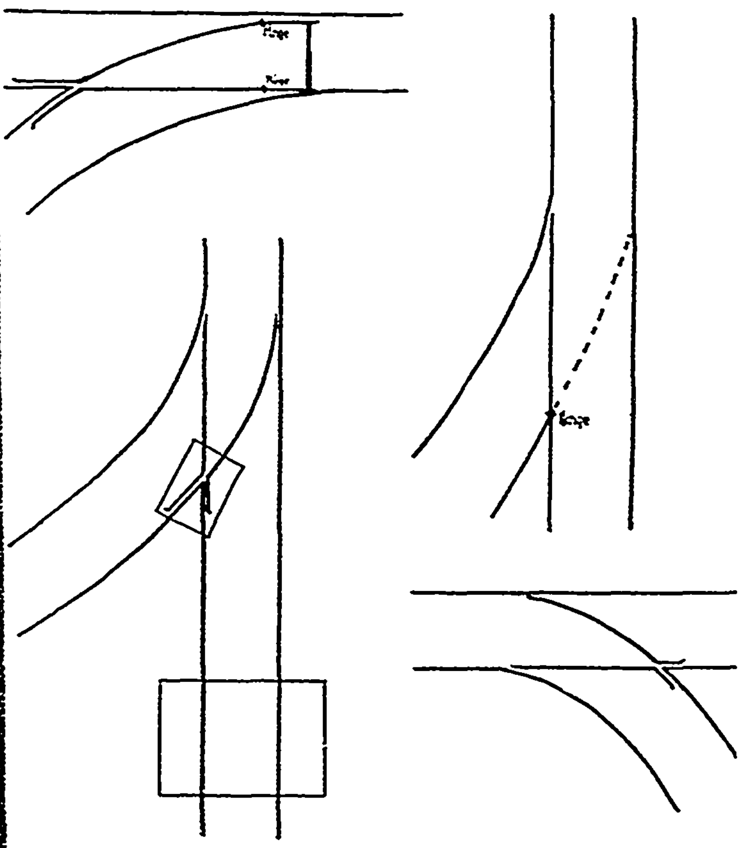
The War Eagle and Centre Star issue a detailed report annually to their shareholders. In this report are shown the general financial balance sheets, the condition of the mine as to ore reserves, and the itemized cost of each branch of work. From the report of 1899 we learn that during the year the total cost of mining per ton of ore stoped was $5.86. To this must be added the transportation charges



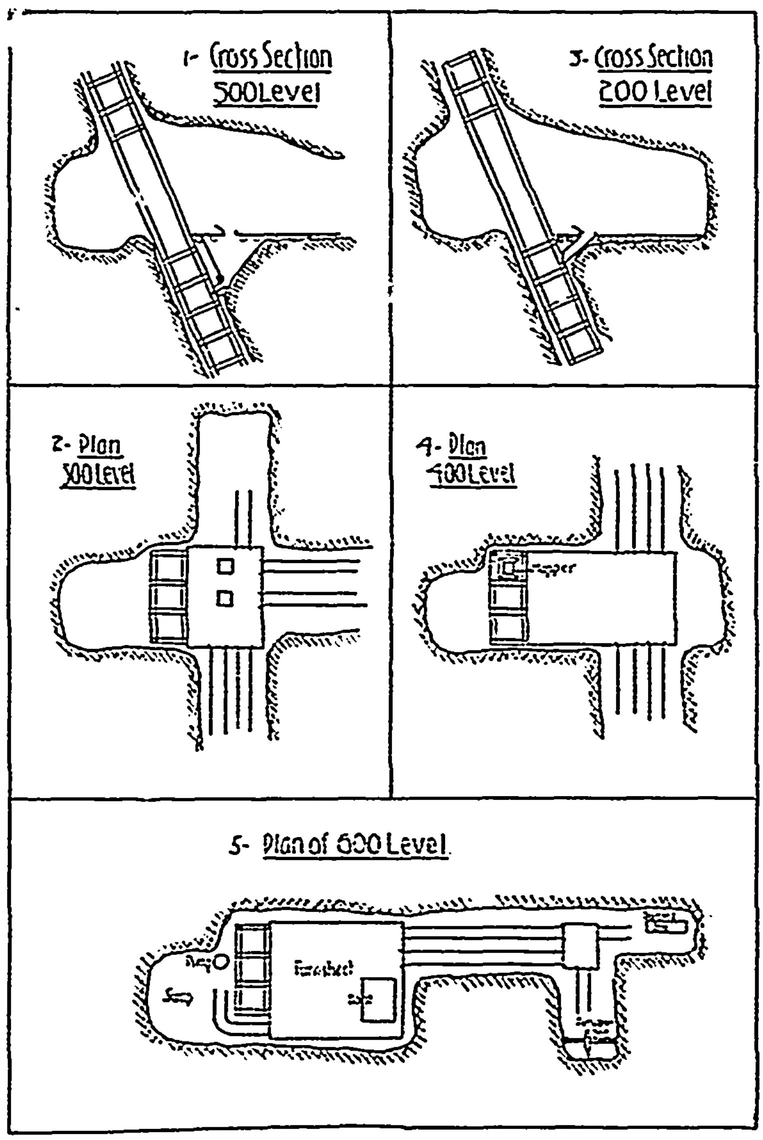
Cross Section of Wood Box enclosing Steam Pipe from Centre Star to War Eagle Mine



