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The CANADIAN MINING REVIEW

Established 1882

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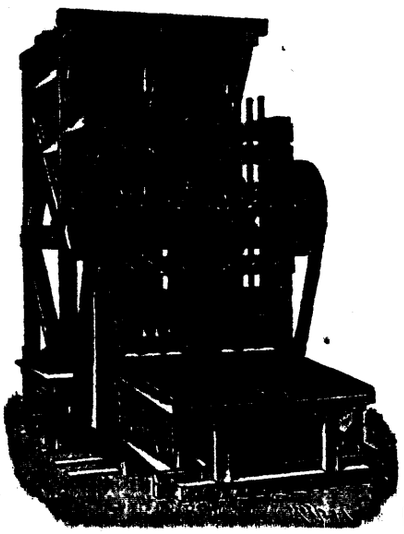

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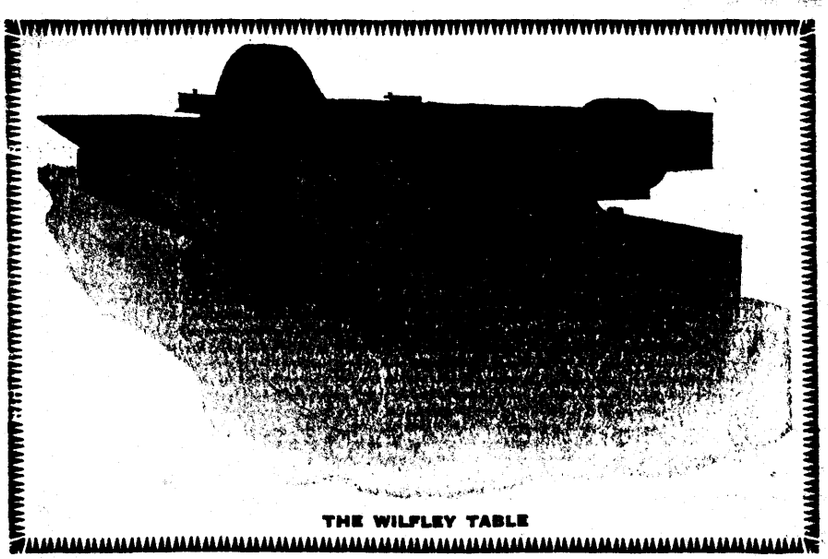

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VOL. XXI., No. 9. SEPTEMBER, 1902. VOL. XXI., No. 9.

An English Expert on some Canadian Gold Mines.

The second edition of Mr. J. H. Curle's "Gold Mines of the World" differs from the first chiefly in its enlargement, so as to include the author's investigations into the mines of Victoria, New South Wales, Tasmania, and the North American Continent; the first edition dealt only with South Africa, West Australia, Queensland, New Zealand, British Columbia and India. The title which Mr. Curle has adopted is most comprehensive, and as the author's travels are extended doubtless future editions will justify the title; as it is, over three-fourths of the world's production of gold comes from the countries which this book endeavors to cover; the attempt is ambitious and the results as shown in the present volume are auspicious.

The value of Mr. Curle's book unquestionably is for investors in mines in South Africa and Australasia, as is evidenced when we state that 43 p.c. of the total number of mines indexed are in Australasia and 46 p.c. in South Africa, nevertheless, the author's honesty and sincerity, and his novel method of criticism, make the book valuable to an investor in any gold mine. He deals with mining from the financial, and not from the technical expert point of view but his sharp and trenchant criticisms of mining methods, and of methods of flotation and organization as practised in England, make his pages most instructive reading. Our regret is that Mr. Curle did not have at hand a complete fyle of Canadian papers for the last five years; with such a source of information he could doubtless have given many trenchant criticisms and memorable phrases concerning the phase of lunacy wich Canadian citizens exhibited during that period.

Our space forbids a summary of Mr. Curle's views concerning foreign gold fields, although we advise such of our readers as have investments in foreign mines to obtain a copy of his book and to study it. His personal knowledge of the South African fields lends weight to his predictions concerning their future; while he is not an enthusiast on Rhodesia he is decidedly optimistic concerning the Transvaal, and predicts an annual yield for that field, for many years to come, of $125,000,000. He believes that Western Australia will increase its production, but that the older colonies will remain practically stationary in their output; the West African fields he declines to judge, believing that they will require five years development before a sound opinion can be given; as to India no increase is looked for. Favorable words are spoken regardlng the United States and Alaska, but of Canada he has little that is good to say, and expresses the belief that the Yukon production has reached and passed its high water mark.

The interest in Mr. Curle's book for REVIEW readers is confined to some thirty-five pages of his text in which he writes concerning the Yukon, British Columbia and Ontario; Nova Scotia is given ten lines and no opinion nor criticism is expressed. He considers that British Columbia must be regarded as the backbone of vein gold mining in Canada, and truly says that the mines there have been disappointing, "Prospecting and development work has not opened up the new mines which the appearance of the country justified one in expecting. This country, too, is badly handicapped in England because of the many worthless mines, of all sorts, which have been floated there." "British Columbia as a mining country has been much written about by mining men and theorized over by geologists;.....and the net result of it all, so far, is almost complete failure. English capital up to the present has been largely used to exploit the country, but English investors are now so disgusted with the dozens of valueless mines foisted on them that this vital source of income is almost dried up." Apropos of this statement, we might say that fully as much American as English capital, and twice as much Canadian as English capital, has been used "to exploit" the country. That very meagre results for the amount of money expended have been obtained is too patent to be controverted, and the REVIEW'S pages have told its readers, during the last half dozen years, many of the reasons why. Mr. Curle truly says that, if one deducts from the total gold production of the Province the individual yields of the Le Roi, War Eagle, Ymir, and Consolidated Cariboo Companies, that "there is no yield from any other gold mine worth noticing." The author shows great consideration for the feelings of his Canadian readers in suggesting that perhaps the reason that so few gold reefs have been discovered, up to the present time, is the fact that coal, silver, lead and copper have been found in such large and easily worked deposits that attention has not been directed especially to gold reefs, "But, whatever the reason is, both the yield of gold and the failure to discover new gold mines is disappointing.....The outlook for an increased gold yield commensurate with the country's great mineral area is not good."

He thinks the Atlin gold field is going to be a payable one, but that it will be profitable to companies and syndicates with large capital rather than to individuals; and we note the following phrase—"In a country like Canada, where litigation is made a specialty"—as indicative of one foreigner's opinion of British Columbia laws. He also has a few words of criticism for the Consolidated Cariboo Co.—"Here is, theoretically, the finest hyrdraulic mine in the world....For the future the mine is evidently at the mercy of the water supply,"—with which statement the shareholders, unfortunately, have been only too familiar for some years.

The REVIEW is glad to quote the following paragraph from Mr. Curle—"Rossland gives me the impression of having been one of the worst handled gold fields I have ever seen, and a monument to the greatest evils with which mining has to deal." We commend Mr. Curle's criticism of this district to all of our readers. Summarized, he says that at the first, the richest ore being picked out and treated, outsiders were given the idea that the mines were unusually rich; in consequence prices went far above values. When the ore got to be low grade big outlays were called for which the majority of the shareholders, having already lost money on their shares, did not provide. Some of the mines went wrong in depth, "On the head of this came the London middlemen, floating unproved claims into big companies, bribing newspapers, and vitiating public opinion generally." The costs of working are fairly summarized as having been cut down from $13 (all charges included) to $9 in the most favorable case, viz., the Le Roi. Mr. Curle considers that the future of Rossland depends upon the Le Roi, Le Roi No. 2, War Eagle, Centre Star, Rossland Great Western, Kootenay and Iron Mask, of these the Le Roi is the best. Mr. Curle considers the Rossland lodes to be "Replacement veins, not fissures, and their continuance to a great depth can not be taken for granted." "They are capricious in the extreme both in size and values, and can never be assumed to exist one foot beyond where they are exposed" The Le Roi No. 2 is criticized and the final summary is in these words—"There is too little ore in sight to place any definite value on the shares." The Rossland Great Western is described as a property "That should not have been floated. The position of the company is not a hopeless one, but it is a bad one." The Kootenay is dismissed with the words "It is even a worse flotation than the Rossland Great Western."

Of the management of the War Eagle a good word is said, but nothing good is said of its reserves; as to the Centre Star, it "Should have done well.....but the payable ore extended only a little way into the claim and, worse still, it dipped rapidly into Le Roi leaving a big unpayable mass of ore in its place." The Velvet, Portland, Duncan, Granite, Poorman, Fern, Dundee, Porto Rico and Athabasca are dismissed with few words, but a word of caution is uttered respecting the Ymir which circumstances, occurring since the book was written, have shown to be wise. Mr. Curle insists that the profits for a year or two should be put into development, so as to give eight or ten years reserves in sight, and fears that some day the Ymir may come to an end in depth.

Passing to Ontario the first phrase met with is, "Ontario as a gold producer is so far a failure. Quite a number of places are known in this great territory where gold is found, and no end of official literature on the subject is turned out; but as for mines showing any signs of permanence—they simply do not exist; and the shares of those already floated are nearly all worthless." He alludes in detail to the three most prominent mines of the Lake of the Woods, the Regina, the Mikado, and the Sultana. In regard to the Regina we may supplement Mr. Curle's remarks by saying that it has been reconstructed into the Black Eagle, it has had over $100,000 spent upon it in twelve months time, and it is yet in need of more reconstruction, and of sound management. The Mikado's future Mr. Curle calls "doubtful"; for the benefit of our readers we say that the mine has been closed. The Sultana floated in London in 1899 on a capital of £275,000 stg., failed to discharge a mortgage of £10,000 held by a Canadian bank, and now finds itself (August, 1902) in the position of owing $9,000 besides the mortgage, and with no visible assets. The remarks made by Mr. Curle regarding these mines have, unfortunately for Ontario, proved only too true and are a strong endorsement of the views with which our readers are familiar, through these pages.

Mr. Curle gives a very just and reasonable account both of the methods and the costs of getting into the Yukon, but we can not say that his strictures on the White Pass and Yukon Railway Company are deserved; we think he has failed to take into account all the circumstances which attended the inception and execution of this enterprise, and the justness of the tolls which the company exacted.

We concede to this book the very great merit of having been written with the intention of giving the facts with absolute impartiality. In some cases of which we have particular and special knowledge we may disagree with his conclusions, but judging his book from the Canadian chapter we must credit Mr. Curle with having written very valuable and honest information for the mining investor.

Mine Timbering by the Square Set System at Rossland, B.C.

By BERNARD MACDONALD, M.E., Rossland.

In mining operations, when the ore extracted exceeds a width of 12 or 15 feet, it has been found that the cheapest and only effective method of timbering is by the square set system.

The system may be generally described as a rectangular skeleton framework of timbers, extending from wall to wall of the vein as exhausted, the different members of which are so framed as to stiffen and support each other, and equalize and distribute local strains after the manner of a truss.

HISTORICAL.

The square set system of timbering was invented by Philip Deidesheimer, while Superintendent of the Ophir Mine, on the Comstock Lode, in 1860.

In Monograph IV. of the United States Geological Survey, "Comstock Mining and Miners" the following reference is made, which will be found interesting under this heading:

"At the fifty foot level (of the Ophir Mine) the vein of black sulphurets was only three or four feet thick, and could readily be extracted through a drift along its line, propping up the walls and roof, when necessary, by simple uprights and caps. As the ledge descended, the sulphuret vein grew broader, until at a depth of 175 feet it was 65 feet in width, and the miners were at a loss how to proceed, for the ore was so soft and crumbling that pillars could not be left to support the roof. They spliced timber together to hold up the caving ground, but these jointed props were too weak and illy supported to stand the pressure upon them, and were constantly broken and thrown out of place. The dilemma was a curious one. Surrounded by riches, they were unable to carry them off.

"The company was at a loss what to do, but finally secured the services of Phillip Deidesheimer, of Georgetown, California, who visited and inspected the treasure lined stopes of the Ophir."

During Mr. Deidesheimer's engagement at the Ophir, all the principles of square set timbering were evolved under his immediate supervision, and the wide and rich ore-bodies occurring in that mine were successfully extracted without the loss of ore or injury from caving by the use of this system. The system was then used in all the mines on the Comstock Lode, and subsequently, in all metalliferous mines elsewhere where the ore bodies exceed a width of 15 feet, the extreme width that is practical to timber by stulling.

The "square set" has underwent numerous modifications of detail in dimensions and the framing of its members in the various camps where it has been since used, owing mainly to local conditions, the dip of the vein and the character of the ore bodies and the enclosing rock.

VEIN CHARACTERISTICS AT ROSSLAND.

In the Rossland mines, the ore deposits have widths ranging up

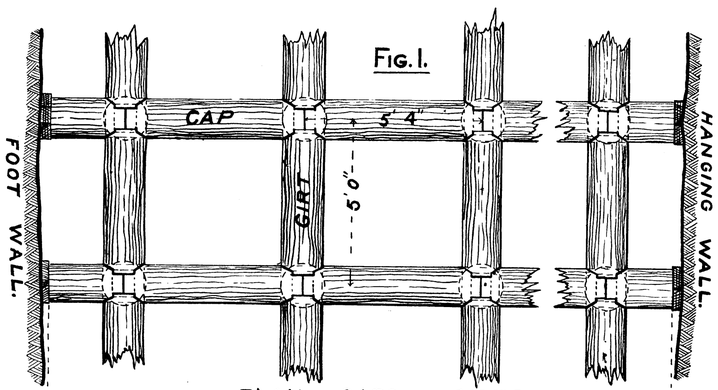


Fig. 1.

PLAN OF CAPS AND GIRTS

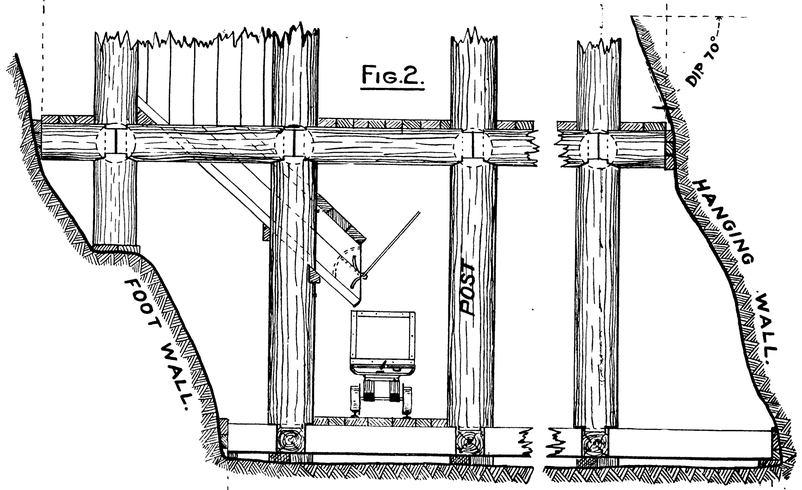


Fig. 2.

CROSS SECTION

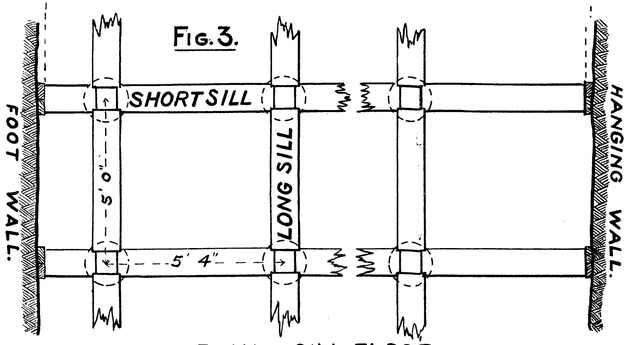


Fig. 3.

PLAN OF SILL FLOOR

IDEAL CROSS SECTION

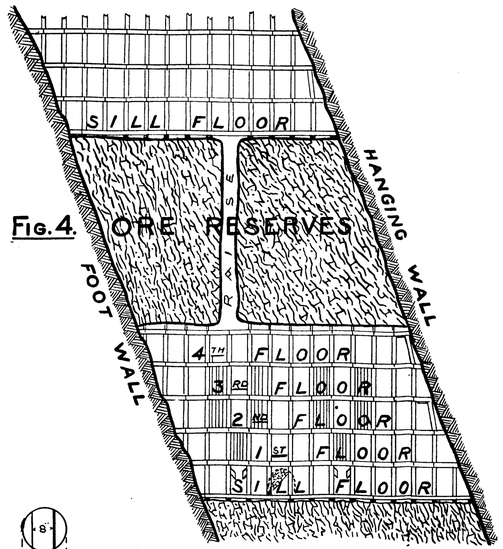


Fig. 4.

IDEAL LONGITUDINAL SECTION

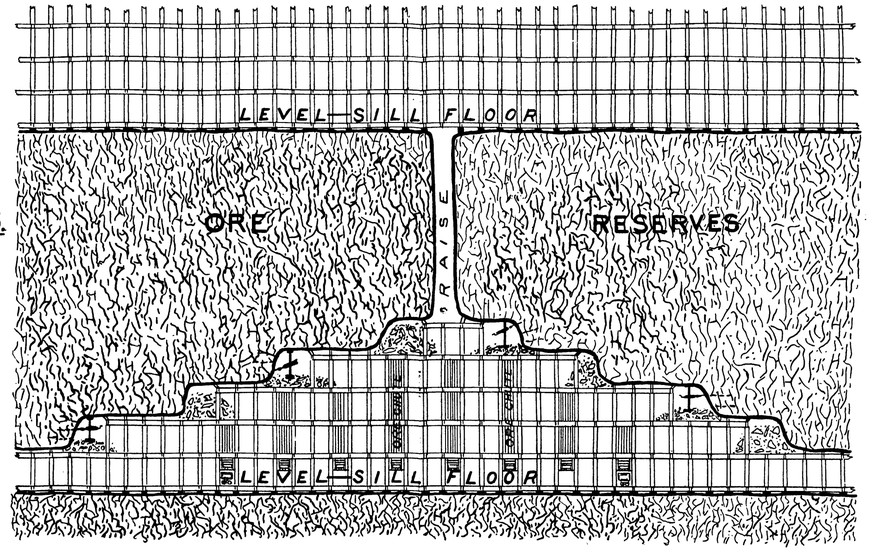


Fig. 5.

