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CANADIAN MINING REVIEW

Established 1882

Vol. XXII—No. V.

OTTAWA, MAY 30th, 1903.

Vol. XXII—No. V.

 <p>AIR COMPRESSORS GAS</p>	<p>THE CANADIAN RAND DRILL Co SHERBROOKE, QUE. BRANCH OFFICES IN MONTREAL, QUE. TORONTO, ONT. HALIFAX, N.S. ROSSLAND, B.C. RAT PORTAGE, ONT. GREENWOOD, VANCOUVER, B.C.</p>	 <p>ROCK DRILLS</p>
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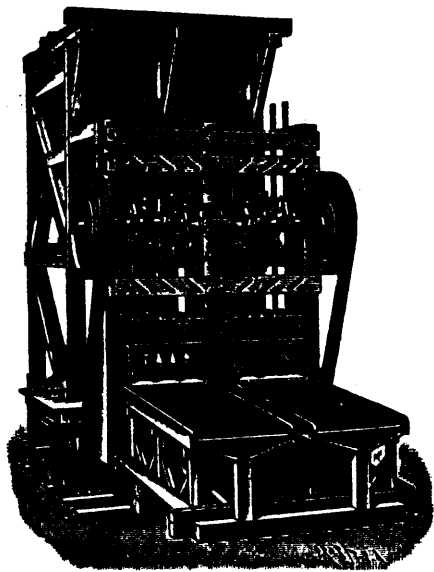
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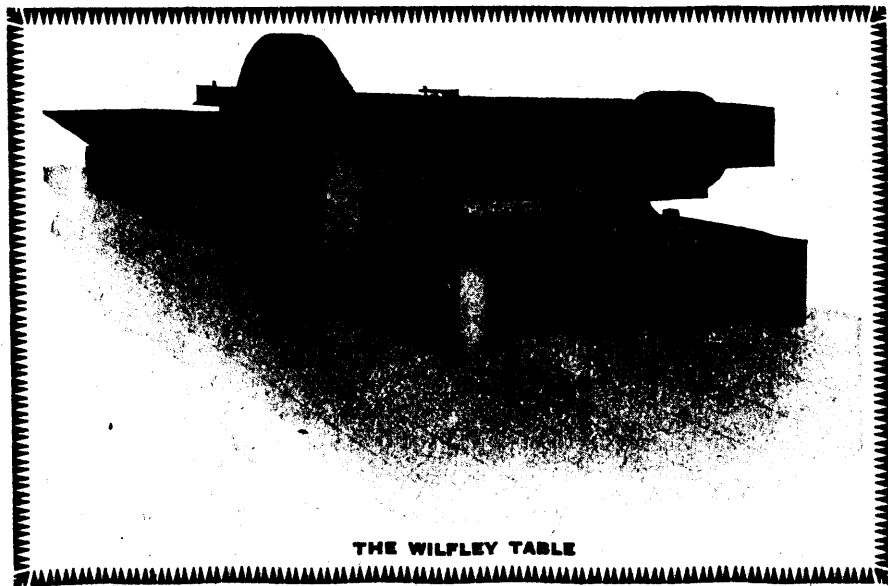
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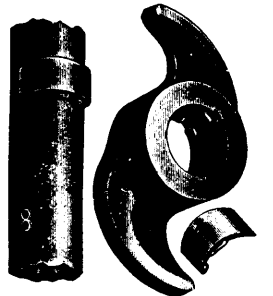
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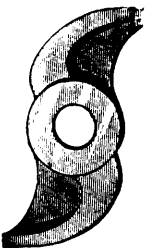
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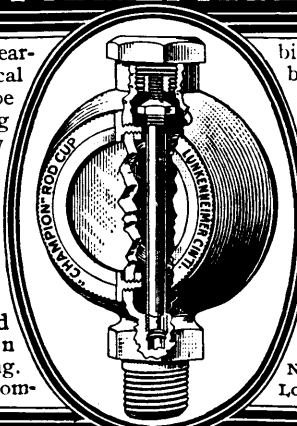
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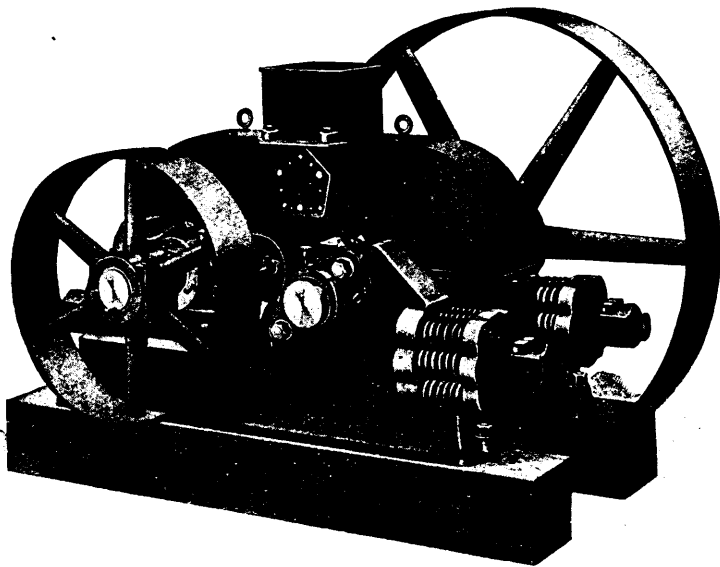
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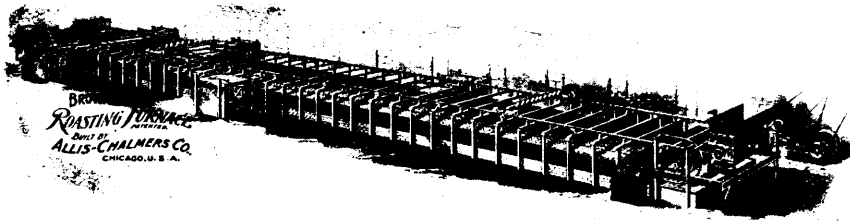
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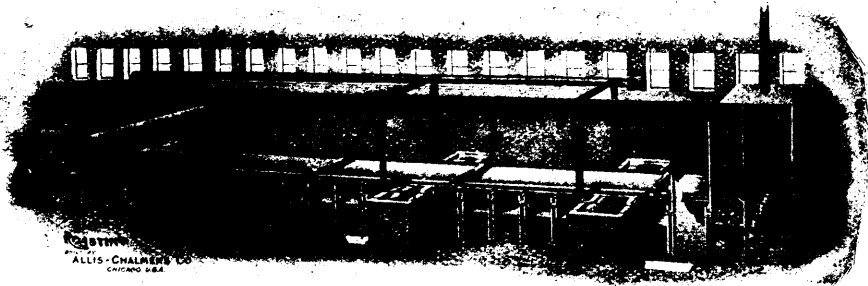
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The Brown Straight Hearth Roasting Furnace is built of different lengths, having roasting hearths from 100 to 200 feet long and 10 feet wide.