SAFETY HOOK



Mine Roads and Tracks



Stations in Centre Star Mine

to the different smelters and the cost of smelting, bringing the total cost up to nearly $11.00.

The Le Roi ore is smelted at their own smelter at Northport. The rest of the Rossland ore goes to Trail, where it is roasted before being treated in the furnaces. The grade to Trail is very steep, and a specially constructed and very powerful stay locomotive is used on the route.

OUPUT OF THE MINES.

For the six months ending June 30 the output has been as follows:

January–June,	1897	30,008 tons
"	1898	39,395 "
"	1899	66,576 "
"	1900	72,080 "
"	1901	204,500 "

The output for the first six months of 1901 was divided as follows:

Le Roi	104,298
Le Roi No. 2	20,270
Centre Star	51,918
War Eagle	19,050
Great Western	8,058
Iron Mask	2,233
I.X.L	189
Monte Cristo	20
Spitzee	80
Velvet	586
Evening Star	74

LABOR CONDITIONS.

Rossland is a union town, the local miners' union being a branch of the Western Federation of Miners. The scale of wages for the leading positions has been:

Shift boss	$5.00
Shaft men	$4.00
Machine men	$3.50
Timber men	$3.00 to $3.50
Shovellers and car men	$2.50
Carpenters	$3.50
Machinists	$4.00
Blacksmiths	$4.00
Blacksmiths' helpers	$3.00
Hoisting Engineers	$3.00 to $4.00
Powder and tool boys	$2.50
Surface laborers	$2.50

Machine men, however, usually work by contract, and are paid according to the total length of holes drilled. Contracts are verbal. Parties are fixed and contracts let at the beginning of each month. The men are provided with a box of tools and a two compartment box for dull and sharp steel. Better wages are usually made by this method, the average being from $4.00 to $4.25. In most cases it is more satisfactory to the employer.

NORTH STAR.

Director's Report for the Past Year.

The following is excerpted from the report of the directors for the year ended 31st May last and submitted to the shareholders at their meeting on 25th ultimo:—

"The directors regret that the extremely unsatisfactory conditions mentioned in the last annual report have continued. To this has to be added a strike of the miners caused by the company's endeavor to bring the wages to a more reasonable scale. This resulted in the closing down of the mine and shipments were discontinued from the 1st December till 10th May. During this time exploration work, with a view to the discovery of additional ore bodies, has been carried on, but the directors regret that the result while encouraging has not brought about the discovery of additional large ore bodies.