FRAMED MEMBERS

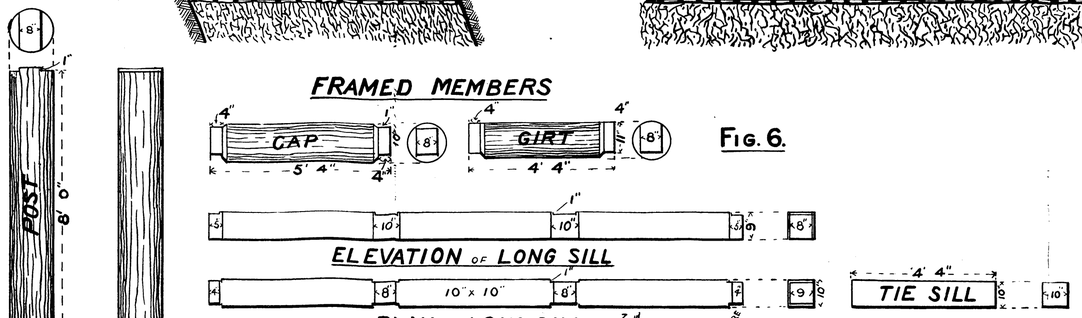


Fig. 6.

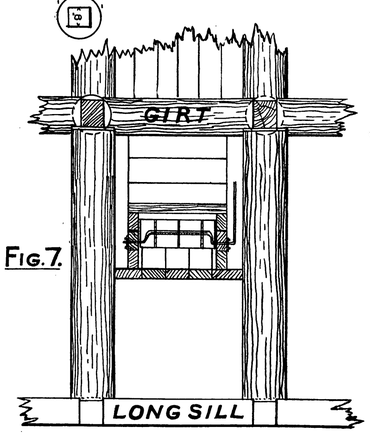


Fig. 7.

CHUTE

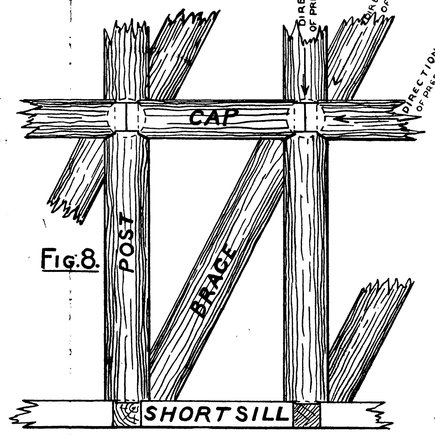


Fig. 8.

ANGLE BRACING

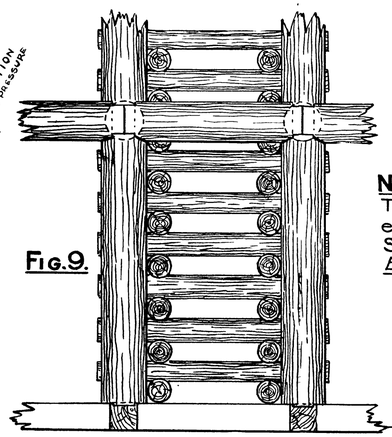


Fig. 9.

CRIBBING

PLATE
SHOWING
SQUARE SET METHOD
OF
TIMBERING
AT
LE ROI MINES
—ROSSLAND, B.C.—

SCALE 3/8 IN. = 1 FT.

12 0 1/2 3 4 5
IN. FT.

NOTE.
This "Plate" to accompany paper entitled "Mine Timbering by the Square Set System", written by
BERNARD MACDONALD
ROSSLAND, B.C.

to 100 feet or more, and lengths of several hundred feet along the veins. The veins are sheer zone fissures, the vein-filling consisting of country rock, which is now found, replaced, and cemented to various degrees of completeness by auriferous pyrrhotite and chalcopyrite.

The ore and the enclosing rock may be designated as extremely hard, and the veins dip at angles of about 70°. These conditions facilitate and simplify timbering, without, however, doing away with its necessity.

PRELIMINARY WORK.

In stoping out these deposits, the work is begun at the level drives or drifts run in the vein, and continued upwards in steps or stopes.

The first work in opening up an ore shoot or deposit preparatory to extraction, consists of running drives or drifts through it from the level stations at the shaft, which are generally cut at distances of from 100 to 200 feet in depth below each other. Such drives may happen to be run along either wall of the vein, or, through the vein at any point or distance (usually varying) from either wall.

These drives are considered as random bores, made longitudinally through the vein to determine, in a general way, its course or strike, and the behaviour and characteristics of the ore shoot. They serve, besides, as preliminary thoroughfares for the traffic, drainage, and ventilation necessary for the preparatory work of stoping, to be hereafter described.

As generally run, the drives have widths of about six feet, and heights of about eight feet, and require no timbering, owing to their comparatively small size and the hardness of the vein rock.

When it is decided to begin stoping on any new level, the first work done is to excavate the ore along the drives from wall to wall of the vein, making the excavation of sufficient height to receive the "sill floor set of timbers, as the first series of square sets on the level is called, and to leave a space of two or three feet over the set. This space serves to provide room for blocking and wedging the timbers to place, and to receive a layer of old timbers, which act as a cushion in preventing the possible breaking of the timbers by the masses of rock that must be blasted down on them, as the work of stoping out the ore above proceeds.

SILL FLOOR CONSTRUCTION.

The sill floor is a framework, made of 10 in. x 10 in. sawn timbers, laid down on the working level in the ore body. They serve as the sills or foundation timbers on which the square sets are to be erected. It is, therefore, the first, as well as the most important part of the square set system of timbering.

Fig I, plate 1, shows the sill floor as laid down and ready to receive the "sill floor set" of timbers. The members of the sill floor consist of three pieces: the stringer, or long sill; the spreader, or short sill; and the butt spreader, or brace. These members, when repeatedly laid in duplicate, will make up a sill floor to any extent required by the size of the deposit.

The dimensions and details of the framing of these members are also shown on the plate.

The long sill measures 15 feet over all, and is framed from a 16 foot timber, which allows six inches to be cut from either end to square the piece and remove sun-cracks.

The short sill, as framed, measures 5 feet 4 inches in length, over all, three of which may be cut from a 16 foot timber, if it overmeasures a few inches, as it generally does, and the ends are sound.

The butt sill or brace is framed of varying lengths to suit the existing space, which generally varies owing to local bulgings or contractions of the vein. It is framed on one end exactly like the short sill, while the other is cut square or bevelled to fit or butt against the wall rock, from which it is wedged tightly to place against the long sills.

A description of the method of framing the sill floor set of timbers is not needed, as it will be fully comprehended by a glance at the figures on the plate.

In laying the sill floor, the long sills are set ends abutting flush against each other, and as nearly as possible parallel with the general strike of the vein, ignoring any local bulging of the walls.

The first sill is laid close and approximately parallel to the foot wall, in which position it is levelled and held by blocking or butt braces; the other long sills are laid paralleling this one at proper distances apart, that is, 5 ft. 4 in. between centres. The cross sills fit on top of these, lying level with them, the ends being halved in framing to rest into similar halvings in the long sills, and to abutt flush against each other and extend endwise from wall to wall of the vein.

When the long sills reach as near the hanging wall of the vein as desirable, they are braced from it by the butt spreaders or by blocking, wedged tightly to bring all the members into proper position. The philosophy of this design of the sill floor is as follows:—

The long sill is made 15 feet in length, so as to better sustain the superstructure of square sets erected on it when the ore upon which it rests comes to be stoped away. For instance, when the ore is being blasted from under the sill floor by the work of stoping coming from the level below, and the blasting tears away a portion of the ore upon which the sill floor rests, making an opening as it generally does, of, say, 8 x 8 feet, the long sills would over-reach such opening, and one or both ends would rest on the solid rock beyond. Nor would the short sills drop away through such opening, owing to the fact that they rest on the top of the long sills, as previously described and shown on the plate.

Through the opening thus made in the ore, the portion of the sill floor exposed would be supported by posts set on the timber sets in the stope below. Thus the long sill operates to allow the work of stoping out the ore upon which the sill floor rests to be safely conducted if such portions of the sill floor as become exposed as the work proceeds are properly supported by posts from the timber-work underneath.

TIMBERS AND METHODS USED AFTER SILL FLOOR IS LAID.

The first tier of square sets erected on the sill floor is known as the "sill floor sets." The assemblage of the framed timbers into square sets then proceeds upwards, by floors, set over set, vertically, *pari passu* as the work of stoping exhausts the vein. The timber structure over any level is referred to in subdivisions as the "sill floor sets," "first floor sets," "second floor sets," and so on until it reaches the level above and catches up and supports the sill floor on that level.

This method of reference to the timbering as it advances, carries with it the data for a general calculation of the portion of the vein exhausted over a level as each set of timbers in place indicates that 9 feet vertically and 5½ feet horizontally of the vein is exhausted, 9 feet being the bare height and 5½ feet the width of space required for a set of timbers. And each square set in place indicates that 24 tons of vein matter have been extracted.

Aside from the sill floor, all the timbers employed in the square set system, except the planks for floorings and chutes, are framed from round logs. These logs are preferably of red fir, it being the strongest native timber, but pine, spruce and tamarac may be used. When cut in the woods, the logs are peeled and allowed to season for a period of from six to twelve months, during which time they lose about one-third of their green weight, which is a very important advantage in subsequent handling. In diameter, they range from 12 to 20 inches, but generally average about 16 inches, and are sawn in lengths of 16 feet 6 inches.

The logs may be framed by hand or with machine saws into the various members of the square set, as follows, viz.: Posts, caps, girts or braces, and butt caps. Like the members of the sill floor, these members may be duplicated to any extent required by the size of the excavation to be timbered.

The posts as framed are 8 feet 2 inches over all; the caps are 5 feet 4 inches, and the girts or braces are 5 feet; the butt caps, like the butt spreaders on the sill floor, are cut in varying lengths to suit such spaces as may exist.

The details of framing the logs into members of the square set are plainly shown in figures on Plate I, and need no further description. The philosophy of this method of framing the timbers is that the cap pieces of the various sets form continuous stringers of timbers running horizontally from wall to wall of the vein, no matter what this distance may be. Such stringers offer the end grain or greatest strength of the timbers to the walls, from which the greatest strains are generated. The posts and girts rigidly support the stringers thus formed of the several cap pieces in true horizontal position, bearing on the joints from right angled directions, while the cap pieces and the girts support the posts in true vertical position.

The whole framework forms a strong rigid structure capable of indefinite extension upwards and longitudinally as stoping proceeds, allowing at the same time for any expansion and contraction in width to suit such irregular widths of the vein as may occur.

Besides the functions of the various members of the square set system to support each other in the manner described, that of the cap pieces is to receive directly and sustain the strains coming from the walls of the exhausted deposit, while that of the posts is to support the vertical weight coming from the undercut ore deposit and the broken ore lying on the floors, but strains coming from any direction are distributed over all the members of the set.

The system possesses, to a considerable degree, the qualities of a truss, and makes it possible to extract all the ore of any deposit and effectually secure the enclosing walls from caving in. When the framework comprising the sets is erected, a floor, consisting of 3-inch plank, is spiked down on the caps of each floor set. These are the working floors on which the miners operate the machine drills, in the method shown in Fig. 5. When the ore is dislodged from the vein by blasting, it falls on these floors, where the waste or second class ore may be sorted out from the shipping ore. The shipping ore is shovelled into chutes which are built of 4-inch plank spiked to the timber framework and carried upwards with the square sets, as shown in the plate. The second class ore or waste sorted out, may be stored temporarily or permanently in the framework of the timbering from whence it may be drawn off at any time through chutes, should removal elsewhere be desired.

Figs. 4 and 5 are ideal cross and longitudinal sections illustrating the method of timbering and the work of stoping as it is carried on between the levels. Fig. 4 is a cross-section through the line A–B on Fig. 5, which in turn represents the longitudinal section through the line C–D on Fig. 4. On Fig. 4, the original position of the level drive in the vein is assumed as shown at the point X. This drive, as already stated, furnishes the point from which the excavation of the vein matter for the sill floor is commenced.

The step method of excavating the ore is shown in Fig. 5, where stoping is proceeding in double-headed steps, each step excavating the ore from wall to wall and having a vertical height of 9 feet in the clear, which allows of the erection of one floor of timber sets, which in turn provides the scaffolding from which the miners may attack the ore above.

In stoping out the ore on any level, the ordinary method is to keep the sill floor at least 30 feet in advance of the first floor, and it about 30 feet in advance of the second, and so on, as is shown in Fig. 5. One machine-drill, or generally two, in case the vein is wide, are assigned to work the two opposite headings of any floor, going in opposite directions, working on each heading alternately. When one face is drilled and blasted, the machine-drills are changed to the opposite face, and the shovellers pass the broken rock into the chutes, or sort it, if sorting is required. When the ore broken is thus removed from the face the timber gang erects another unit of timber there, and the stope is again in readiness for the machine drills, which have by this time finished drilling on the opposite face.

Generally the step method of stoping proceeds in opposite directions from a raise, run through the ore body between the levels, as shown in Fig. 4. The framed timbers are delivered in the stope by dropping them down through this raise or hoisting them from the level. Sometimes the framed ends of the timbers are injured by dropping them through the raise, but as a rule no material injury is done to them, while the time gained by this method is a very important factor in cheapening the cost of timbering, compared with hoisting piece by piece from the sill floors underneath.

PER TONNAGE COST OF SQUARE SET TIMBERING.

After the sill floor is laid and the framework started, a square set which is made up of one post, one cap and the brace, consumes 18 feet 6 inches running feet of logs.

The logs peeled and seasoned cut measuring 16 feet 6 inches cost $1.20 each delivered f.o.b. the cars at the works, or about 8 cents per running foot. Therefore, the 18 feet 6 inches required for the set would cost $1.48, or say $1.50 unloaded in the framing shed, provided the logs are not cut to waste in framing, which may be avoided with a little care and foresight.

The cost of framing the pieces comprising the set would be about $0.553, when framed by hand labor, carpenters being paid $3.50 per day of nine hours.

COST DATA PER SQUARE SET, HAND FRAMED.

Material.—A log, measuring 16 ft. 6 in., costing $1.20, cuts into two posts, or three caps, or three braces; therefore:

Material in one post costs	$0 65.0
" " cap "	0 43.0
" " brace "	0 43.0
Total cost of material in one set is, say	$1 50.0

Labor.—One carpenter (wages $3.50) frames per day:

About 21 posts, costing each	$0 16.7
About 21 braces, "	0 16.7
About 16 caps, "	0 21.9
Total cost for framing	$0 55.3
Total cost of labor and material in set	$2 05.3

The details of cost of the individual members of the set framed on the surface, ready to go into the mine are therefore as follows:—

1 post costs, for...	Material	$0 65.0	$0 81.7
	Labor	0 16.7	
1 cap costs, for ...	Material	0 43.0	$0 64.9
	Labor	0 21.9	
1 brace costs, for..	Material	0 42.0	$0 53.7
	Labor	0 16.7	
Making the total cost			$2 05.3

The costs next attaching to the square set, or unit, of this method of timbering are:

Lowering into the mine	approximately	$0 10
Delivering to place required	"	0 10
Labor in erecting	"	1 50
Incidental material, such as blocks, wedges, tools, nails...	"	0 10
Cost of sill floor, averaged over 11 sets between levels 100 ft. apart	"	0 15
		$1 95

These costs last above given may vary greatly, being increased or decreased with the completeness of the facilities for handling the framed timbers, the cost of the several items as stated may vary accordingly from time to time, but the total will be about the average cost, and will closely approximate that of carefully supervised operations. Therefore, from the foregoing it will be seen that the cost of the square set placed in the mine will come down, as follows:

Total Cost of Labor and Material, as above.....	$2 05.3
Labor and material when set is in place as above.....	1 95.0
Total cost say.....	$4 00.0

When framed by machine saws, the cost of framing a square set does not exceed 30 cents, including the cost of power, as against 55 cents by hand, a difference of 25c. per sett. Therefore, if the framing is done by machinery, the cost of a set in place would be $3.75 as against $4.00 as shown above when the framing is done by hand work.

The per tonnage cost for timbering by this method works out as follows:—The average space to be excavated for each set square is 5.3 feet wide by 5 feet long, by 9 feet in height, or 240 cubic feet. The Rossland ores, being heavily impregnated with iron and copper pyrites, yield a ton of 2000 pounds for each 10 cubic feet of ore in place; therefore, from the 240 cubic feet of vein required to be excavated for a set of timbers, the yield will be 24 tons. If the timbers were framed by hand the cost of timbering, so far as described, would be about $0.17 per ton; if by machinery, $0.15.6, a difference of $0.01.4 per ton in favor of the machine-framed sets.

In addition to the costs above tabulated, there still remain the costs of the chutes, floors, ladders, and railings, necessary for the convenience and safety of the miners and the passage of ore and supplies. These require, on an average, about 100 feet of lumber, board measure, per square set, which, at $11.00 per 1000 feet, would add for the lumber $1.10, and for placing it, say $0.10, or a total of $1.20 to each square set; which would then cost, in the case of hand-framing, $5.20, or a total cost of $0.21.6 per ton of crude ore; and in the case of machine-framing, $4.95, or a total cost of $0.20.6 per ton of crude ore.