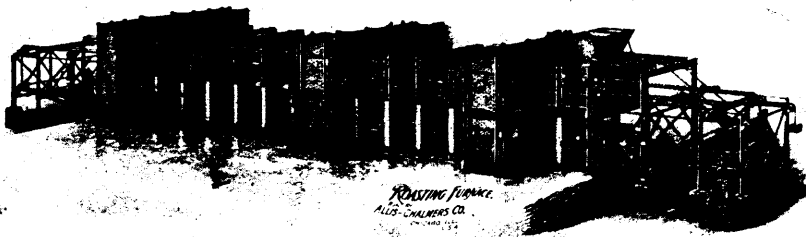
The Brown Circular or Oval Roasting Furnace (horse-shoe type), is often built with a cooling hearth.

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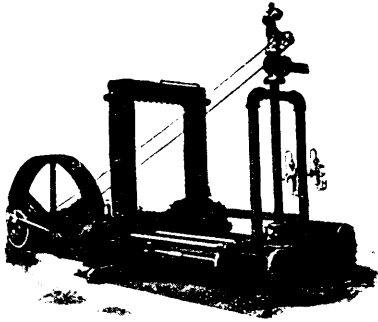
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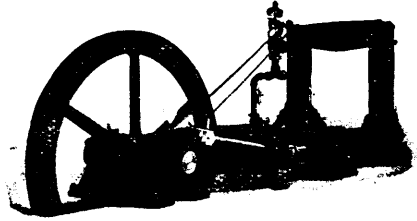
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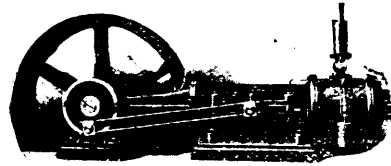
AIR COMPRESSORS



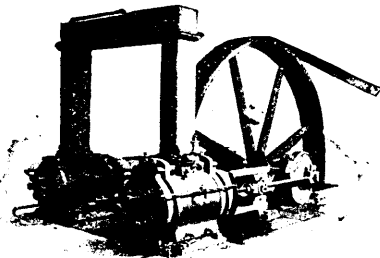
Class B-D Compressor
[Air Cylinders next to Frame]



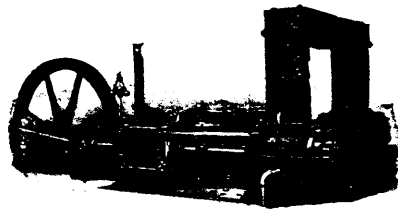
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Straight Line Belt Driven Compressor



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Cross-Compound Corliss Compressor