The company is still in a strong financial position and dividends have been paid during the year."

MANAGER'S REPORT.

"I beg to submit the following report upon the operations of the mine for the past year.

During the past year there has been driven 3,780 ft. of drifting, cross-cutting, sinking and raising, both in rock and gravel work. In the former the contact of porphyry and the country rock has been followed, since apparently the porphyry is genetically related to the ore. The gravel work is also necessary, since the ore deposits already found have occurred near the surface on the top of the country rock and imbedded in gravel and porphyry.

This year two small ore chutes have been found by following in one case the contact mentioned above and in the other case by cross-cutting in the gravel across the direction of strike and keeping on top of the country rock. No bonanza shoot of ore has been found, although there is every prospect of more being discovered. The ore occurring in well defined channels or routes, when found, is more difficult to locate when lost than would be imagined, but there are certain signs which if noticed carefully from day to day enable us to follow the ore channels even when there is no ore.

Owing to the fact of the area owned by this company being so large it is difficult to cover this quickly. This is best realized when it is known that only 13 per cent. of the strike distances have been developed or even prospected. I refer to the strike distances of the ore channels which to date are three in number. In view of this there are very great possibilities ahead of this property. I think the old channels can be relied upon to yield more ore and that others may be found.

The operation at the mine were interfered with for a period of about two months by a shut down caused by a strike of the miners.

During the year, 5,918 tons of ore have been shipped, the average assay value of which has been 25.4 ozs. of silver and 54.1 per cent. of lead.

At present there is a force of 70 men employed in development, prospecting and stoping

After careful consideration, not of the moment, but of days, and after the experience of this property during the time I have been here, first as superintendent and now as manager, I consider the future prospects of this property as not being unfavorable."

FINANCIAL STATEMENT FOR TWELVE MONTHS ENDING 31ST MAY, 1902.

Assets.

Mines, Mineral Claims and Assets		$1,129,644 89
Permanent Equipment		64,751 43
Office Furniture		870 47
Mine Supplies and Stores on hand, as per inventory		6,798 98
Accounts Receivable		3,139 27
Ore in transit	$ 1,711 11	
Cash on hand and in Banks	180,666 44	
		182,377 55
		$1,387,582 59

Liabilities.

Capital Stock	$1,500,000 00	
Less in Treasury	200,000 00	
		$1,300,000 00
Accounts payable		85 04
Dividend No. 9. Payable 16th June		19,500 00
Profit and Loss		67,997 55
		$1,387,582 59

WORKING ACCOUNT.

Dr.

To Cost of Mining, Development and Prospecting	$ 54,766 04	
" Freight and Treatment	101,336 17	
" Ore Tax	1,052 71	
" Maintenance	1,659 80	
" Depreciation on Ore Sacks	800 00	
" General Expenses	2,054 35	
" Montreal Office Expenses	1,245 86	
" Directors' Fees	2,000 00	
		$164,914 93
" Balance transferred to Profit and Loss		8,701 04
		$173,615 97

Cr.

By Proceeds of Ore Sales	$164,838 72
" Miscellaneous Receipts	8,777 25
	$173,615 97

PROFIT AND LOSS.

Dr.

To Dividends 6 to 9 inclusive	$97,500 00
" Balance	67,997 55
	$165,497 55

Cr.

By Balance at Credit of Profit and Loss	$156,796 51
" " from Working Account	8,701 04
	$165,497 55

DOMINION IRON AND STEEL.

The following is the Directors' report, submitted to the shareholders on the 17th instant:

During the past year the company has steadily pressed forward with its construction work, and your directors have to report that, with the exception of the rail mill, the entire plant is now almost completed. As might be expected, the output during the time when the plant was still under construction did not realise working expenses, but your directors anticipate that the expenses will now show reduction each succeeding month, and as soon as the changes on the blast furnaces and other operations mentioned below have been carried out, the company will be able to show satisfactory commercial results.