INCIDENTAL COSTS.

The cost of timbering, per ton of ore shipped, would be greater than the figures given above in proportion to the quantity of waste or second-class ore that would be sorted out from the crude ore extracted.

In the Rossland mines about 20 per cent. of the ore mined is sorted out and goes to the second-class ore dump to await profitable treatment, expected to come in the future. Deducting 20 per cent. of the twenty-four tons of crude ore in a square set, there would remain 19.20 tons as the shipping ore, against which the total costs of the square set as above, $5.20 or $4.95 as the case might be, would have to be charged. This would raise the per tonnage costs on the ore shipped to about $0.27 and $0.26 respectively.

Where there is a reasonable expectation that the second-class ore will eventually pay a profit after suitable treatment, it would be only fair to charge a pro rated cost of the timbering to it, and the cost would then remain $0.20.6 and $0.21.6 per ton as above.

In cases where, on account of bad ground, angle bracing, bulkheading, or cribbing and filling would be required, the per tonnage cost would be still further increased, but to a comparatively small extent.

LIMITATIONS OF THE SQUARE SET.

The limit of the capacity of the square set system as already described without any reinforcing devices to withstand the pressure that may be exerted on it by the enclosing walls of an ore body when that ore body is extracted, may be reached.

This limit depends on the nature of the walls enclosing the deposit, and the extent of the excavation. If the wall rocks are solid and do not swell on exposure to the air and dip at a high angle, the ore body may be extracted between levels, say, 100 feet apart and for a length of 200 or 300 feet along the vein, and the pressure likely to be exerted by the walls will be sustained by the skeleton square set without reinforcement of any kind.

If, however, the vein dips at a low angle, and the wall rocks are decomposed, or of a talcose or serpentine character and disposed to swell, the pressure that might be exerted on the timbers, when even a comparatively small excavation of the ore body has been made, may cause them to crush, "jack knife," or collapse, allowing the wall rocks to cave in and close up the stope. When the members of the square set become squeezed out of the truly right-angled position which they should occupy, their capacity to resist wall pressure or strains from any direction is practically *nil*.

When, owing to wall pressure or imperfect erection of the sets, "jack knifing" of the square sets results, the cave-in, which sooner or later will follow, with disastrous consequences, may be prevented by either bulk-heading, cribbing, or filling the skeleton framework of the timbers.

The cost of the foregoing methods of reinforcement, which are the only practical ones that can be successfully used in bad ground, cannot be given with any general degree of accuracy, as that is so much affected by the local conditions in each case.

A general idea of what the cost is likely to be may be gleaned from the description following:—

REINFORCEMENT METHODS.

Angle-bracing.—If, after the square sets are properly erected in place, the members manifest an inclination to swing out of the right-angled positions they originally occupied to each other, this tendency may be arrested and prevented by a system of angle-bracing. This consists of placing diagonal braces made of round or square timber on the sill floor and against the foot of the posts, and leaning the heads so they will fit snugly against the top of the posts underneath the caps or girts, as the case may be, of the next adjacent set. The head of this diagonal brace should lean in the direction from which the pressure comes. This method is illustrated in Figure 8.

Cribbing.—When the square sets manifest a stronger tendency to swing than in the case referred to, the collapse threatened may be prevented by crib-work. This consists of crossing alternate layers of round or square timbers of any convenient size between the posts of the sets until the space between the sill and cap is filled, as shown in Fig. 9. This crib-work may extend from wall to wall through two or more rows of sets if required, and the spaces between the sets thus cribbed may be filled with waste rock, but this is called "Filling," and will be referred to under that heading below.

Bulkheading.—This method of reinforcement consists of placing timbers closely together in much the same way as the crib-work above referred to, and wedging them tightly between cap and sill.

Filling.—This method consists of filling the spaces between the members of the square set with any material such as waste rock, earth, or sand. When the filling is done it is retained within proper bounds, and the necessary passageways are kept open through the timbers by building crib-work around them as described.

Waste rock for filling purposes is generally secured from the development or dead-work that is being prosecuted in other sections of the mine, but where a large quantity is required, it is often found necessary to mine it specially for that purpose, or draw it from the waste dumps on the surface. About eight cubic yards of material is required to fill the vacant space of the frame of a square set, and the cost of such filling will be the cost of obtaining and placing such material, together with the crib work required to retain it within proper bounds.

GENERAL REMARKS.

The square set system of timbering is used successfully and exclusively in all mines where large deposits of metaliferous ores occur.

Where favorable conditions, such as railway transportation and a moderate supply of timber exist, it is comparatively cheap. If care is taken in the construction of this system in the mine, it ensures that all the ore existing may be extracted without injury to the workman or the

mine. Round logs or sawn timbers of any dimension, ranging from 8 inches upwards, may be used, but the sizes are governed by the economic conditions and mining requirements.

In the mines of Rossland, the round logs or timbers used for the square sets cost $1.20 for each log 16 5 feet in length f o b. the framing shed at the mine. These logs are cut in the State of Washington, and delivered over the Spokane Falls & Northern railway on flat cars, over distances ranging from 45 to 75 miles, each flat-car being loaded on an average with 60 logs. The unloading at the framing shed is done in a few minutes by cutting off the retaining standards on the flat cars, and allowing the logs to roll off on the storage platform

Of course, where wagon transportation is required from the railway terminus, the expense will be correspondingly increased

In every mining camp there will be more or less variation in the method of framing, and in the cost of the square sets in place, also in the tonnage of ore to be extracted from the space occupied by each square set.

Where the dip of the vein is at a flat angle or the walls are bad, shorter posts than those described herein will probably be more advantageous: the more vertical the dip of the ore deposit, the longer the posts may be, and *vice versa*.

Where sawn lumber is comparatively cheap, three-inch plank is preferable to lagging poles for floors, on account of the better floor it offers for shovelling, and the fact that it may be removed and re-used.

Safety Lamps and Colliery Explosions.

(Discussion of the paper by Mr. James Ashworth.)

By Mr. William Blakemore, Montreal.

There can be no doubt that the subject of safety lamps is of the greatest importance in connection with coal mining; possibly of greater importance than the regulation of blasting, with which it divides the attention and interest of mining men.

The result of thirty years' experience, during which time I have tested every safety lamp which has been put on the market, leads me to the conclusion that the best result which can be obtained is only a certain percentage of safety, and of the lamps which approximate the closest to this standard I would specify the improved Hepplewhite Gray for testing processes, and the Mueseler. The former will, in my judgment, detect the presence of a smaller percentage of fire damp in the air than any other lamp, certainly than any other oil and wick lamp: and as long as this is the method of illumination I do not see how it is possible to construct a lamp mechanically more perfect than this. The fact that the only inlet is by way of the vertical tubes which admit air and gas at the top of the lamp and deliver them direct to the flame seems to me to give the maximum efficiency in this particular. I commenced to use the Hepplewhite Gray for testing purposes when it was first invented, and had have continued its use ever since: the only objection which has developed with experience is its liability to become extinguished by a sudden jerk, but this is a defect which it has in common with the best lamps, and can hardly be considered an element of danger. I have always found the finger-holes and slides upon the tubes of great value for testing purposes, and the proper manipulation of these renders the lamp as sensitive as can reasonably be expected for practical purposes.

With reference to the Mueseler, this lamp, when bonnetted, is as efficient and safe as any lamp with which I am acquainted for ordinary working purposes, and if used in combination with the more delicate lamp above referred to, furnishes a combination which I think meets the requirements of the case.

I am aware that the Wolf lamp is largely used in Pennsylvania and is growing in favor, it is a good lamp, but possesses one drawback which I consider fatal to all lamps of this class, viz., that it burns benzoline oil. The presence of a volatile oil in connection with a safety lamp is an added source of danger and will not long be tolerated in mines. I agree with Mr. Ashworth's remarks that the safety of a lamp is dependent, not upon ordinary conditions prevalent in a mine, but upon its ability to resist exceptional conditions which may be instantaneously produced, and this point must never be lost sight of, because the exceptionally dangerous condition may be produced at any moment and without the slightest warning. This is why all such lamps as the Clanny must be resolutely condemned, because although they may be perfectly safe under the normal conditions prevailing in a mine they become unsafe and highly dangerous in the presence of a sudden outburst of gas, an acceleration in the velocity of the air current, or the presence of a large quantity of coal dust.

As reference has been made in Mr. Ashworth's paper to the Fernie explosion I may be permitted to say that in my judgment the preponderance of the evidence adduced at the inquest pointed to the Clanny lamp as the undoubted origin of the explosion. This lamp was being used in immediate proximity to a feeder of gas, and at a point where, according to the evidence of the chief mine superintendent, the velocity of the air current was ten feet a second. After the explosion a lamp was found within a few feet of this feeder completely shattered, and although of course there can be no direct evidence on the point, the conjunction of all the elements necessary to produce an explosion rendered the matter one of easy natural deduction, especially as it was proven that the air was heavily charged with dry coal dust at this point. The behaviour of different lamps in a mixture of coal dust and air will undoubtedly form a subject for careful investigation, as hitherto the experiments made with coal dust have been more or less confined to testing its behaviour in the face of explosives; it may, however, be interesting to mention that in connection with the Fernie explosion one of the most experienced miners, Angus Ferguson, stated that he had frequently, when carrying a bonnetted Clanny in the works along the main haulage road where there was heavy coal dust but no gas, found the coal dust accumulate upon the lamp, and on shaking it slightly to get rid of the same a dull red flame would fill the lamp. The next question to solve would be—at what point this flame would connect with the outside of the lamp, and this is undoubtedly one of the problems of the times in connection with dry and dusty mines, because the conditions referred to prevail in so many.

My concluding remark must be an endorsation of Prof. Galloway's observation in his report on the explosion at the Universal Colliery, viz.: that recent occurrences lead to the irresistible conclusion that coal dust is relatively more dangerous in a mine than fire damp.

By Mr. W. D. L. Hardie, Lethbridge, Alta.

During many years practical experience in bituminous coal mines, both in America and Europe, I have paid much attention to modes of working and the dangerous elements that enter into the practice of coal mining. I have found in nearly all, if not every one of the superior coking coals, which lie comparatively flat and not much faulted, whether marsh gas be present or not that the dust has a more or less marked "greasy feel," indicating that in addition to the carbon there must be some of the heavy hydro-carbons of the paraffin series present in the volatile matter. When such a seam gives off fire-damp the damp is very likely to be "sharp," indicating that hydrogen, as well as the heavy hydro-carbons, is likely a constituent of the fire-damp.

Under these conditions, which, I think, from personal examination, hold good at Fernie, B.C., the inflammable point of the explosive gas given off is very much lower than that of ordinary fire-damp. Under such conditions the explosive point is reached with a less per-

centage of gas, and of course the quantity of the gas to give the maximum explosive force will also be much less in the explosive mixture. If the Fernie coal dust carries a small percentage of heavy hydro-carbons or free hydrogen, it can be readily imagined how easily the dust could be raised to an incandescent heat and the hydro-carbons distilled in quantities large enough to cause an explosion of any magnitude, if plenty of coal dust has been deposited in the mine, having its initial cause in the ignition of a small quantity of gas, or from many other causes, even if explosive gases were not present in such quantities as could be detected with the ordinary, or even improved safety lamps. By improved safety lamp I do not mean those specially designed for delicate work.

Under these circumstances it is of the utmost importance that the smallest percentage of gas should be detected, but it is just of as much importance that all the other dangers should be known and cared for. For years I have used the Ashworth-Hepplewhite-Gray lamp in several forms, including Clow's hydrogen flame, the Pieter lamp without and with Garforth's rubber ball, and Shaw's gas-testing machine, with singularly good results. To the use of these appliances and a fairly good knowledge of gases, and a good grasp of "the hydro-carbon in coal dust" theory I attribute my success, in over twenty years practical experience, in avoiding accidents in some of the most gaseous, dry, and dusty mines on this continent. In one colliery which exploded before I took charge I had the greatest difficulty for a long time in instilling into the officials' minds the great necessity of getting a complete knowledge of "the hydro-carbon in coal dust" theory, but was successful in avoiding accidents while I remained there. Since then there have been several minor explosions, and one very large one, killing over 100 men, dating not more than six months back.

I do not think that the coal dust theory should ever be lost sight of in mines where the volatile constituents form any considerable percentage of the analyses. In anthracite mining the problem is not so difficult; in such seams the danger is mostly, if not altogether, marsh-gas. The South Wilkes-Barre Colliery, Pennsylvania, U.S.A., is perhaps the most fiery colliery in the United States, as much as three and four per cent. of fire-damp being detected almost constantly in the fan drift by the Shaw gas tester, but there the problem is not a partticularly difficult one, because there is no dangerous coal dust, no element not well understood.

By far the largest number of explosions on the American continent take place in dry and dusty bituminous coal mines, some of which gave off firedamp, while in others that have exploded never a sign of fire-damp has been seen on a safety lamp, yet the lives lost in each of these mines count up in hundreds. In many of them I am sceptical as to whether there was any gas given off. I trudged round the East mine of the South-west Virginia Improvement Co., Pocahontas, Va., and worked at the coal for over six months after the explosion there, in the vain hope that I would be able to find something that would indicate that there was some marsh grass present, but I never saw it. In the presence of several officials of the company and Andrew Roy, then the chief mine inspector for Ohio, I fired a heavy shot in a wide room where the coal was mined at least five feet deep. After such a shot a long tongue of red flame invariably shot out from twenty to thirty feet, and if the coal came down, flame at white heat played around behind the coal, in many cases dying out gradually, the last small flame presenting the blue cap. This only supported my idea of the distillation of the hydro-carbons in the coal dust. I have seen the same phenomena in most seams of a good coking quality. If marsh-gas be present, forming a mechanical mixture with air, the phenomena will be intensified.

From the foregoing remarks it will be seen that I am not one of those who believe that it is necessary to have a percentage of marsh-gas present before we can have a "coal dust explosion." But woe will surely betide the manager who has both coal dust and gas present if he does not carefully take care of both with the most advanced knowledge of the day. I would not think of being in charge of any dry and dusty mine without endeavouring to detect explosive gas with the most improved safety lamp or other detector known to the mining fraternity, even if in my mind I thought there was no possibility of gas being present: one can never tell.

Even if it be admitted that gas must be present before a "coal dust explosion" can take place, "the enquiry into the Seaham disaster in 1880 showed that the presence of two and one-half per cent. of fire-damp in a dry and dusty mine created an atmosphere which would in the presence of a blown-out shot, over-powdered shot, or a badly placed shot, bring about a fearful disaster." There are not so very many who can detect even three per cent. of fire-damp with the ordinary safety lamp. Of course there are lots who think they can, but can they?

Where gas, coal dust, or both are present in a mine it is the duty of the manager to know all that is knowable about the dangers connected with the same so that he may do the best to protect the lives of the men intrusted to his guidance and protect the company's valuable property from damage or destruction.

It is a well known fact that increased temperature reduces the temperature of ignition and that a low barometer reduces the violence of a gas explosion, but these are factors of small moment where coal dust is one of the elements when looking into the mechanical effect of an explosion; but in the case of gas detection, increase in temperature and reduction of temperature (low barometer) may be of considerable importance.

Another point, I will mention in passing, is that the effect of coal dust on the flame of a testing lamp is not generally given the consideration it should have by the fire bosses and other officials in dry and dusty mines, on this continent. Here is another opportunity for the distillation of explosive gases on which I have laid so much stress. Coal dust in contact with the flame of a testing lamp is a condition that might well be made the subject of a scientific paper. Coal dust in the meshes of the gauze of an ordinary safety lamp becomes incandescent almost instantly and passes the flame to the mixture outside of the lamp.

Mr. Ashworth's lamp is simply an improvement on the Gray lamp, which had the good fortune to be highly recommended by the Royal Commission, and there is no doubt but it is a good lamp; however, it has not passed through its course without considerable objection being raised to it by many able mining engineers and mine managers in Great Britain. As recently as the years 1892-3 Mr. Stokes and Messrs. Ashworth and Clowes had considerable controversy as to the relative merits of the Stokes and the Ashworth lamps. From the discussion that followed I gathered that both lamps had about an equal number of supporters, but all seemed to be unanimously of the opinion that both lamps were good and capable of detecting equally small percentages of gas, but the Stokes lamp had the advantage of using alcohol instead of hydrogen gas used in the Ashworth lamp then under discussion. Both lamps use oil for testing for over 2½ per cent. of gas.

Mr. Ashworth in his paper does not discuss the percentage of gas his lamp will detect, but satisfied himself with saying that "it will detect more readily and with greater certainty the presence of the blue cap than any Davy lamp which was ever made." This is definite, but not very informative, and presupposes a knowledge not had by all who will read his paper.

Mr. Ashworth's paper is a valuable one, if it will induce the mine managers and mining engineers in Canada and the United States to give safety lamps and other subjects in coal mining the thought they deserve, by giving the chase for cheap coal just a little less attention, it shall have served a good purpose.

Mine Signalling by Compressed Air.

By Bernard MacDonald and Wm. Thompson, Rossland B.C.

In mining operations the problem of signalling from the mine workings to the engineer running the hoisting engine on the surface is receiving more thought than formerly. This is due to the rapidly increasing depths of mine workings, and to the fact that the devices now in general use render signalling from considerable depths unreliable.

The system in general use is known as the pull bell system. The mechanical appliances used in this system consist of a marine gong or other sounding apparatus, called the bell, a rope, called the signal rope, a device for deflecting the direction of the signal rope, called the bell crank, and a counterbalance for the weight of the signal rope, called the balance bob.

The bell is located in the engineer's room, or within ear-shot, and generally within convenient sight of the engineer.

The signal rope is attached to the bell and carried to the collar of the shaft, thence down it to the deepest workings from which it is desired to transmit signals to the engineer at the surface.

The bell crank is a triangular lever, placed at the collar of the shaft, or at any other place, where the direction of the signal rope is changed.

The balance bob is placed at the collar of the shaft, or at suitable distances apart in it, to balance or slightly overbalance the weight of the signal rope. It is fulcrumed as a beam, the signal rope being attached to one arm, while the other arm is weighted as mentioned.

Balance bobs are sometimes substituted by spiral or coiled springs to produce the same effect.

The signals for hoisting or lowering men or material, or telling what is wanted by the workmen below are given by the bell, in the form of strokes and pauses in singles or in any alternating series or combinations conformable with the code used.

The signals are transmitted from any level in the mine by pulling the signal rope, as the signal code requires. The arms of the bell crank, to the ends of which the signal rope is fastened, extend outwards from a fulcrum pivot at right angles to each other.

In the case of an incline shaft the arms of the bell crank radiate from the fulcrum pivot at an angle to each other equal to the angle the dip of the incline shaft makes with the horizon.

A convenient combination bell crank and balance bob is often made in one piece. The balance bob and the bell crank extend as little as is necessary into the shaft, and are boxed in as securely as the conditions will admit, in order to prevent accident in case of pieces becoming loose and falling down the shaft.

The signal rope is preferably a wire one, but plaited cotton or hemp rope is of common use. Twisted rope is not suitable on account of the alternate stretching and shortening that would result from the pulls necessary to transmit the signals.

The signal rope is kept from sagging or swinging into the shaft by staples or other fastenings driven into the timbers in the corner of the shaft.

The balance bobs are so weighted as to overbalance by some 10 or 15 pounds the dead weight of the signal rope. Overbalanced thus, unless interfered with by some other causes, the signal rope returns promptly after each pull to its normal position in a state of rest. This device facilitates and makes possible the transmission of signal strokes to the bell at the surface from the workings of the mine.

Separate installations similar to that described are made for each shaft compartment through which hoisting is to be done, and to avoid confusion to the engineer, or mistakes, the gongs or sounding apparatus on the surface have different tones, and are frequently placed at considerable distances apart, and toned in this way the engineer is less likely to mistake from which compartment the signal was transmitted.

SIGNAL CODE.

That which remains yet to be said about the pull bell system of signaling may be better understood, one of the signal codes in common use is given below for reference.

General.

1 Bell, hoist.
1 " stop, is in motion.
2 Bells, lower.
3 " warning that men are going aboard, and that the cage is to be hoisted or lowered according to the signal to be given subsequently.

Station Signals.

2 Bells,	pause;	2 bells,	pause;	2 bells, to station at surface.
1 Bell,	"	1 bell,	to station at	1st level.
1 "	"	2 bells,	to station at	2nd "
1 "	"	3 "	to station at	3rd "
2 Bells,	"	1 bell,	to station at	4th "
2 "	"	2 bells,	to station at	5th "
2 "	"	3 "	to station at	6th "
3 "	"	3 "	to station at	7th "
4 "	"	1 bell,	to station at	8th "
4 "	"	2 bells,	to station at	9th "
4 "	"	3 "	to station at	10th "

DEFECTS OF THE PULL BELL SYSTEM.

When the mine workings are shallow and there is but one or two hoisting compartments, the pull bell system of signaling works very well, but when any considerable depth is attained or where there is more than one hoisting compartment and the traffic is heavy and from various levels, the defects of the system become apparent.

The primary cause of most of the defects is the fact that all the parts of the apparatus are moving parts, having to reciprocate to each other for every pull given by the signal sender. It will be readily understood how an apparatus constructed with a large number of reciprocating parts extending through vertical or inclined shafts to depths of over 1000 or 2000 feet may become deranged and out of order.

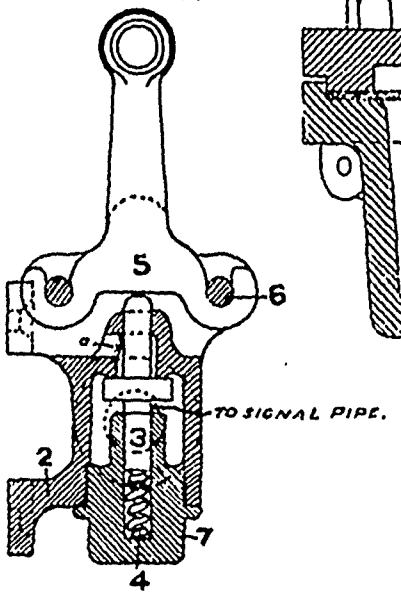
One of the greatest defects of the system is that the signal sender cannot know whether the signal he sent to the engineer has been properly transmitted and reported by the bell, as the bell strokes cannot be heard at any considerable depth in the mine. Then, at any time one or more of the numerous parts of the apparatus may become deranged and cease to work during the transmission of a signal, and the part of the signal sent before the derangement occured may, in itself, be a complete signal, conveying to the engineer an entirely different signal from that which was intended. If the erroneous signal thus received be acted upon by the engineer, an accident to life or machinery might result.

Again, the apparatus might become deranged by expansion or contraction of the signal rope. In the case of a wire rope this might result suddenly from the rise or fall of temperature in the shaft due to change of air currents in the shaft from an upcast to a downcast, or *vice versa*. In the case of a cotton or hemp rope, the alternate wetting and drying, not uncommon in shafts, would have the same effect. The devices for fastening the balance bobs or for retaining the signal rope in one corner of the shaft are liable to become broken or destroyed by wear or accident, and the rope sag or swing into the shaft, where it would be likely to be caught and carried away by the ascending or descending cages. The numerous defects to the pull bell system of signaling mentioned become more accentuated when the system is operated through an incline shaft.

On account of these defects, a number of electric signalling systems have been devised, from time to time, and tested. While some of these have shown considerable merit, in certain ways, over the pull bell system, nearly all of them demand the use of apparatus too delicate for the rough usage and conditions inseparable from mining

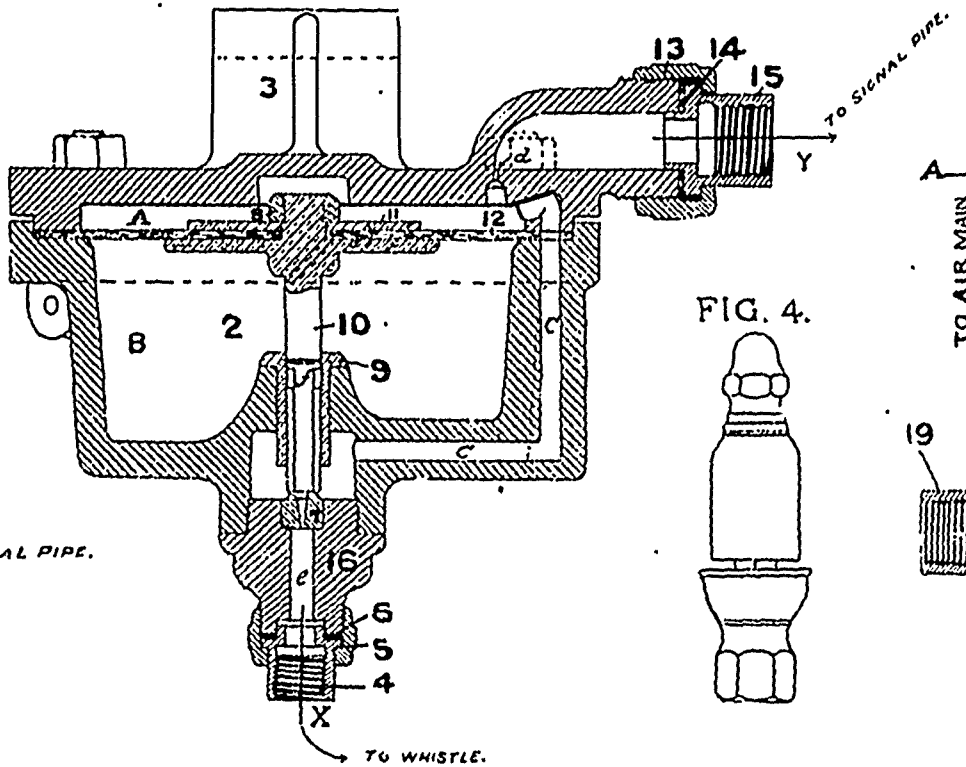
MINE SIGNALLING BY COMPRESSED AIR.

FIG. 1.



DISCHARGE VALVE.

FIG. 3.

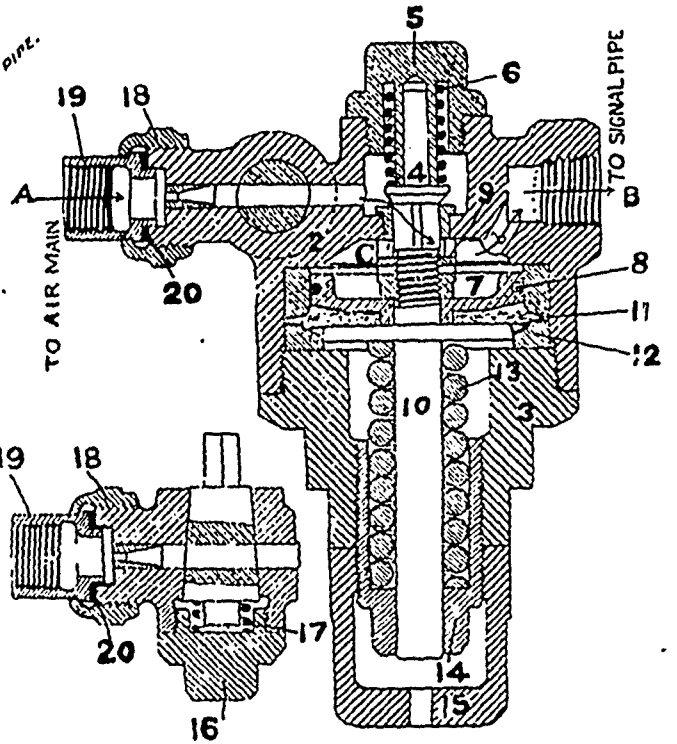


SIGNAL VALVE.

FIG. 4.

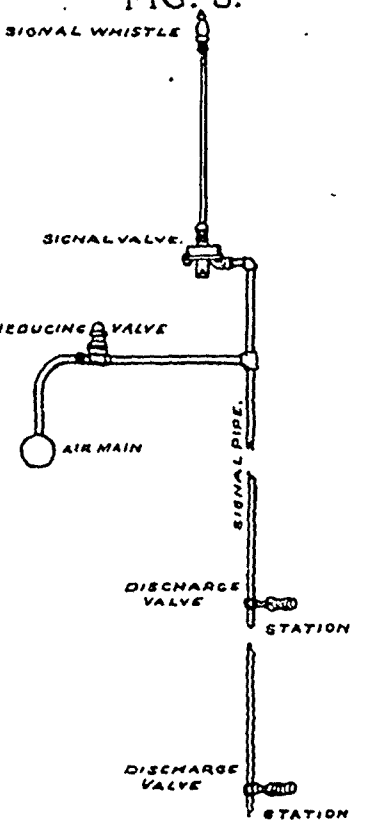
SIGNALWHISTLE

FIG. 2.



REDUCING VALVE.

FIG. 5.



Illustrating paper by Messrs. Wm. Thompson and Bernard MacDonald, Rossland.

operations. These reasons and the lack of simplicity of construction which permits of extension, maintenance and repairs of the apparatus by men lacking technical training constitutes a serious defect in the otherwise best of the electric systems.

The defects of the pull bell system became painfully apparent to the writers when they undertook the installation of a signalling system in each of the four hoisting compartments of the Le Roi combination (incline) shaft. If the pull bell or electric systems were installed, the four bells representing the four compartments would have to be in the room with the two hoisting engines. With the possibility of four bells ringing at once, confusion and mistakes would be inevitable. In devising ways to overcome this difficulty, it occured to us that since the signalling between the conductor and engineer of express trains is now carried on most satisfactorily by compressed air, it would not be more difficult to obtain equally good signal service by the same system through the combination shaft.

With this object in view, correspondence was opened with the Westinghouse Air Brake Company, of Philadelphia, the patentees of the air system used on trains. Being informed that the apparatus of that system was obtainable, and of moderate price, it was purchased and installed in two of the compartments of the combination shaft, in the month of February, 1900. The system was a success from the start, and has been in continuous operation ever since, giving perfect satisfaction without any expense for maintenance or repairs. Recognizing its superiority over the pull bell system described, and believing that its adoption where the circumstances are suitable will add another improvement to mining equipment, the following detailed description of the apparatus and its cost is given.

THE COMPRESSED AIR SIGNAL SYSTEM.

The apparatus of this signalling system is the same as that used by express trains, with some slight modifications in the installation. Fig. 1, 2, 3, 4, and 5 accompanying show the details, of the apparatus used, all of which may be purchased from the Westinghouse Air Brake Company.

The *Whistle*, Fig. 4, is the sounding device which conveys to the engineer the signal sent from the mine workings. This is located in the engine room, and where signals from more than one source are received each whistle may be tuned or chimed differently from the other, so the engineer may readily distinguish the source from which the signal is sent.

The *Signal Pipe*, Fig. 5, is ½ or ¾ inch in diameter, and must be used exclusively for signalling purposes. It connects with the whistle down to the deepest workings in the mine. Signalling apparatus may be fitted in this pipe at any intermediate points desired. In fitting this pipe care must be taken that no leaks exist, for the smallest leak would destroy the working of the system.

The *Signal Valve*, Fig. 3, must be placed at some point in the signal pipe where there is no danger of freezing—close to the hoisting engine would, perhaps, be most suitable. This part of the apparatus consists of a mechanical device containing two compartments "A" and "B", separated by a diaphragm 12, and the diaphragm stem 10, attached thereto extends through bushing 9, its end forming a valve on seat 16, over port (e.)—a small portion of the diaphragm stem 10, fits bushing 9, snugly, while just below its upper surface a peripheral groove is cut in the stem and its lower end is milled in triangular form, signal valve is attached to main signal pipe at Y, where pressure enters, and passing through port (D) charges chamber "A" and through port C, past stem 10, charges chamber "B".

A sudden reduction of pressure in the signal pipe reduces the pressure on top of diaphragm 12, in chamber "A," and the greater pressure in chamber "B" acting on its under surface forces diaphragm upward and momentarily permits portion of the air in the signal pipe and chamber "B" to escape to the whistle, thus sounding a signal to the engineer as often as the discharge valves are opened at any one of the stations.

The *Reducing Valve*, Fig. 2, is inserted in the feed pipe that connects the compressed air mains of the mine with the main signal pipe of the system. The regular mine pipes should be connected by suitable piping at outlet "A," and other piping extend from outlet "B" to the signal pipes, in which the maximum pressure should be 40 pounds per square inch. As this pressure is reduced by signalling, piston 9 rises under pressure from spring 13, and forces supply valve 4 from its seats, when pressure from air mains entering at "A" passes through valve 4 to chamber "C" and through port (b) to the signal pipe at "B." The pressure therein being restored to 40 pounds, piston 7 is forced downwards by air pressure and valve 4 is seated by spring 6, shutting off further supply of air until another signal has been sent, releasing pressure contained in signal pipe.

The *Discharge Valve*, Fig. 1, is inserted in the signal pipe in close proximity to the signaling station so the sibilant sounds of the air discharges may be easily heard by the signal sender. The importance of this lies in the fact that the discharge sounds give assurance that the signal has been delivered to the engineer on the surface. A branch pipe should extend to the main signal pipe and a valve set between the discharge valve and main signal pipe, to permit repairs being made to discharge valve at any time.

A moderately light cord should be attached to the discharge valve at lever 5, and extended to within easy reach of the operator.

With each pull of the cord lever 5 pushes open valve 3, permitting a small quantity of air to escape from the signal pipe, and causing the signal to be transmitted to the engineer in the manner described.

COST OF INSTALLATION.

The apparatus required in the engine room consists of

1 Small whistle, Fig. 4,	cost	$1 25
1 Reducing valve, " 2,	"	4 50
1 Signal valve, " 3,	"	6 00
Total cost		$11 75

The entire cost of an installation to a depth of 1,000 feet, with signaling stations 100 feet apart would be $127.50, made up of details as follows:—

Engine room part of apparatus, as above	$11 75
Sufficient ¾" pipe to connect from engine room to collar of shaft—say 100 ft	5 00
Labor installing (1 day, fitter and helper)	6 50
11 Discharge valves, located one at collar and one at each working station, cost each $2.00	22 00
11 ¾" Common globe valves, 75c. each	8 25
1,000 feet of ¾" common iron pipe	50 00
50 Wrought iron hangers, 5c. each	2 50
Labor installing (1 fitter, 2 helpers—2 days)	19 00
10 pounds ¼" dia. cotton bell cord, at 75c	2 50
Total cost of equipment ready for service	$127 00

OPERATION.

Signals are given the engineer from any station or signaling point in the mine workings by a quick short pull of the signal cord attached to the lever of the discharge valve. Such pulls momentarily reduce the pressure in the main signal pipe and transmit an impulse on the column of air contained therein, the effect of which is to automatically operate the signal valve and discharge a small quantity of air through the whistle, sounding a sharp, clear blast, corresponding to each pull of the cord. Each whistle blast in the engine room is represented by a sharp discharge of air from the discharge valve, which gives to the signal sender the means of accurately checking the signal sent in.

Signal blasts may be given at the rate of two per second,—in fact, this rule should be generally observed, as long discharges of air at the

signal valve are not only unnecessary, but likely to confuse the engineer.