The principal difficulty to be overcome, in the commencement of an enterprise such as the present is to be able to so contrive from the first that the different parts of the plant will work together harmoniously with the least possible waste of energy and expense, and it is clear that the larger the property is the more difficult it will be to achieve this satisfactorily. Your directors consider that they have no reason to be discouraged by the course of events in the history of your property. The mistake which has proved the one most detrimental was that of not keeping the washing plant well ahead of the blast furnaces. It was originally calculated that it would be necessary to wash only one-third of the coal required for use in these furnaces, but experience has demonstrated that in order to ensure first-class results, it is necessary that the entire supply should be washed. Since, therefore the washing plant has now been enlarged, this handicap on the production of the blast furnaces is removed.

As regards the quality of the product, your Directors think that the company has every reason to congratulate itself. The steel manufactured by the company is of the first quality and has everywhere given satisfaction.

During the past year Mr. A. J. Moxham resigned the position of general manager, and Mr David Baker, superintendent of the works, has been appointed general manager.

The following is a brief description of the property and plant of the company:—

The principal supply of ore is from the company's mine at Bell Island, Newfoundland, about 400 miles from Sydney, where there is an immense deposit of red hematite. This mine has been equipped with modern machinery and shipping piers, capable of handling about 5,000 tons of ore per day. In addition to this mine the company has acquired, for the purpose of obtaining the necessary furnace mixtures, several mining leases in the Province of Nova Scotia, and, for the purpose of making sulphuric acid, a pyrites mine on the coast of Labrador. Some of these properties are now being developed. The company owns a property of remarkably pure marble, from which a very large supply of limestone can be procured. This quarry is situated on the Bras d'Or Lakes, about 60 miles by water from Sydney. There is also a dolomite quarry at George's river, 14 miles by rail from Sydney, from which open hearth furnace lining is obtained, and which was used in the blast furnaces while the Marble Mountain quarry was being developed.

The Marble Mountain quarry is equipped with crushing machinery, and with storage bins and shipping facilities, capable of handling 600 tons per hour. The George's river quarry is also equipped with crushers and shipping appliances of a capacity of 1,200 tons per day.

For receiving the ore and limestone and shipping the product, two piers have been constructed in a most substantial manner; the one, a large pier equipped with five heavy steam unloading machines, rope haulage, and all appliances necessary for the most economical handling of the material; the other, a low level pier, also equipped with four machines, arranged both for unloading ore and loading finished material. From the docks the material is transported in special railway cars about a quarter of a mile to the stock yards, where it is distributed by standard electrically operated ore bridges. The coke for the blast furnace is also brought on railway cars to the bridges from the coke ovens, which are situated about a mile distant.

The coke ovens consist of eight batteries of Otto-Hoffmann by-product ovens, there being 50 ovens in each battery, or 400 in all. The plant, which has been running for some time, has a capacity of 1,200 tons per day, but with the compressing machinery now being installed, it is expected that this will be increased about 10 per cent., and that the quality of the product will be improved, allowing a larger yield from the blast furnaces. The present production of coke averages about 1,000 tons per day. The coke ovens are well equipped with machinery for economically handling material, and are so arranged that the gases usually wasted are collected for heating the open hearth furnaces, and the tar and ammonia saved for sale as by-products.

Before being sent to the ovens, the coal is thoroughly washed, to reduce the ash and sulphur. The washing plant was at first planned to wash only a portion of the coal, but the results were found unsatisfactory, as referred to above, and it has recently been increased to provide for washing all the coal, and is now giving very satisfactory results.

The blast furnaces are four in number, of a capacity of 1,000 tons per day. Since the completion of the washing plant, Nos. 2 and 4 are giving perfect satisfaction. No. 3 will be blown in again on July 10th, after being re-lined, and No. 1 will be blown in shortly after. There is no doubt as to their working satisfactorily. The waste gases from the blast furnaces are used for firing the boilers, supplying steam for the blowing engines, electric plant, and pier unloading machinery.