In case the supply of compressed air is likely to be shut off at any time, this system might be supplemented with the pull bell, or some of the electric systems of signaling.

THE ADVANTAGES OF SIGNALING BY COMPRESSED AIR AS COMPARED WITH THE PULL BELL SYSTEM.

In the apparatus for signaling by compressed air there is only one moving part, viz., the lever of discharge valve, whereas in the pull bell system all the parts are of the necessity moving parts, being obliged to reciprocate to every pull of the signal rope given by the signal sender. The advantage lies obviously with the apparatus having the least number of moving parts, as every moving part is subject to wear and disorder, which is costly to maintain and repair, and unreliable in operation.

Another very important advantage with the compressed air system, is the fact that the signal sender has always the means of knowing whether the signal sent by him has been delivered to the engineer. Changes of temperature, likely to occur from change of air currents, do not effect the working of the system. If any accident should injure the signal pipe or any other of the apparatus of the system, warning would be given at once to the engineer, so the injury could be rectified at once.

In the matter of costs for maintainance, the compressed air system has undoubted advantage of any other system. This system has been established and in operation for about 1½ months at the Le Roi Mine, and during this time has required no repairs whatever.

Mineral Resources of Vancouver Island.*

By W. M. BREWER, M.E., Victoria, B.C.

The mineral resources of Vancouver Island comprise coal, gold ores, copper gold ores, a little galena, and magnetite. Although the first discovery in coal was made on the east coast of the island as early as 1835, no systematic work of prospecting or developing was commenced until 1849, when the Hudson's Bay Company brought a party of coal miners from Scotland and commenced work at Suquash, a point on the coast near Port McNeil and semi-distant between Alert Bay Harbour and Hardy Bay. About 1852, the Company abandoned work at this point and commenced mining for coal on the present site of the City of Nanaimo. In 1862, that portion of the coal field together with the coal on Newcastle and other nearby islands was sold to the New Vancouver Coal Company. It was about this time that the late Honourable Robert Dunsmuir, who had been in the employ of the Hudson's Bay Company during their operations, resigned from their employ and started to prospect for coal fields on his own account. The first locations he made were the Harewood mines, which he sold to an English syndicate and which are at present being worked by the New Vancouver Coal Company. About 1869 or '70 Mr. Dunsmuir discovered the Wellington seam on the Nanaimo River and secured from the Imperial Government—previous to the entry of British Columbia into the Confederation—the tract of coal-bearing land which laid the foundation to the large fortune which that gentleman acquired before his death. The shipment of this coal to California ports is directly responsible for the partnership which was entered into later between the late Mr. Dunsmuir and Messrs. Huntington, Stanford, Crocker and Hopkins, the *Big Four* of the Southern Pacific, which partnership resulted in the building and equipping of the Esquimalt and Nanaimo Railway, and opening of the Northfield, Extension and Union Collieries. The foregoing is a brief history of the beginning of the coal mining industry on Vancouver Island.

The history of metalliferous mining commenced with the discovery of placer gold on the Leech and Sooke Rivers about 25 miles from Victoria in 1860, and during the big rush to the Cariboo Placer Mines. These discoveries were succeeded later by others on the China and Granite Creeks which empty into Alberni Canal as well as on Bear River, which empties into Bedwell Sound, on the west coast of Vancouver Island. It was not, though, until 1893 or '94 that any further attention was given to prospecting for other than placer gold and it was really not until the commencement of the Klondike excitement that any really serious efforts were made in prospecting even the coast-line on the western side of the island. Since then gold-bearing quartz, partially free-milling, copper ores and iron ores have been discovered on the west coast occuring in zones, having a general trend to the north-west, as well as copper-gold ores in the south-eastern portion of the island on Mounts Mallahat, Skerrit, Sicker and Brenton.

Geology.—Roughly speaking the geological formation of Vancouver Island can be divided into three separate classes of rocks, viz.:—Cretaceous sandstones, and shales in which occur the coal measures, a belt of semi-crystalline slates, and Dawson's Vancouver series, which according to his classification embrace the igneous and metamorphic rocks together with the crystalline limestones. The latter is considered by the same authority as probably belonging to the carboniferous period.

If a map of the island is consulted, the areas covered by these different formations are found to be as follows:—

Around Victoria and the extreme south end of the island, rocks of the Vancouver series, north from these and occupying a belt extending from Saanich Inlet across the island to the Gordon River and San Juan Harbour occurs the belt of semi-crystalline slates and schists in which are found a considerable quantity of graphitic slates. Northerly from this and extending along the east coast are the cretaceous coal measures with occasional breaks occupied by rocks of the Vancouver series. West from the coal measures, the island so far as is known is made up of rocks of the Vancouver series except a narrow fringe of sandstones, shales and conglomerates, possibly belonging to the Tertiary period, along portions of the shore line of the west coast.

No thorough geological survey having ever been made of the island it is very difficult to particularize and give other than a rough and approximate idea of the general geological features. Several geologists, mining engineers and prospectors, as well as the writer, have made notes on various sections, but as all of these are separated from one another by miles of intervening rock, of which absolutely nothing is known, the conclusions drawn are necessarily only vague. For instance, the Sooke mountain range is made up of a semi-crystalline slate and schists with stringers of quartz, which often widen out into lenses of some 3 or 4 feet in width and 40 to 50 feet in length interfoliated conformably with the general strike and dip of the formation, which has been traversed by several streams, among them the Leech, Jordan, Gordon and San Juan rivers. Consequently the writer has assumed that this zone or belt of formation extends across the island, although the middle portion of it, from the head waters of the Leech River on the eastern side to the head waters of the San Juan on the western side has never been actually visited by him.

As a matter of fact there is a very large portion of Vancouver Island even to-day which has never been explored by white men, and it is less likely to have been by the Indians because all the tribes occupy rancheries or reservations on the coast lines, devote their time to fishing and sealing, as they very much prefer travelling by canoe or boat to climbing mountains and pushing their way through the sallal or other underbrush with packs on their backs. For this reason but little information can be gathered from the aborigines, who, as a rule, in most of the western country have explored extensively previous to the invasion by white men.

There is a certain regularity about the mineral-bearing zones on

*Read before the September meeting of The Canadian Mining Institute.

the west coast: for instance, the zone in which non cupreous magnetite occurs is situated nearer to the coast line than the zone carrying copper ores; while the zone in which gold-bearing quartz is found lies to the north-east from that in which copper ores are found

The geological and mineralogical features of Vancouver Island, so far as the observations of the writer go, present many very interesting, complicated and to a great extent, unique characteristics

While the zones of country rock have some regularity as regards strike and dip, yet the results from eruptive action have been such that extensive and innumerable faults are encountered which add to the complications in prosecuting development work. There are no leads in the general acceptation of the word. The ore bodies are composed principally of lenses occurring either at the contact of igneous dykes and limestone or else in fissures in the igneous rocks or as lenses in schistose rocks. The characteristic fissure veins of Colorado are, so far as the writer's observations have extended, entirely wanting on the island. While it is true that you can in many instances follow an outcrop from point to point for distances varying from 200 to 1,000 feet, yet development demonstrates that the so-called lead is made up of lenses lying *en eschelon* to each other and usually having a pitch in a different direction to the dip. In following such ore bodies down it has been found that they possess similar characteristics in a vertical direction to those in a horizontal direction. Consequently, before the engineer is thoroughly competent to prosecute development work on the island, he should make a very close study of the geology and of the results from development work on neighbouring properties, otherwise he is liable to make mistakes which he will regret.

One of the features peculiar to Vancouver Island is the heavy outcroppings of hornblend which contains so great a percentage of iron that the surface has the same rusty ochreous appearance as is found in the regular gossun outcroppings, but on being broken into it is found that this apparent iron capping is only a thin scale underlaid by hornblend crystals, many of which are undergoing the evolution which alters the hornblend into asbestos and closely associated with which are crystals of iron pyrites. Another is, that there is practically no oxidized zone, but the unaltered sulphides of copper occur immediately under the surface; in fact the writer has found crystals of copper pyrite which showed by assay as high as 24 per cent. copper within a foot or two of the surface and enclosed in a mass of magnetite. Garnet rock and epidote are usually found associated with the magnetite and copper deposits on the island, as gangue material and forming ledge matter.

The question of origin of the ore deposits is one which will interest geologists and engineers very much. Apparently the magnetite is the resultant from the basic igneous rocks and illustrates Posepny's theory, but the question has been propounded as to whether these rocks are sufficiently basic and whether or not the deposition of the magnetite is due to some other cause.

Posepny, in his treatise on the "Genesis of Ore Deposits," has the following paragraph, viz.: "As to the eruptive rocks we do not know what they once were, as we study them only from the moment of cooling. But we observe at once that iron—a metal widely distributed in all deposits and in nature—generally occurs primitive in these rocks in the form of magnetite, a mineral of striking metallic appearance."

Felsite is found very frequently in contact with the crystalline limestone and the igneous rocks. This felsite apparently occurs in dikes as intrusions, and a close examination of the formation where such dikes occur suggests the probability of movements at different periods and the possibility that the felsite intrusions belong to an older period than the intrusion of the other igneous rocks, and also that the ore bodies are more closely associated and have been more thoroughly influenced by the intrusions of the felsite than of the other igneous rocks in locations where the ore occurs as contact deposits, but where the ore fills fissures in the diorite or dialase the writer has noticed the absence of felsite and also the fact that the magnetite with the associated chalcopyrite does not apparently maintain continuity to any great depth, but that both classes of ore give out simultaneously. Evidently the chalcopyrite has been deposited by the infiltration of copper charged waters through crevices and porous places in the magnetite, and it is very questionable, in the opinion of the writer, whether these fissure ore bodies will possess any great value as compared with the contact bodies and the lenses in the schist formation. In the two latter occurrences but little if any magnetite is noticeable associated with the chalcopyrite.

One peculiar characteristic which is generally noticeable with regard to the ore bodies which fill fissures in the igneous rocks is that there is only one well defined wall instead of both walls being well defined as in the general run of fissure veins in Colorado, for instance. As a matter of fact the fissures in the igneous rocks on Vancouver Island appear to approach more nearly to the cleavage planes of faults in which the work of replacement has been progressing until ore bodies of variable width and of lenticular structure have been deposited. The change from solid ore to barren country rock has been gradual. These conditions are noticeable in very many of the ore bodies occupying these so-called fissures. Often, too, when the ore has given out entirely the one wall remains perfectly good with a coating of calcite varying in thickness from several inches down to a knife blade as a parting between the wall and the country rock. Narrow seams of calcite will often be found extending into the country rock on both sides of the wall and filling fractures. These fractures, and indeed the fissures in which ore bodies are found, in the judgment of the writer, are merely contraction joints caused by the cooling of the igneous rocks from a molten condition.

Economic Features.—Those portions of the island which are actually productive at the present time naturally possess a greater interest than the non-productive, and it is these which the writer will discuss in the present paper rather than the sections in which, although mineral has been discovered, locations made and prospecting work done, are still in a non-productive stage

Starting from the south end of the island the first productive district is Skerrit Mountain, where in 1897 was made one of the first locations of copper gold ore recorded on the island. The ore body has a maximum width of about 4 feet and occurs in shoots. The one on which most development has been done is 90 feet in length. The ore mined from it to a depth of about 60 feet was shipped to the Tacoma smelter during the year 1900 and yielded from 12 to 15 per cent. of copper and about 7 ounces of silver and a dollar in gold to the ton. This ore body occurs in a metamorphosed slate, in which occur dykes of eruptive rock and the ore body apparently fills a space between these two varieties of rock, in which also has been deposited a considerable thickness of quartz, so that, frequently, the quartz ledge-matter is found unaccompanied by ore, but at other times the solid ore occupies the entire space. A series of faults have been exposed during the progress of development work, through which the ore body is thrown several feet horizontally; consequently, to a casual observer there are apparently three or four distinct leads, when, as a matter of fact, the conditions indicate the system of faulting as described by the writer.

The next productive portion of the island is that known as the Mount Sicker District, in which are located the "Lenora," "Tyee," and other mineral claims. Of these, the Lenora has shipped in all about 35,000 tons of ore, and in the Tyee the management report 60,000 tons blocked out. The character of this ore is chalcopyrite in a barytа, garnet, quartz and iron pyrite gangue. The grade averages about $5.00 per ton in gold, 5 per cent. (dry) in copper, and variable silver values.

These ore bodies are lenticular in structure and occur interformated between schists, with their lines of strike conformable to the schistosity of the rock, but apparently not conformable to the original bedding

planes. The schistosity has been caused apparently through shearing movements, resulting from the intrusion of dykes and convulsions of the earth's crust. The schistose rock is so altered as to make a microscopical examination by experts necessary before it can be properly classified, the igneous dykes in some instances have porphyritic structure, in others resemble diabase. The occurrences of ore are, so far as the writer's observations have gone, confined to the sheared zone, and where the rocks are massive, or even at the contact of the massive dykes and the schistose rock, ore bodies do not occur This condition, though, may not be a general rule, but may prevail only at such points as have been examined by the writer.

During the early development stages of these properties, the writer was severely taken to task for expressing the opinion that the ore bodies were lenticular in structure instead of occupying a continuous lead and maintaining unbroken continuity to some undetermined great depth. But the development work done up to the present time has demonstrated clearly that the writer at that time described the structure of the ore bodies accurately as such has been since determined by actual work.

The sheared zone in this district is of, as yet, undetermined extent; longitudinally it maintains continuity through Mt. Sicker, across the Chemainus river, and westerly through Mt. Brenton. The trend, or line of strike, of this zone is to the west, while the general trend of the country rock of the island is north-westerly. It is quite possible that this zone of schistose rocks has merely local limitations, because the Alberni Canal traverses the westerly portion of the island for some 28 miles, and if these schistose rocks maintained continuity in a westerly direction, this canal ought to crosscut the formation; but, if such be the case, the fact has been unobserved by the writer, notwithstanding that he has made several expeditions along both shores of the canal—which, however, does crosscut a copper-bearing zone, the rocks composing which, though, suggest a different geological formation. The Mt. Sicker formation also occurs on the north side of Maple Bay, on the east coast of the island, but in that locality the belt of schistose rocks is apparently of very much less extent in width than on Mts. Sicker and Brenton.

Travelling northerly from the Mt Sicker district, the coal measures are met with within a comparatively short distance, and so far as the extreme eastern coast of the island is concerned the crystalline rocks do not again appear, except in limited areas around Nanoose Bay and a strip along the shore line of Discovery Passage and Johnstone Strait. It is along that portion of the Eastern Coast from Oyster Harbor—a short distance north from Mt. Brenton—to Comox Harbour, a distance of about 75 miles, that the productive coal mines are located. From these have been exported for several years an average of about a million tons of coal per year; in fact the chief market for the total output of these mines has been California. There are collieries located at Extension, about 10 miles west from Oyster Harbour, at Alexandria, about 10 miles north of the Harbour; at Nanaimo and Harewood, 15 miles north from the Harbour, at Wellington, about 6 miles north-west of Nanaimo, and at Union, about 11 miles inland from Comox Harbour. All of these collieries, with the exception of the original Wellington Colliery, are producing bituminous coal to-day and a good quality of coke is being made at Comox Railroad. Connection between the collieries and salt water have been established for several years past. The coal industry alone has built up the flourishing towns of Nanaimo, on Nanaimo Harbour, Ladysmith, on Oyster Harbour, and Union, about 12 miles from Comox Harbour, besides being the cause for the building of extensive wharves, bunkers and coal washers at the harbours. Coke is only manufactured at Comox, where a plant of 200 bee-hive ovens has been constructed. The coke manufactured at that point, although carrying a somewhat higher percentage of ash than the best Pennsylvania coke or the Crow's Nest Pass coke, has always found a ready market in the coast smelters and previous to the development of the Crow's Nest Pass coal field was used by the smelters in the interior of British Columbia.

In the southern portion of this coal field there are two workable seams of coal designated as the Wellington and Douglas, of these the Douglas is the upper seam and is mined at the Nanaimo and Alexandria collieries, while the lower is only mined at the old Wellington and Extension collieries, in which fields apparently the upper seam has been carried off by erosion.

Much faulting has occurred through this portion of the island, which of course causes many complications in the workings. For instance, a bore-hole on the Harewood property, which adjoins the Nanaimo Colliery property, exposed a workable seam of coal, but a shaft sunk about 200 feet from the bore-hole failed to intersect the seam at the depth estimated and later investigations prove that a fault has occurred in the space between the shaft and bore-hole which was not apparent on the surface, and the downthrow had been 80 feet.

The total area of the productive territory of the coal fields on the east coast of Vancouver Island cannot be estimated because no accurate detailed geological survey has been made. With the exception of the Wellington Colliery proper, which was the private property of the late Honourable Robert Dunsmuir and at which work was suspended some months back, the acreage owned by the New Vancouver Coal Mining and Land Co. and a few small holdings, the entire field is included in the land grant of the Esquimalt and Nanaimo Railway Company. So far as the east coast of the island is concerned there are no other productive mineral-bearing properties, and in fact but comparatively little is known of the interior of the island to the north-west from the Mt. Sicker district, and south-easterly from Quatsino Sound, except around the head of the Alberni Canal, which body of water penetrates to within about 25 miles of the east coast with its entrance in Barclay Sound on the west coast. Quatsino Sound penetrates from the west coast to within about 10 miles of the east coast of the island and near the north-west end.

It was on the China and Granite Creeks which empty into Alberni Canal on the eastern side, where placer gold was discovered in the '80's, but the neighbourhood was not prospected for lode mines until since 1894.

Gold-bearing quartz bodies, occurring as long lenses with their lines of strike conformable to the trend of the country rock, have been mined on Mineral Hill, near the head of China Creek, and in the mountains near the head of Granite Creek, but at the present time no operations are being conducted. Some of this quartz carried extremely high gold values at and near the surface and was partially free milling, several tons of ore having been treated from the Consolidated Alberni group of claims on Mineral Hill and the 3 W's group near the head of Granite Creek. At the former of these properties the country rock is a schist but at the latter the ore occurs in granite. The schists of China Creek contain considerable hornblend and very probably are really altered granite. Further down the canal, which crosscuts the country, there is quite a marked change in the country rock and a wide zone of crystalline limestone, in which diorite, diabase and some felsite as intrusive dykes occur. In this have been discovered a large number of prospects carrying copper ores, usually chalcopyrite, associated with pyrrhotite, some of which have been productive, and on one at least some 5,000 feet of development work have been performed. This zone appatently extends to the north west for quite a considerable distance, because the streams which empty into the inlets further to the north-west crosscut similar formation, in which a great many prospects carrying the same character of ore—but associated with magnetite, as a rule, instead of pyrrhotite—have been located. A prominent feature with regard to the ore bodies in this zone is the phenomenal appearance of

the outcroppings, both as to extent and grade, while another prominent feature is the complicated geology as demonstrated by the mine workings. Apparently this particular zone disappears under the ocean in the vicinity of Nootka Sound.

In the mountains near the shore line of Sydney Inlet occurs a mineral-bearing zone which, judging from the character of the country rock, belongs to or is an extension of the same zone as has just been described, but in which the character of the ores differ, to this extent that extensive bodies of high-grade bornite occur, with which is associated at the deeper levels chalcopyrite. Although a very considerable amount of development work has been performed upon, at least, two groups, the Anaconda and Black Prince, and it is reported that considerable ore has been accumulated, yet because of lack of tramways to connect the mine working from the shore no shipments have been made. Between Sydney Inlet and Quatsino Sound but comparatively little prospecting has been done. The country is very difficult to travel in; the mountain ranges are higher than is usually the case from Sydney Inlet to the south-east, the growth of timber is very heavy and the sallal and other underbrush extremely dense.

The most northerly productive section of the island is along the shore line of the main Quatsino Sound and its arms, where copper ores occur in enormous outcroppings and from which shipments, carrying satisfactory values, have been made to the smelters. These occurrences of ore are found at or near the contacts of crystalline limestone with felsite or other igneous dykes. Although the country rock belongs to Dr. Dawson's Vancouver series, yet the particular zone in which the mineral occurs, in the opinion of the writer, does not bear any relationship to that crosscut by the Alberni Canal, but appears rather to belong to another zone which crosses from the eastern side of the island. However, this is merely offered as a suggestion, as neither the writer, nor to his knowledge, anyone else has exploited to ascertain the extent of the zone towards the south-east or east. During the present year considerable activity has been shown in the development of this section and shipments have been made to the Tacoma and Crofton smelters. At the present time an aerial tramway is being constructed to facilitate shipment from the mines to the coast.

The non-cupreous magnetite deposits which have been before referred to in this paper, as occupying a zone along the west coast of the island, have during the past two or three years received a great deal of attention from syndicates which acquired bonds on all the available workable deposits possible, and have been developing such with a view of shipping the ore to the Irondale furnace in the State of Washington for manufacture into pig-iron.

So far as the writer's observations have gone this zone is apparently entirely distinct, so far as the mineral deposits are concerned, from any other on the island; but so far as the country rock is concerned, practically the same geological conditions exist as in the copper-bearing zone already described. The known deposits of magnetite occur on the Gordon River, which empties into the San Juan Harbour, about 70 miles west from Victoria; Serita River, which empties into Barclay Sound, near the entrance to Alberni Canal; Tzartoos or Copper Island, situated in Barclay Sound, and on Sechart Peninsula, a promontory north-westerly from Copper Island, and also in Barclay Sound. Whether the same zone extends farther to the north-west has not, to the writer's knowledge, been yet determined, but deposits of iron ore are reported as occurring in the mountains near the shore line of Nootka Sound.

From the foregoing paper some idea can be gleaned as to the possibilities of the mineral resources of Vancouver Island when thoroughly exploited and developed. The writer has only attempted to go into the subject in a crude manner and not in the finished, comprehensive style which the subject really merits.

Notes on Machinery Constituting a Mining Plant.

By ALFRED C. GARDR, M.E. Sandon B C.

The following notes may be found useful to mine investors and engineers in charge of mining properties, and, although written with a particular view to conditions in British Columbia, pertain to mining elsewhere as well.

From the very time that a mineral claim passes out of the prospector's ownership the question "how to work the property at the least expense and with the best results" presents itself to the investor, and that this has been an important as well as a difficult question nobody will doubt when referring to the numerous idle plants of more or less value found in nearly all mining camps.

Any mining failures cannot but reflect on mining in general and should therefore be guarded with all possible care by the professional engineers.

To make a paying investment and a mine out of a prospect without employing other power than hand labour is hardly possible nor excusable now-a-days, except perhaps where the formation is unusually soft and the ores of very high grade, or possibly where the property is remote from any convenient point of transportation. In certain sections of the Slocan and Lardo districts conditions of this nature exist, but, being rather exceptional, do not exactly come in under the class of mines referred to here.

Hand labour should therefore only be employed to prove the property to a reasonable depth, perhaps one hundred feet or so, or sufficient to warrant the investment in a medium sized hoisting plant, but here I have frequently observed that instead of getting a medium sized hoist, say a 10 x 12, that would develop the property for a couple of years, a large plant, and sometimes even direct motion hoists with corresponding equipments are put in. Anyone that is interested and makes inquiries why a smaller plant would not have answered the purpose, receives invariably the same answer, viz.: Expectations of having a great mine some day, which would make it impossible to get along with anything smaller. If the mine turns out to be wonderful, good and well, but the chances for becoming a great mine are nearly always against the prospect. The number of claims recorded every year compared with the number of paying mines shows this only too well; but even supposing that the small hoisting plant, within a couple of years, should have to be replaced with a larger one, there is hardly a stock-holder to be found in any country that would not be pleased to learn that the mine was producing ore so rapidly that the original prospecting plant was now unable to cope with the increased output. The above does not pretain to hoisting plants alone but to all matters pretaining to mining and milling investments as well, and it is hardly necessary to add that if this first principle of economy in mining ventures had been followed out more generally during the past history of mining in British Columbia, considerable of the investors money and disappointment would have been saved.

Hoists.—In regard to hoisting machinery I find that it is quite common to see ordinary cast-iron gears and pinions used. As a matter of fact a hoist should not be permitted to handle men anywhere without having the most perfect kind of gearing. I would recommend to use a cast-steel gear with well cut teeth running together with a rawhide pinion. I have used this design successfully even on large double cylinder hoists, where the hoisting speed at times would exceed 1000 feet per minute, and where a speed of 600 feet per minute with the ordinary cast-iron gears would be considered unsafe and excessive. The rawhide pinion also does away with 50 per cent. of the objectionable noise peculiar to geared hoists, and reduces friction as well as wear of teeth.

Where two drums have to be used the main shaft should be in one piece and supported by three pillow-blocks. One substantial gear with rawhide pinion placed as close to the centre journal as possible will be found to give better satisfaction than two smaller gears on either side. Drums should be loose on the shaft and provided with removable composition metal bushings. Each drum should be operated by an independent friction clutch, keyed to the shaft close to the main gear, so that the drums can be run in balance or independent of each other as required. The engine should be fitted with reversible link motions of forced steel.

For a brake device I prefer the post brake to which a very neat safety contrivance for over-speed can be attached. It consists of a small speed governor geared from the main shaft. Whenever the speed exceeds the safety limit—say 1000 feet per minute—the automatic governor will cause a throttle valve to open, thus permitting steam, or preferably, compressed air, into two small air cylinders having their piston rods directly connected with the post brakes in such a manner that the compressed air forces the piston down, setting the brakes at the same time. One mutual governor will do for both sides but each post brake must have its own independent air cylinder.

To take care of the surplus hoisting rope and to save the dead coils from being worn by that portion of the rope which is in constant use a false reel can be placed inside of each drum and so arranged that the extra rope can be conveniently let out through a slotted hole in the rim of the drums whenever required. This avoids rope splicing.

Unless the mine is producing 500 tons per 24 hours from a depth of 1500 feet or more I prefer a self-contained double cylinder 14 x 18 geared hoist of the above description even to a first-motion hoist. The amount of material that a hoist of this character is able to handle is quite astonishing, especially where two skips, each of two tons capacity are used.

Skips versus *Cages*.—For vertical shafts where the vein is perpendicular or nearly so it is only fair to admit that the well known mining cage has done good work, but wherever it is possible to use a skip or skip-car I always prefer it to the cage. Within the last few years the skip system has gained much favour and has been introduced pretty well throughout all the large mines in Butte, Montana, as well as South Africa, both for vertical and incline shafts. It stands to reason that where a large amount of material has to be handled from several levels and from a considerable depth, a single-deck cage with room for 1 ton car only is quite insufficient, and two, three or even four deck cages will have to be employed to do the work, in such cases the combined dead weight of cages and cars becomes both enormous and impracticable. I remember two well know mines in Butte where four-deck cages were used until a five ton vertical skip was introduced. Each deck was carrying a one ton ore car, and the combined weight of four cages and four empty ore cars aggregated 9600 pounds, or 2400 pounds of steel per ton of material hoisted, while a five ton vertical skip that was put in later on only weighed 5000 pounds, being equal to 1000 pounds of steel to one ton of material hoisted. Where good fuel is expensive and several thousand tons of material are hoisted every day, as in the above case, the amount saved in coal represents a very handsome yearly dividend. The same rule also applies to a smaller hoisting plant. The average weight of a standard mining cage is about 1200 pounds and a 16 cu. ft. standard ore car weights about 800 pounds, making a total of 2000 pounds, while a one ton skip or a skip car with safety clutches, will not exceed 1500 pounds. If 200 trips are made during 24 hours the extra dead weight would amount to 50 tons or 25 per cent. of the hoisting capacity.

To make the skip system a success it is necessary to have bins or ore pockets cut out at each station in the mine so as to receive the ore or waste made during one shift. When the car-man has emptied his car into the ore pocket he returns to the chute to re-fill it. Any time during the shifts the pockets are emptied and it will then require a man at the bin gate to fill the skip and prevent spilling of material down into the shaft. This last feature was solved in vertical shaft propositions when the pneumatic ore-bin gate was introduced in Butte, as it enables the operator to shut off the ore stream within a second, or in other words when the skip is loaded. In addition to the pockets at each level a storage bin will be required at the top landing. Depending upon the arrangement several combinations for handling both ore and waste on top can be made, depending upon the ingenuity of the engineer in charge. It will readily be seen from the above that by the skip system economy in labour is possible and the proverbial "waiting for the cage" is done away with. The skip is equally as convenient for handling men and material down to the mine and is safer than a cage.

It is generally advisable to have a large bin capacity on top as it is often necessary to store different classes of ore. Ideal conditions are those where the ore can be loaded directly into railway cars. A crusher and screen placed above the bin will always be found convenient for breaking and sizeing the ores. Ore bins and gallows frame can usually be built together and I think that in British Columbia wooden gallows frames are preferable to expensive steel ones. The danger from fire is equal in both cases, as wood cannot be avoided for the construction of floors and the cost is at least twice as much again as the best wooden frame.

Head sheaves should always be large and lined with rubber or hemp to save the hoisting rope. Wrought iron spokes cast in with the hub and rim should be avoided as the spokes soon will get loose and commence rattling. Substantial shafts made of hammered steel and self-oiling journals are recommended.

For hoisting rope a flexible plough steel, six strands 19 wire rope is the best. For a skip of one ton capacity a $\frac{5}{8}$ in. rope is sufficient and for a two ton skip $\frac{7}{8}$ in. It is very common to find too heavy rope used, which, unless the sheaves are proportionally large, will ruin the rope within a short time. The most convenient incline in a shaft using skips is 70 degrees. Rollers should be provided at intervals in the shaftway, thus preventing the rope from dragging on the foot wall.

For inside work over winzes and for sinking purposes, I like a friction hoist. It is not exactly the type of hoist that should be placed over an important outside working shaft, but will be found extremly convenient for prospecting with a bucket or small skip. Care should be taken that the hoist is not overloaded, in which case the friction might slip.

Where compressed air is used for hoisting purposes it will nearly always pay to re-heat the air just before entering the cylinders. The re-heater should be placed as close to the hoist or air drills as possible, and all pipes wrapped with waterproof asbestos covering. It is not always convenient to use coal under ground. In some cases coke, if not too expensive, might be used.

British Columbia is extremely fortunate in possessing large areas of desirable steaming coal, a feature which, I think, is only surpassed by the abundant water power distributed over the greater portion of the province. No other section in North America can probably equal it in that respect.

Where coal is used for generating purposes I find that 80 or 90 pounds steam pressure is frequently the limit. I should however advise to have the boilers built to carry 125 or even 150 pounds pressure as it will be found a saving of fuel to do so.

MINING INSTITUTE.

Holds Highly Successful Series of Meetings in British Columbia. Many New Members Elected, and a Provincial Branch Organized.

A local meeting of British Columbia mine managers and mining engineers was held under the auspices of the Canadian Mining Istitute, at Nelson, British Columbia, on Wednesday and Friday, 10th and 12th September, in the room of the Board of Trade. There was an excellent attendance, among other representative mining men being the following:—

J. H. Tonkin, General Manager, Crow's Nest Pass Coal Co., Fernie.
J. H. MacKenzie, E.M., General Manager, LeRoi Mining Co., Rossland.
Bernard MacDonald, E M., General Manager, Rossland Great Western, Rossland.
S. S. Sorensen, M.E., Velvet Mines, Ltd., Rossland
Wm. Thompson, Superintendent, Le Roi No. II, Rossland.
S. S. Fowler, S.B, E.M., London and B.C. Gold Fields, Nelson.
Leslie Hill, C. and M.E., Hastings (B C.) Exploration Co., Nelson.
R. R. Hedley, Hall Mines, Ltd., Nelson.
James Cronin, St. Eugene Cons. M. Co., Moyie.
James McEvoy, Crow's Nest Pass Coal Co., Fernie.
Frank Fletcher, P.L S, Nelson.
James W. Moffatt, B.Sc., Nelson
Norman Carmichael, Assayer, Nelson.
Ernest Woakes, M E., Duncan United Mines, Nelson.
A. C. Garde, E M, Payne Consolidated, Sandon.
S. F Parrish, E.M, B. C. Chartered Co., Eholt, B C
H. G. C. Croasdaile, Nelson, B C.
Alex. Sharp, Mine Superintendent, Rossland.
H. Mortimer Lamb, Editor B. C. Mining Record, Victoria.
E. B Kirby, E M, General Manager, Centre Star Mining Co., Rossland.
Bruce White, Molly Gibson M. Co., Nelson.
M. H. Davys, C. & M.E., Nelson, B.C.
A H. Gracey, Venus and Athabasca Mines, Nelson, B.C.
G W. Chaplin, St. Catharines, Ont.
E E D Wilson, Kingston, Ont.
Smith I. Curtis, M L A, Rossland, B.C.
H. C. Black, Nelson, B C.
B T. A. Bell, Editor *Canadian Mining Review*, Ottawa.

The opening session was held on Wednesday afternoon, 10th September, at three o'clock.

On motion of the Secretary, Mr. S. S. Fowler, E.M., was called to the chair.

Mr. S. S. FOWLER, in welcoming the members of the Institute to Nelson, referred to the excellent work done by the organization on behalf of the profession and industry of mining in Canada. The proposition to organize a local branch in the Province was one which received his heartiest commendation, and would doubtless be carried out. The following new members were elected.

NEW MEMBERS.

Dr. Bernard Mohr, Mond Nickel Co., London, Eng.
Mr. Wm. Thompson, Superintendent, LeRoi No II, Rossland.
Mr. J. H. MacKenzie, E.M., LeRoi Mining Co., Rossland.
Mr. S. S. Sorensen, M.E., Velvet Mine, Ltd., Rossland.
Mr. J. H. Tonkin, General Manager, Crow's Nest Pass Coal Co., Fernie.
Mr. Thomas Stockett, Junr., Superintendent, Crow's Nest Pass Coal Co, Fernie.
Mr. James Cronin St. Eugene Con. Mining Co., Moyie.
Mr. George L. Griffith, C.E., Winnipeg.
Mr. Frank H. Probert, M.E., Los Angeles, Cal.
Mr. Edward H. Sanborn, Con. Lake Superior Co., Philadelphia.
Mr. A. R. Wilson, Crow's Nest Pass Coal Co., Fernie, B.C.
Mr R. W. Coulthard, Analytical Chemist, C N.P. Coal Co., Fernie, B C.
Mr. H. C. Richle, Mining Engineer, Black Lake, Que.
Mr. H Mortimer Lamb, *B. C. Mining Record*, Victoria B.C.
Mr. James W. Moffat, B.Sc., Nelson, B.C.
Mr. Norman Carmichael, Assayer, Nelson, B.C.
Mr. Frank Fletcher, P.L.S., Nelson, B.C.
Mr. A. H. Gracey, Athabasca-Venus Mines, Nelson, B C.
Mr. Aaron H. Kelly, Nelson, B.C.

MINE SIGNALLING BY COMPRESSED AIR.

Mr. WM. THOMPSON, Superintendent of LeRoi No. II, Mining Company, presented a paper on this subject, reproduced elsewhere in this REVIEW

TIMBERING BY THE SQUARE SETT SYSTEM AT ROSSLAND.