Open hearth plant: There are ten 50-ton open hearth steel furnaces, of the tilting type. The first heat of steel was made December 30, 1901, and the furnaces have been put in operation as fast as they could be lined up. The fifth furnace was started on the 26th May; the sixth will probably be ready about the 23rd June, and the remaining furnaces at intervals of three and four weeks. The output of steel for the week ending May 31 was 1,800 tons, when four furnaces were in operation, giving a daily average of 75 tons per furnace, but considerable increase of the output per furnace is expected as the organization is perfected.

The open hearth furnaces are contained in a building 102 feet wide by 832 feet long, of steel construction, with the wall spaces filled in with brick. It is equipped with two 75-ton ladle cranes, two Wellman-Seaver charging machines, and has adjacent to it a calcining plant, a ladle repair shop, and gas producers for heating those furnaces not supplied from the coke ovens.

The blooming mill building is 82 feet by 480 feet, of steel and brick construction, similar to the open hearth building. It contains 16 soaking pits, 35 ft. roll train, with latest type of tables; hydraulic and steam shears, steel cranes, billet conveyors, etc. The rolling mill was started in February, and has rolled up to the first of June about 14,000 tons, principally in the shape of billets and slabs.

When the company was first organized it was intended to produce nothing but blooms and billets, but the directors subsequently decided that it would be an advantage to get more capital and provide a modern plant, capable, if necessary, of rolling all the product of the open hearth into finished rail sections. The steel frame work for the rail mill, hot bed building, and finishing mill building, is now all erected, and some of the foundations for the machinery are in place. The engines are contracted for, to be delivered August 9th, and much of the machinery is well under way in the company's own shops. Were it necessary, the rail mill could probably be completed in October or November, but in the present condition of the markets it is considered advisable to perfect the organization of the other departments before pushing the rail mill to completion.

The rail mill building is 530 ft. x 65 ft., with engine houses alongside; the hot bed building, 90 ft. x 135 ft., and the finishing mill building, 90 ft. x 525 feet. They are all of heavy steel construction; to be covered on the sides with expanded metal and cement, and to have corrugated iron roofs. All of the equipment will be of the latest type to handle the product in the most economical manner.

In addition to the steel making plant proper, the company has a foundry, 92 ft. x 192 ft., equipped with two electric travelling cranes, and cupolas for making iron and brass castings. A machine shop, 92 ft. x 256 ft., which has a full equipment of machine tools capable of handling all the repair work, and in which a large part of the new rail mill is now being constructed. There are also a large wood-working shop, tin shop, and pipe shop, all well organized and equipped to make repairs or construct anything required about the plant.

There is an electric power station, equipped with three 300 k.w. generators, to supply current for lighting, electric cranes, and other electrically driven machinery about the plant. It is built in a most substantial manner, with a steel frame, brick walls, and tiled roof. All machinery in it is the best procurable.

The docks and various departments are connected by a complete system of broad gauge tracks, about 15½ miles in all, and the steel departments have in addition a system of narrow guage tracks covering 2½ miles.

The rolling stock comprises 81 flat cars, 59 gondolas, 90 hoppers, two 80-ton locomotives, three 50-ton locomotives, two 45-ton locomotives, and one 55-ton locomotive, all of standard gauge, and a full equipment of narrow gauge locomotives and cars, consisting of five locomotives, 54 ingot cars, 38 billet cars, and 40 charging boxes.

The company controls an unlimited fresh water supply from Sydney River, about five miles distant, to which connection has been made by a 24 in. main, and where a pumping station has been erected, with pumps of about 6,000,000 gallons daily capacity.

The company owns about 500 acres of land, deeded to it by the Corporation of Sydney, for the purposes of its works and possible additions to the plant, and has also acquired other real estate, affording ample space for workmen's houses; a number of these have been erected, suitable for the company's employes.

Respectfully submitted,

ROBERT MACKAY,
Acting President.

DOMINION IRON & STEEL COMPANY, LIMITED.