Mr. BERNARD MacDONALD, General Manager of the Rossland Great Western Mines, Ltd., presented a summary of his paper on this subject, which provoked an interesting discussion among the members.

B. C. BRANCH ORGANIZED.

The SECRETARY explained that in accordance with a resolution passed at the last annual meeting, it had been determined to organize branches of the Institute in different sections of the Dominion, and two had already been formed in Ontario and Quebec. The Institute had a large and representative membership in British Columbia, and if this was organized into a Provincial Branch meetings could be held at different provincial points more frequently, and doubtless much good could be accomplished for the profession and industry of mining in British Columbia.

Mr. BERNARD MacDONALD (Rossland)—I am satisfied it will be a great advantage to have a Provincial Branch of the Institute in British Columbia to compare ideas on mining practice in the various districts of the Province, and also to promote better mining legislation.

Mr. E. B. KIRBY (Rossland) concurred, and suggested that, inasmuch as many of the members of the Institute were also members of the British Columbia Mine Owners' Association, it would be advantageous to both if it could be arranged to hold their meetings at the same time and place. One meeting could be devoted to business and government questions and the other to the discussion of papers.

After some further discussion, a resolution—"That a branch of the Institute in British Columbia be now formed," was unanimously adopted. The appointment of a committee of management was deferred until a later session.

The meeting adjourned at 5.30 p.m.

WEDNESDAY EVENING SESSION.

The members reassembled at eight o'clock, Mr. Leslie Hill, C. & M.E., Nelson, being called to the chair.

COARSE CONCENTRATION IN THE SLOCAN DISTRICT.

Mr. S. S. FOWLER, S.B, E.M., presented his paper on Coarse Concentration in the Slocan District, B.C., reproduced elsewhere in this issue

The paper was discussed by Messrs. Woakes, Harris, Hill, Garde, Cronin and others.

THE INFLUENCE OF GOVERNMENT UPON MINING.

Mr. E. B KIRBY (Rossland)—In most mining districts of the world the difficulties which we as engineers have to confront are mainly business-technical problems. Methods and economics in mining, transportation, milling and smelting, studied both from the scientific and business side, absorb our attention In few cases do questions of State economics force themselves upon us, because mining is almost everywhere a favored industry treated by governments with fostering care, and considered worthy of every sacrifice and every encouragement by the State. It is rightly recognized as the mother of industries, focusing the attention of the entire world upon each newly-discovered mineral area. Upon this all the resources of civilization in men, money and skill are poured out. Around it agriculture, stock-raising and lumbering spring up, railroads appear without the aid of land grants or subsidies, manufactures and towns follow, and a commonwealth is established.

Now the British Columbia mining industry is unique in the world, not only in its entire lack of State recognition and fostering, but in the fact that difficulties imposed by State economics overshadow in importance all the ordinary technical and business problems with which mining men have to deal. It affords today a curious and interesting illustration of the injury wrought by unwise government, and also of the reaction of repressed mining on commerce and other industries. These effects are emphasized by contrast with the present prosperous condition of the other Provinces of the Dominion and also of the United States.

It is clearly recognized by the Canadian Mining Institute that British Columbia contains one of the largest and most promising mineral areas of the Dominion. But in considering the welfare of its leading industry of what use is it to concentrate attention on the fine points of machinery, mining methods and ore treatment if we ignore such realities as a Government tax-

ation which amounts to one-fourth of the gross value of its product? And a single item of which bars the treatment of low grade ores.

The phenomenon before us presents the following features: The Rocky Mountain range has been developed from lower South America to British Columbia, yielding a practically continuous chain of productive mining districts. It is found equally productive at the two points touched of Southern British Columbia and the Yukon. The unexplored area between, some six hundred miles of which is in British Columbia, should average up as well as that already known. Concerning the development of this area I quote from a memorial of the British Columbia Mining Association, of June 28, 1901:—

"The development of these resources, begun a few years ago so "auspiciously, has been brought to a practical standstill, and whereas a "few years ago the mountains were swarming with prospectors, today "these pioneers of the mining industry have practically disappeared. "The flow of capital into the Province has been practically cut off, the "metal production is at present decreasing, numbers of producing "mines have closed down and those operating have with few exceptions "ceased to pay dividends. The working mines are struggling under "heavy burdens which are still accumulating each year. It is now "frankly admitted by mining men that the industry is prostrated in "many mining divisions, and that its condition is rapidly becoming "worse."

Allowing for all the reaction from the mining boom the Association correctly ascribes the increasing paralysis to two main causes—excessive taxation and oppressive legislation.

At present conditions are even worse than those described. Prospecting, and the development of new deposits to replace those exhausted, have practically ceased. Of 14,326 Crown-granted and recorded claims held December 31, 1901, only 78 yielded ore in excess of 100 tons total production for the year. This is about one claim in every 2,000 held. The bulk of the tonnage was confined to a dozen or so mines, most of these operating at a loss. The increased metal statistics for 1901, $15,000,000 against $11,348,000 for 1900, was due entirely to two mines, neither of which yielded dividends, and one of which has announced a large increase in its debt. Moreover, the statistical figures of production are fictitious in that the metals are valued theoretically by New York quotations for the refined product, the true or actual values received by British Columbia industry being much less. Meanwhile the serious financial condition of the Province has been clearly shown by Mr. F. J. Proctor in his pamphlet on "The Financial Crisis in British Columbia" and it is currently reported that the Government met with failure in its recent attempt to float another loan in London. The stagnation of commerce and the present exodus of population is recognized by everyone.

It is not of interest here to go into details about the oppressive and threatening legislation which in British Columbia has so characterized the dealings of the State with its chief industry. What is of interest is the spectacle, unknown elsewhere in the Dominion or in the Empire, and probably unparalleled in the world, of a mining industry trying to exist under a burden of taxation which amounts to between 20 and 30 p.c. of its gross product.

The gross products of British Columbia in 1901, were about $27,000,000, distributed as follows:—

Industry.	Probable Annual Production.	Per Cent.
Metal mining	$15,070,382	55.1
Coal mining	5,016,398	18.3
Fisheries	3,065,900	11.2
Lumbering	1,690,000	6.2
Agriculture and Miscellaneous	2,520,000	9.2
	$27,362,680	100.7

Without considering an increase of about $800,000 yearly in the $10,000,000 debt, the actual taxes collected, Dominion and Provincial, amount to $5,350,000 which is 20 p.c. of everything produced. This is from a population which probably does not exceed 125,000 or 130,000 whites. Through the shifting of taxation by other industries onto mining the burden on the latter probably approaches 30 p.c. of its product, even when the latter is valued by the aforesaid fictitious method. In this remarkable state of affairs the fact that mining exists at all is the strongest evidence of the value of British Columbia's mineral deposits, and of the future which awaits the industry here when these artificial burdens are removed.

Even if the total load permitted it low grade ore must remain for the most part untouched on account of the so-called 2 p.c. tax on the gross output of mines. This tax is only one item in the total mentioned above but it has the peculiar effect of exacting an increasing proportion of the profits on the lower grade of ores. For instance, on the milling grades of Rossland it will seize anywhere from ten to twenty per cent. of the net profit. This bars Treadwell's in British Columbia.

The present state of affairs is instructive not only to the mining profession, showing how unwise Government can injure mining, but also to students of economics, presenting an extreme case of the blighting effects of taxation upon industry. To the student the phenomenon is marked by the same familiar symptoms which always accompany evils caused by acts of the political organism. There is the same curious indifference and refusal to see facts as they are, the same tendency to ascribe the evils to every cause but the right one. There is the usual effort to conceal the truth from the outside world and to condemn those who boldly and clearly call for reform. There is the same old anxiety not to correct the evil but to find excuses for evading action.

WHAT GOVERNMENT COULD DO FOR MINING.

Buckle, in his history of Civilization, briefly characterizes its progress as the abolition of bad laws. Beyond this, industry requires nothing. All it wants from the State is what Diogenes asked from Alexander, "Keep out of my sunlight." As every economist knows the State is all powerful to injure industry but cannot directly aid it except by the familiar procedure of assisting one branch by robbing others for its benefit. Indirectly, however, the State can do wonders by the gradual, persistent removal of laws which oppress. Few people realize the sensitiveness of industry, or the narrow margin of profit by which it lives. Upon its delicate organization taxation acts literally like the hand of death. It shrinks, withers or dies at its touch. Taxation which is excessive or badly placed is worse in effect than war or pestilence. As industry declines the burden becomes heavier on the survivors, and thus the disease accelerates its own progress. Such taxation kills the goose that lays the golden eggs, and the bankruptcy of the State inevitably follows.

The simple principles of modern scientific taxation are well understood. In theory if not in practice the world has advanced since Colbert, the famous Minister of France, summarized government finance simply as "the art of plucking the goose with the least amount of squealing." In the light of modern knowledge taxes may be so laid that industry is not only uninjured, but is on the contrary actually benefitted by them. In this 20th century there is no excuse for excessive taxation or mediæval methods.

The State, if it will, may not only relieve the "mother of industries" from all its burdens, but may in a less important way encourage and aid it by attending to those matters which are beyond private enterprise. Maps, geological surveys, studies of districts, and the collection and distribution of all kinds of information valuable to the industry, are peculiarly the province of the State. It should, however, be confined to this field, the only exceptions being the few cases where it is necessary for the State to interfere by regulations for the distribution of mining property and for the public safety. It is easy for a Department of Mines to maintain such close touch and cordial relations with the whole industry as to secure its effective co-operation in all its work. It should in fact as well as in theory be its representative, its advocate and its watchful guardian.

As to the outlook for relief in British Columbia, we do not delude ourselves with any illusions. The disease has gone too far. History shows clearly that in all such cases the evil forces which control the machinery of government hold out against reform. No government ever reforms until it is forced to do so by the overwhelming power of popular will. The exertion of this power is always long delayed because of the apathy and blindness of the public towards economic questions and the long time required for it to recognize the causes of its distress. It is probable that a long period of depression and suffering will be necessary to educate voters and compel reform. Meanwhile only the richest and most fortunate enterprises will survive.

But notwithstanding the gloom of to-day we mining men, looking far beyond the present, have a clear view of the future grandeur of the commonwealth of British Columbia. We know its wonderful natural resources, the character and energy of its people. We know that civilization cannot be held back. Some day there will be good government, and with this one requisite supplied will appear an era of prosperity beyond the wildest hopes. Whether its arrival will find us here or laboring in other parts of the world we neither know or care. We only know our present duty, which is to

maintain a united front to the evils before us and to steadily press the fight for reform.

The SECRETARY—Mr. Kirby's remarks open a wide field for discussion. I am not, however, quite certain that the provincial tax upon your output is entirely responsible for the depressed state of mining in British Columbia. There has naturally been a reaction from the boom, and wild-cat speculation, incompetent management, over capitalization, depressed markets and other causes have played their part in bringing about this stagnation. A tax on industry is always to be deplored and while at sight this Government impost may appear to be small it is unquestionably an onerous burden on an industry whose future success and prosperity must depend on the extraction of its low grade ores. Such a tax was proposed at one time in the Province of Quebec but was happily abandoned. In Ontario an export tax upon copper and nickel ores has been urged but we are in hope that this too will never go into operation. I am sure we are all indebted to Mr. Kirby for having so ably given us such a vital topic for discussion at this meeting.

Mr. BERNARD MACDONALD having referred to method of raising revenue from the gold mining industry of Alaska emphasized the point that British Columbia mines paid American wages and their men worked shorter hours than they did across the line. They paid a heavy duty upon their machinery and supplies and were burdened with a tax which virtually made the successful extraction of their low grade ores impossible.

Mr. WM. THOMPSON—I think we are specially indebted to Mr. Kirby for having spent a good day's work at the last moment in the production of this paper and I am sure his trenchant criticism of the treatment our industry receives from the Government cannot fail to be of the greatest possible benefit to the mining industry of British Columbia. We recently had the pleasure of entertaining the Hon. Mr. Prior, the Minister of Mines. We took him under our wing and did not do "a thing to him." (Laughter.) But as soon as he left our genial company and the Scotch began to work off (laughter) he changed his tune and he now appears to be not quite so sure that the mining industry was dead. We should have regaled him with a red herring (laughter) for he evidently has gone from us with the idea that we really had some money after all and that the Government should have some more of it. (Laughter.) It is all very well for the Slocan mine managers to get together and for us in Rossland and in Nelson to sympathise with them but unless the public is made acquainted with the real facts, unless the people are made to realize the part which foolish legislation has played in bringing about this deplorable state of affairs, unless we act vigorously and in no uncertain manner on behalf of our own interests and the interests of our shareholders, I am afraid very little good will come out of it. As Mr. MacDonald and Mr. Kirby have well pointed out, the mining industries of the Province are severely handicapped by taxation and duties and there is an immense tonnage of ore on the dumps and in the mines which under better treatment and more liberal legislation would be mined at a profit and which must lie there untouched until conditions change. (Applause.) This state of affairs cannot go on. Hardly a session of the Legislature passes without some tinkering with our mining legislation—some new effort to hamper and restrict mining. Last session we had several examples. Just as soon as the Government is satisfied we are making progress, down comes the axe, and tomorrow the hours of labour may be still further reduced and the mineral tax increased. We asked Mr. Prior to give us a fair fighting chance. Our members at Victoria ought to know and be made to realize the injury foolish mining legislation has inflicted upon the mining industry of the Province, and an effort must also be made at Ottawa to secure relief from burdensome duties, especially upon our machinery and mining supplies. If this thing continues nothing else will remain but to shut down every mine and let them have them to themselves. (Applause.)

Mr. S. S. FOWLER—My company has spent a very large quantity of money in this Province during the past five or six years and has got very little of it back. Our working costs have been cut down and economies exercised in every direction but what use of it if this state of affairs is to continue. The whole subject resolves itself into this. Let this thing go on until those who are responsible for the present state of affairs starve to death or we get out of the country."

Mr. A. SHARP—Allow me to say how I appreciate the observations of Mr. Kirby and how much they have been needed not only at a meeting of the Institute but throughout the Province of British Columbia. I have lived in this Province for a great many years. I have tried in my own little way to affect the legislation of the Province just upon the lines upon which Mr. Kirby has laid before us tonight. There is no doubt whatever that the mining industry, as an industry, has been crippled in the way he pointed out to us. At the same time, I cannot help saying that the mining engineers, the mine superintendents and the owners of the mines have hitherto been very much to blame. They have held aloof and been indifferent when they should have been active. I have appeared on the political platform at several elections and endeavored in my own little way to show the harmful effects of much of our provincial legislation. I have done so alone without a single associate. I would like to say, what I believe, that if mine owners, mining engineers and mine superintendents would use their great influence to counteract what is known as the popular cry in the Province we would be able to send members to the Legislature whose views would be more in accordance with our demands. I hope the Institute will go into this and aid us to prevent further legislation being enacted which will handicap mining as it is and has been in the past.

The SECRETARY—With respect to the suggestion to appeal to the Federal Government for a reduction or repeal of the duties on machinery and supplies, I would only say that in my experience of mining in Canada, extending over a period of some seventeen years, the present Government—and I speak with no political bias whatever, being neither Grit nor Tory—is the only Government during that period which appears to have appreciated the great value and importance of our mining industries and I am confident that any representations made to Mr. Fielding or to Mr. Sifton will receive their earnest consideration. It may be of interest to state that the Minister of the Interior has gone so far as to establish the nucleus of what promises very soon to evolve into a thoroughly well equipped Department of Mines. This is a step in the right direction. It is unfortunate that Dr. Haanel, the Superintendent of Mines, is not present to hear this discussion for he could have assisted us materially by presenting the views of this representative meeting to Mr. Sifton. Mr. Fielding for many years has taken a deep interest in the mining industry and I am sure he may be relied upon to do whatever is possible to give relief either by a reduction of some of the duties or, as he has done, by aiding certain branches of the industry with a bonus.

On motion of Mr. Thompson, seconded by Mr. Sharp, Messrs. Fowler, Tomkin, MacDonald, Kirby, Bell and Hedley, together with the mover and seconder of the motion, were appointed a committee to draw up a suitable despatch for the Associated Press and to transmit copies of Mr. Kirby's remarks to the papers of the Province.

The meeting then adjourned until three o'clock on Friday.

FRIDAY AFTERNOON.

The members assembled at three o'clock, Mr. Robert R. Hedley in the chair.

BRANCH EXECUTIVE APPOINTED.

On motion, the following executive of the British Columbia branch of the Institute was elected:—S. S. Fowler (chairman) and R. R. Hedley, Nelson; E. B. Kirby and Bernard MacDonald, Rossland; F. Keffer and S. F. Parrish, Boundary District; James Cronin and A. C. Garde, Slocan; J. H. Tonkin, Fernie; W. F. Brewer and W. F. Robertson, Victoria.

FURTHER DISCUSSION OF MR. KIRBY'S PAPER.

The CHAIRMAN—It was thought desirable the other evening to have some further discussion upon Mr. Kirby's remarks on the influence of Government upon mining. We should be pleased to hear from any other members.

Mr. H. E. C. CROASDAILE—Mr. Kirby has given a great deal of thought to this matter as his paper shows, but the strong indictment of the Government which he presents requires to be substantiated before it goes abroad as the views of the members of this Institute. Statements such as those which he has made must have a serious effect upon the investment of capital in the Province. If it is shown that the present burden upon our mining industry amounts, as he has stated, to 20 per cent. upon our output it is going to make men hesitate before they put their capital into mining in this Province.