Balance Sheet as of April 30th, 1902.

ASSETS.

Propert Account	$29,419,534 62	
Cash	97,983 20	
Accounts Receivable	591,198 43	
Product on hand	590,793 62	
Raw Material on hand	600,983 65	
Warehouse Material on hand	296,894 53	
		$31,597,388 05

LIABILITIES.

Bonds	$8,000,000 00	
Common Stock	15,000,000 00	
Preferred Stock	5,000,000 00	
Notes Payable	2,589,550 54	
Accounts Payable	955,396 14	
Reserve for replacement	52,441 37	
		$31,597,388 05

N.B.—Since the close of this report 50,000 shares common stock have been underwritten at $60.00 per share. This will bring the sum of $3,000,000 (less commission) into the treasury by July 11th, and will be used for reducing the debt and further improving the property.

R.M.

Rossland Great Western.—The company's manager at Rossland cables. —"Downward continuance of high-grade ore shoot below the 300 feet level has been disordered by dyke and faults."

NEW COMPANIES.

BRITISH COLUMBIA.

Diamond Vale Coal and Iron Mines, Ltd.—Incorporated 12th May, 1902. Authorized Capital, $1,000,000, in shares of $1.00 each.

Brydges, Blakemore & Cameron, Ltd.—Incorporated June 9th, 1902. Authorized Capital, $50,000, in shares of $1.00 each.

Commodore Mines, Ltd —Incorporated 20th June, 1902 Authorized Capital, $750,000, divided into 75,000 shares of $10 00 each.

Juno Mines, Ltd Re incorporated 27th June, 1902. Authorized Capital, $625,000, divided into 2,500,000 shares of 25 cts. each.

International Gold Mining and Development Co., Ltd.—Incorporated 3rd July, 1902. Authorized Capital, $1,000,000, in shares of $1.00 each.

NEW BRUNSWICK.

British Columbia Mica Co., Ltd.—Authorized Capital, $1,000,000, in shares of $100 00 each. Head office: Lewisville, New Brunswick.

ONTARIO.

The Flint Lake Gold Company, Ltd.—Incorporated 25th June. 1902. Authorized Capital, $100,000.

The Mariposa Mining Co., Ltd.—Incorporated July 16th, 1902. Authorized Capital, $3 000,000, in 600,000 shares of $5.00 each. Head office: Sault Ste. Marie, Ont.

The Phœnix Gold Mining Co., Ltd.—Incorporated 13th June. 1902. Authorized Capital, $1,000,000, in shares of $1.00. Head Office. Fort Erie, Ont.

The Du wich Gas and Oil Co., Ltd.—Incorporated 25th June, 1902. Authorized Capital, $100,000. divided into 400,000 shares of 25 cents each. Head office: St. Thomas, Ont.

The Clover Leaf Mining Co, Ltd.—Incorporated 20th June, 1902. Authorized Capital, $1,000,000, in shares of $1.00 each. Head office: Toronto, Ont.

The Copper Queen Mining Co., Ltd.—Incorporated 27th May, 1902. Authorized Capital, $3,000,000, divided into 300,000 shares of $10.00 each. Heod office: Sault Ste. Marie, Ont.

Oil Exploration of Canada, Ltd.—Incorporated 27th May, 1902. Authorized Capital, $200,000, in shares of $100.00 each. Head office: Walkerville, Ont.

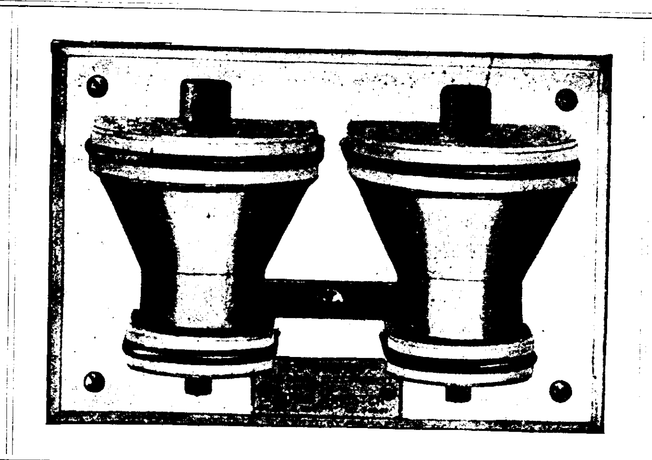
Union Petroleum Co. of Canada, Ltd.—Incorporated 31st May, 1902. Authorized Capital, $25,000, in shares of $100.00 each Head office: Toronto, Ont.

The Syndicate No. 1, Ltd.—Incorporated 27th May, 1902. Authorized Capital, $5,000 Head office: Rat Portage, Ont

Protogene Gold Mines Company, Ltd —Incorporated 31st May, 1902 Authorized Capital, $1,500,000; shares $1.00 each. Head office: Windsor, Ont

Giant Gold Company, Ltd —Incorporated 31st May, 1902. Authorized Capital, $700,000, in shares of $1.00 each. Head office, Gold Rock, Ont.

Monitor and Ajax Fraction Ltd.—The following cablegram was received from the manager, dated Three Forks, 11th inst. :—"Struck important body of ore three feet wide, level No. 5. The ledge is believed to run for a distance of about 5,000 feet through our properties; it has already been proved in levels 3 and 4 to a distance of about 1,200 feet, starting from the point at which the No. 5 cross-cut tunnel has struck it. The vast importance of this strike needs no comment, as between those who know the ground and understand this class of mining The big strike in No. 5 seems allowing for the dip of the ledge to be under a very important 'chute, which was driven through in No 4, where the pay streak was found to be from 18 inches to 2 feet wide Present appearances indicate that this chute extends the entire distance between the two levels, viz : 217 feet."



DOMINION OF CANADA

SYNOPSIS OF REGULATIONS

For Disposal of Minerals on Dominion Lands in Manitoba, the North-West Territories, and the Yukon Territory.

COAL.

Coal lands may be purchased at $10.00 per acre for soft coal, and $20.00 for anthracite. Not more than 320 acres can be acquired by one individual or company. Royalty at such rate as may from time to time be specified by Order in Council shall be collected on the gross output.

QUARTZ.

Persons of eighteen years and over and joint stock companies holding Free Miner's Certificates may obtain entry for a mining location.

A Free Miner's Certificate is granted for one or more years, not exceeding five, upon payment in advance of $10.00 per annum for an individual, and from $50.00 to $100.00 per annum for a company, according to capital.

A Free Miner having discovered mineral in place may locate a claim 1500 x 1500 feet by marking out the same with two legal posts, bearing location notices, one at each end on the line of the lode or vein.

The claim shall be recorded within fifteen days if located within ten miles of a Mining Recorder's Office, one additional day allowed for every additional ten miles or fraction. The fee for recording a claim is $5.00.

At least $100.00 must be expended on the claim each year or paid to the Mining Recorder in lieu thereof. When $500.00 has been expended or paid the locator may, upon having a survey made and upon complying with other requirements, purchase the land at $1.00 an acre.

Permission may be granted by the Minister of the Interior to locate claims containing iron and mica, also copper in the Yukon Territory, of an area not exceeding 160 acres.

The patent for a mining location shall provide for the payment of royalty on the sales not exceeding five per cent.

PLACER MINING, MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

Placer mining claims generally are 100 feet square; entry fee $5.00 renewable yearly. On the North Saskatchewan River claims are either bar or bench, the former being 100 feet long and extending between high and low water mark. The latter includes bar diggings but extends back to the base of the hill or bank, but not exceeding 1,000 feet. Where steam power is used, claims 200 feet wide may be obtained.

DREDGING IN THE RIVERS OF MANITOBA AND THE N.W.T., EXCEPTING THE YUKON TERRITORY.