Mr. E. B. KIRBY—I should only be too glad to give every explanation of the way in which I arrive at these figures. As you can readily imagine I would not have dared—no one would have dared—to present such appalling figures and stand responsible for them unless they were absolutely facts which I have verified from the most authentic sources. (Mr. Kirby proceeded to give figures in detail, but as these are subject to correction of our stenographer's report, it would not be fair to publish them until they have been revised by Mr. Kirby himself.) In the memorial of the Mine Owners' Association similar figures were given to those which I have just quoted. These have not been questioned. They have stood fire for a year and no one has ventured to call them to question. Every statement I have made I

am prepared to verify. I have some of the data with me over in my rooms at the hotel and back in Rossland. If Mr. Croasdaile or any other member would like to see them and to thoroughly go into details I would be only too glad to go into the matter with them.

Mr. H. E. C. CROASDAILE—I am afraid Mr. Kirby has ignored my question. What I ask him to explain is his statement that because the Province pays $5,400,000 in taxation therefore the mines are contributing 20 per cent. of their output. How does Mr. Kirby arrive at the conclusion that the mining industries are paying over four millions of dollars in taxation?

Mr. E. B. KIRBY—I did not know I was not answering the question fully because I desire to do so. Now the official figures of the mineral production of the Province show a total production of twenty-seven millions of dollars. Take the total taxation as shown by the blue books at $5,400,000. If you divide that you will find one is 20 per cent. of the other—where does this money come from? Does it come from the money borrowed by Tom, Dick or Harry? Does it come from the remittance men? It comes out of our production. You have $5,400,000 taken from us for the privilege of being governed and out of the balance we must pay expenses and dividends. (Mr. Kirby again goes into details which it were better to omit here until the stenographer's notes have been revised.) I don't know that there is any more that I can explain except to state in the most emphatic manner that there is no guess work about these figures. Those of us who pay out the cheques have a realizing sense of the truth of these statements. For instance, the "War Eagle" and "Centre Star" mines which have been operated something like seven and nine years respectively, have paid in dividends $640,000 and during the same period $160,000 in taxes, or about one-fourth.

Mr. BERNARD MacDONALD—I look upon Mr. Kirby's remarks as a simple statement of fact. If it would be acceptable to the members of the Institute it might be well to incorporate with Mr. Kirby's paper the statements presented in the Memorial of the Mine Owners' Association. The Memorial gives many figures which would substantiate the argument presented by Mr. Kirby.

The SECRETARY—If I remember correctly there were certain features of the Memorial which were not free from the suspicion of inaccuracy.

Mr. JAMES McEVOY—I do not quite understand from Mr. Kirby how he apportions this taxation. Would it not be fairer to state it as revenue derived directly and indirectly from mining?

Mr. KIRBY—It includes all possible taxes We may apportionate it among the leading industries. You can figure it any way you please. We look at it from the standpoint of the mineral producer. Take, for instance, the mining districts of Rossland or of the Boundary, the taxes are derived it is true from different sources. But I repeat, where does this money come from? Suppose the mines were closed tomorrow how much revenue would be derived from Rossland?

Mr. McEVOY—I cannot see why the money paid, for instance, by a Nelson storekeeper should be credited to mining. That is hardly a fair argument. Upon the same principle one might take the whole taxes contributed by the other industries and place the amount to the credit of mining. I don't think these taxes are chargeable to mining in any direct way.

Mr. H. E. C. CROASDAILE—You must bear in mind that every citizen has to bear his share of taxation and it is absurb to claim that the revenue yielded by a mining community is a direct tax upon the mines.

Mr. WM. THOMPSON—I must confess that I am surprised that Mr. Croasdaile should stand up and assert that the mineral tax is the only direct tax upon our mines. Mr. Kirby desired to purchase a large hoisting engine. It could not be obtained in Canada. He purchased it in the United States and had to pay a duty of something like $6,000 on that single engine. What was that but a direct tax upon the mining industry? If a piece of machinery which costs $14,000 at Northport is laid down at Rossland for $20,000 surely that is a very serious disadvantage to the mining industry of British Columbia. We are taxed on our powder, on our candles, on our steel, our oil, in fact on everything we use in our mines. These mountains are rich in mineral wealth, but much of the ores are low grade and unprofitable to work under existing conditions. No mine manager objects to reasonable taxation. It is the accumulation of a little here and a little there until it makes it impossible to carry on mining and make it pay. No wonder that last year several millions were invested in Mexico from various sources but largely from London. Their mines are no better than ours but the investor is treated more liberally and it is possible to make something for the shareholders. I must certainly object to Mr. Croasdaile's contention that the two per cent. tax is the only burden our mines have to bear.

Mr. SMITH CURTIS, M.L.A. I merely came to this meeting to listen and to learn, but I must say a few words. Whether we agree with Mr. Kirby or not, we should be thankful to him for having brought this important question of the taxation of our mines so clearly and forcibly to the attention of the members of this Institute. Mr. Kirby's statement of the revenue collected from the various industries is correct. I had occasion to verify these figures and I know they are substantially correct. We have heard of the heavy burdens placed upon the various industries of British Columbia, and of these the mining industries of the Province, coal and metalliferous mining, overshadow all others, and we have the right to ask whether these taxes are unnecessarily burdensome. It is our right to know how that revenue is applied, and how much of it is applied for the benefit and to promote the development of mining in the Province, but we have no time to discuss that to-day. Now, as to who pays the taxes, Mr. Kirby is quite within the mark. If you trace the source from which each person gets the money to pay these taxes, it will average at least 20 per cent., and a far greater proportion comes out of the mining industry. In the city of Rossland the merchants pay $3 00 poll tax, he has to get that money, where does he get it? He gets it out of the miner, and the miner gets it out of the industry.

The SECRETARY—I would suggest that Mr. Kirby's paper, together with the remarks of the various speakers, be published in pamphlet form after due editing and revision.

The CHAIRMAN—I think it is advisable to do so.

Mr. WM. THOMPSON then moved that Mr. Kirby's paper and the discussion, after revision by the members, be published in pamphlet form, as suggested by Mr. Bell, and that copies be sent to the ministers and members of the Legislature.

Mr. S. S. FOWLER seconded, and the motion on being put to the meeting was carried unanimously

PAPERS READ BY TITLE.

The following papers were then read by title.—

On the Future of the Coal and Coke Supply of British Columbia.
By Mr. Wm. Blakemore.

On the Mineral Resources of Vancouver Island.
By Mr. W. M. Brewer, Vancouver.

On the Machinery Constituting a Mining Plant.
By Mr. A. C. Garde, Sandon.

EXHIBIT OF A MODEL OF THE POORMAN MINE.

The SECRETARY remarked that as Mr. Norman Carmichael, who had constructed the exceedingly interesting glass model of the Poorman Mine *which had been on exhibition in the hall during the meeting, was present*, the members would be pleased if he would make a few remarks upon the model.

Mr. NORMAN CARMICHAEL—I appreciate very much the kind remarks that have been made regarding the model on exhibition and the interest taken in it by the members present. I must explain, however, that the model was not made with a view to public exhibition and in many respects it is crude and unfinished. On it you will notice Eagle Creek flowing down the gorge, the profile of the hillsides, the outcrop of the vein, tunnels, stopes, dykes, faults and nearly everything connected with the mine but the 2 per cent. tax. My attention was first drawn to the striking manner in which the workings of a mine can be shown on glass by the beautiful models in the museum of the Bureau of Mines in San Francisco, which are well worth a visit; and later I was indebted to Mr. W. A. Carlyle, who was a strong believer in their usefulness, for some suggestions regarding plotting on glass, and also to Dr. James Douglas, of Bisbee, Arizona, who very kindly supplied me with notes on the construction of the large glass model of the Copper Queen Mine at that place. That mine models are of more than mere artistic value is shown by the extensive use made of them by the courts in Colorado and elsewhere to aid in the adjustment of many important mining disputes, and I have no doubt that were they more generally employed by mining engineers they would often prove an invaluable aid in the solving of difficult underground problems. In the present instance the model was constructed with a view to showing a rather intricate system of dykes and faults which traverse the vein in an irregular manner, the dykes varying in thickness from a fraction of an inch up to about 20 feet and for the most part dipping in an opposite direction to the vein, while the faults have in most cases caused a displacement of only a foot or two, one of them throws the vein some 25 feet and thereby affected the workings considerably in the ground contiguous to it. These dykes and faults are shown in different

colors so that they may be more clearly traced in their meanderings through the mine. The model is made to a scale of 40 feet to the inch, the block of ground represented being 1,200 feet long by 800 feet wide, and with a vertical depth of 560 feet. The strike of the vein is made approximately parallel to the longest dimension of the model, and each sheet of glass represents a tranverse section through the vein and workings. The sections being placed at a uniform distance apart, corresponding to 50 feet in the mine, where important workings, such as upraises, fall between the regular sections and in consequence would not be shown on them, intermediate sections are set up at their correct angles. All the sections are easily removed and replaced, so that the model may be kept up to date with the surveys in the mine. If there is any further explanation desired by any one I shall be very pleased to give it.

Mr. ERNEST R. WOAKES, managing engineer of the Duncan United Mines, desired to bear testimony to the care that had been taken in making the model as accurate as possible, and to the practical utility of the model in the actual working of the mine, and felt sure that were the practice of making these models more general much benefit would accrue.

NEXT MEETING OF THE BRANCH.

On motion it was decided to hold the next meeting of the Branch in Victoria some time in March, 1903.

The meeting adjourned at 5.30 p m.

ENTERTAINED BY THE CORPORATION.

On Thursday evening the members of the Institute were the guests of the mayor and corporation of Nelson at a banquet in the Hume House. About one hundred persons sat down to an excellent dinner. After the usual loyal and patriotic toasts, the mayor proposed the "Mineral Industries" in an excellent little speech. On behalf of the industry suitable responses were made by Mr. S. S. Fowler, Mr. B. T. A. Bell, and Mr. Bernard MacDonald. A splendid musical programme was presented and the festive gathering did not separate until daybreak was well advanced.

NEW COMPANIES.

ONTARIO.

Lau entian Mining Company, Limited.—Incorporated 27th August, 1902. Authorized capital, $1,000,000, divided into 1,000,000 shares of $1.00 each. Head office: Toronto, Ont.

Canada Metal Milling Company, Limited.—Incorporated 17th July, 1902. Authorized capital, $50,000, divided into 1,000 shares of $50 each. Head office: Toronto, Ont.

The Northern Light Mines Compa·y.—Incorporated 14th August, 1902. Authorized capital, $50,000.

The Algoma Consolidated Silver Mines Company, Limited.—Incorporated 12th August, 1902. Authorized capital, $1,000,000, divided into 1,000,000 shares of $1.00 each. Head office: Toronto, Ont.

BRITISH COLUMBIA.

The Kingston Gold and Copper Mining Company, Limited.—Incorporated 29th July, 1902. Authorized capital, $1,000,000, divided into 1,000,000 shares of $1.00 each.

The Myee Exploration Company, Limited.—Incorporated 11th August, 1902. Authorized capital, $150,000, divided into 150,000 shares of $1.00 each.

The Canadian Oil and Mines, Limited.—Incorporated 15th September, 1902. Authorized capital, $2,500,000, divided into 2,500,000 shares of $1.00 each.

The East Kootenay Placer Mining Company, Limited.—Incorporated 15th September, 1902. Authorized capital, $50,000, divided into 50,000 shares of $1.00 each.

The Revelstoke and McCullough Creek Hydrau ic Company, Ltd.—Incorporated 11th September, 1902. Authorized capital, $125 000, divided into 125,000 shares of $1.00 each.

COMPANY NOTES.

Le Roi Mining Co.—The report for July from this mine is as follows:—"The tonnage shipped during the month, together with its contents and gross values per ton was as follows:—

	Dry tons.	Ozs Au.	Ozs. Ag.	Lbs Cu. wet.	Value per ton.
1st class.....	14,492.734	8 437.974	14,099.69	672,314	$17.67
2nd class dump.....	1,677.534	1,005.887	1,376.89	55,332	$16.35
	16,170.268	9 443.861	15,476.58	727,646	—

MINE EXPENDITURE.

The expenditure for the month on mine account was..... $51,385.53

The cost of breaking and delivering ore on the railroad cars for the month was $2 87 per ton. The cost of loading second class ore from the dump was 27.3c., which, added to the 2 per cent. ore tax for the month, brings it to 40c. per ton. The cost of delivering first class ore on the railroad cars, including all mine expenditure other than cost of second class ore, was $3.50 per ton.

NORTHPORT SMELTER.

The expenditure for the month was..... $5 ,314.86

The following statement gives the details of the ores received at the smelter during the month and the contents:—

	Dry tons.	Ozs. Au.	Ozs. Ag.	Lbs. Cu. wet.
Public Ores:				
Le Roi No. 2.....	6,454.924	3,255.196	7,700.19	293,483
Le Roi Ores:				
1st class.	14,492.734	8,437.974	14,099.69	672,314
2nd class dump...	1,677.534	1,005.887	1,376.89	55,332
	22,625.192	12,699.057	23,176.77	1,021,129

The tonnage treated during the month was 19,965, segregated as follows:

Roasted ores.....	10,764.5
Raw Le Roi No. 2.....	5,006
Raw Le Roi second class	2,286.5
Raw Le Roi first class	1,908
	19,965.0

PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of Chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents anuually for each area contained in the lease it becomes non forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted Gold valued at $18 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquired promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc, are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,
Commissioner Public Works and Mines,
HALIFAX, NOVA SCOTIA.

PROVINCE of QUEBEC

The attention of Miners and Capitalists in the United States and in Europe is invited to the

GREAT MINERAL TERRITORY

Open for investment in the Province of Quebec.

Gold, Silver, Copper, Iron, Asbestos, Mica, Plumbago, Phosphate, Chromic Iron, Galena, Etc.

ORNAMENTAL AND STRUCTURAL MATERIALS IN ABUNDANT VARIETY.

The Mining Law gives absolute security to Title, and has been specially framed for the encouragement of Mining.

Mining concessions are divided into three classes :—

1. In unsurveyed territory (*a*) the first class contains 400 acres, (*b*) the second, 200 acres, and (*c*) the third, 100 acres.

2. In surveyed townships the three classes respectively comprise one, two and four lots.

All lands supposed to contain mines or ores belonging to the Crown may be acquired from the Commissioner of Colonization and Mines (*a*) as a mining concession by purchase, or (*b*) be occupied and worked under a mining license.

No sale of mining concessions containing more than 400 acres in superficies can be made by the Commissioner to the same person. The Governor-in-Council may, however, grant a larger extent of territory up to 1,000 acres under special circumstances.

The rates charged and to be paid in full at the time of the purchase are $5 and $10 per acre for mining lands containing the superior metals* ; the first named price being for lands situated more than 12 miles aud the last named for lands situated less than 12 miles from the railway.

If containing the inferior metal, $2 and $4 according to distance from railway.

Unless stipulated to the contrary in the letters patent in concessions for the mining of superior metals, the purchaser has the right to mine for all metals found therein ; in concessions for the mlning of the inferior metals, those only may be mined for.

*The superior metals include the ores of gold, silver, lead, copper, nickel, graphite asbestos, mica, and phosphate of lime. The words inferior metals include all other minerals and ores.

Mining lands are sold on the express condition that the purchaser shall commence *bona fide* to mine within two years from the date of purchase, and shall not spend less than $500 if mining for the superior metals ; and not less than $200 if for inferior metals. In default, cancellation of sale of mining lands.

(*b*) Licenses may be obtained from the Commissioner on the following terms :—Application for an exploration and prospecting license, if the mine is on private land, $2 for every 100 acres or fraction of 100 ; if the mine is on Crown lands (1) in unsurveyed territory, $5 for every 100 acres, and (2) in unsurveyed territory, $5 for each square mile, the license to be valid for three months and renewable. The holder of such license may afterwards purchase the mine, paying the prices mentioned.

Licenses for mining are of two kinds : Private lands licenses where the mining rights belong to the Crown, and public lands licenses. These licenses are granted on payment of a fee of $5 and an annual rental of $1 per acre. Each license is granted for 200 acres or less, but not for more ; is valid for one year, and is renewable on the same terms as those on which it was originally granted. The Governor-in-Council may at any time require the payment of the royalty in lieu of fees for a mining license and the annual rental - such royalties, unless otherwise determined by letters patent or other title from the Crown, being fixed at a rate not to exceed three per cent. of the value at th mine of the mineral extracted after deducting the cost of mining it.

The fullest information will be cheerfully given on application to

THE MINISTER OF LANDS, MINES AND FISHERIES,

PARLIAMENT BUILDINGS, QUEBEC, P. Q.

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 of 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 per 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 or bars in the rivers 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 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 2½ per cent. on the value of the gold shipped from the Territory to be paid to the Comptroller.

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 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, at the rate of 2½ per cent. on the value of the gold shipped from the Territory. Operations must be commenced within one year from the date of the lease, and not less than $5,000.00 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.

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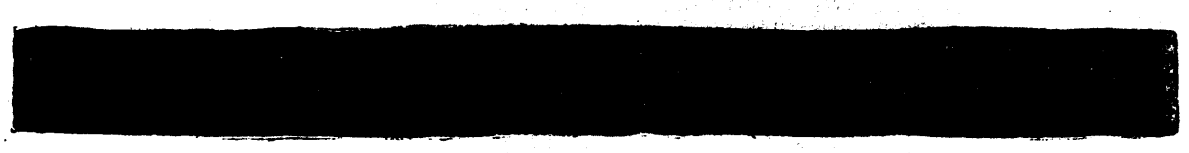

Illustration of ¾" diar. Special Improved Patent Steel Wire Rope, 1760 yards long, supplied to Dalzell Colliery, Motherwell, Scot., which ran two years and 8 months, shewing condition when taken off. Previous rope from another maker lasted 1 year and 9 months

TELEGRAMS—"Ropery Rutherglen." A B C, A I and Lieber's Codes used.

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