A Free Miner may obtain only two leases of five miles each for a term of twenty years, renewable in the discretion of the Minister of the Interior.

The lessee's right is confined to the submerged bed or bars of the river below low water mark, and subject to the rights of all persons who have, or who may receive entries for bar diggings or bench claims, except on the Saskatchewan River, where the lessee may dredge to high water mark on each alternate leasehold.

The lessee shall have a dredge in operation within one season from the date of the lease for each five miles, but where a person or company has obtained more than one lease one dredge for each fifteen miles or fraction is sufficient. Rental $10.00 per annum for each mile of river leased. Royalty at the rate of two and a half per cent., collected on the output after it exceeds $10,000.00.

DREDGING IN THE YUKON TERRITORY.

Six leases of five miles each may be granted to a free miner for a term of twenty years, also renewable.

The lessee's right is confined to the submerged bed in the river below low water mark, that boundary to be fixed by its position on the 1st day of August in the year of the date of the lease.

The lessee shall have one dredge in operation within two years from the date of the lease, and one dredge for each five miles within six years from such date. Rental, $100.00 per mile for first year, and $10.00 per mile for each subsequent year. Royalty ten per cent. on the output in excess of $15,000.00.

PLACER MINING IN THE YUKON TERRITORY.

Creek, Gulch, River and Hill Claims shall not exceed 250 feet in length, measured on the base line or general direction of the creek or gulch, the width being from 1,000 to 2,000 feet. All other Placer Claims shall be 250 feet square.

Claims are marked by two legal posts, one at each end bearing notices. Entry must be obtained within ten days if the claim is within ten miles of Mining Recorder's office. One extra day allowed for each additional ten miles or fraction.

The person or company staking a claim, and each person in his or its employment, except house servants, must hold a Free Miner's Certificate.

The discoverer of a new mine is entitled to a claim 1,000 feet in length, and if the party consists of two, 1,500 feet altogether, on the output of which no royalty shall be charged, the rest of the party ordinary claims only.

Entry fee $15.00. Royalty at the rate of five per cent charged on the gross output of the claim, with the exception of an annual exemption of $5,000.00.

No Free Miner shall receive a grant of more than one mining claim on each separate river, creek or gulch, but the same miner may hold any number of claims by purchase, and Free Miners, not exceeding ten in number, may work their claims in partnership, by filing notice and paying fee of $2.00. A claim may be abandoned and another obtained on the same creek, gulch or river, by giving notice and paying a fee.

Work must be done on a claim each year to the value of at least $200.00, or in lieu of work payment may be made to the Mining Recorder each year for the first three years of $200.00 and after that $400.00 for each year.

A certificate that work has been done or fee paid must be obtained each year; if not, the claim shall be deemed to be abandoned, and open to occupation and entry by a Free Miner.

The boundaries of a claim may be defined absolutely by having a survey made, and publishing notices in the *Yukon Official Gazette.*

HYDRAULIC MINING, YUKON TERRITORY.

Locations suitable for hydraulic mining, having a frontage of from one to five miles, and a depth of one mile or more, may be leased for twenty years, provided the ground has been prospected by the applicant or his agent; is found to be unsuitable for placer mining; and does not include within its boundaries any mining claims already granted. A rental of $150.00 for each mile of frontage, and a royalty of five per cent. on the gross output, less an annual exemption of $25,000.00 are charged. Operations must be commenced within one year from the date of the lease, and not less than $5,000 must be expended annually. The lease excludes all base metals, quartz and coal, and provides for the withdrawal of unoperated land for agricultural or building purposes.

PETROLEUM.

All unappropriated Dominion Lands shall, after the first of July, 1901, be open to prospecting for petroleum. Should the prospector discover oil in paying quantities he may acquire 640 acres of available land, including and surrounding his discovery at the rate of $1.00 an acre, subject to royalty at such rate as may be specified by Order in Council.

JAMES A. SMART,

Deputy of the Minister of the Interior.

OTTAWA, 9th Dec., 1901.