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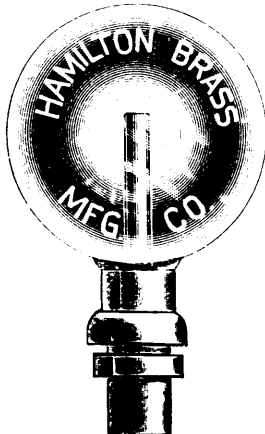
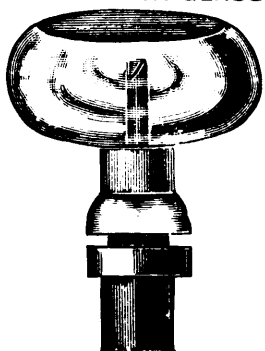
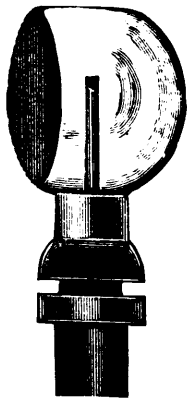
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On a PATENT PNEUMATIC and SELF-ACTING PRINCIPLE, IN GLASS



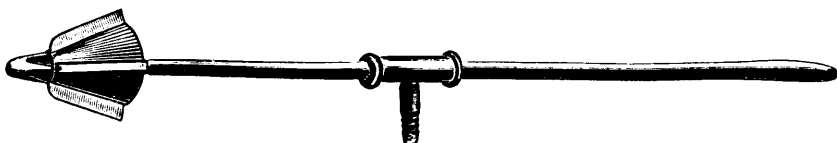
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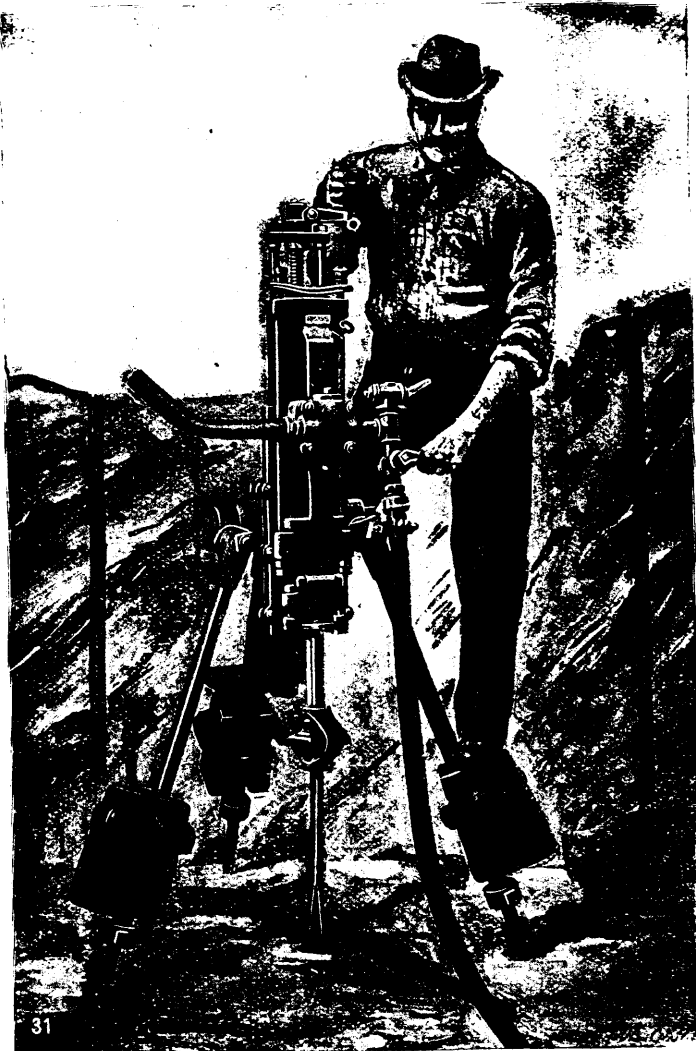
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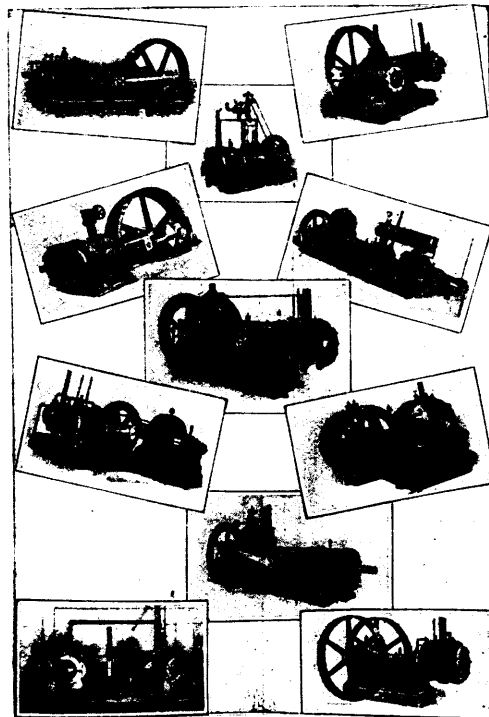
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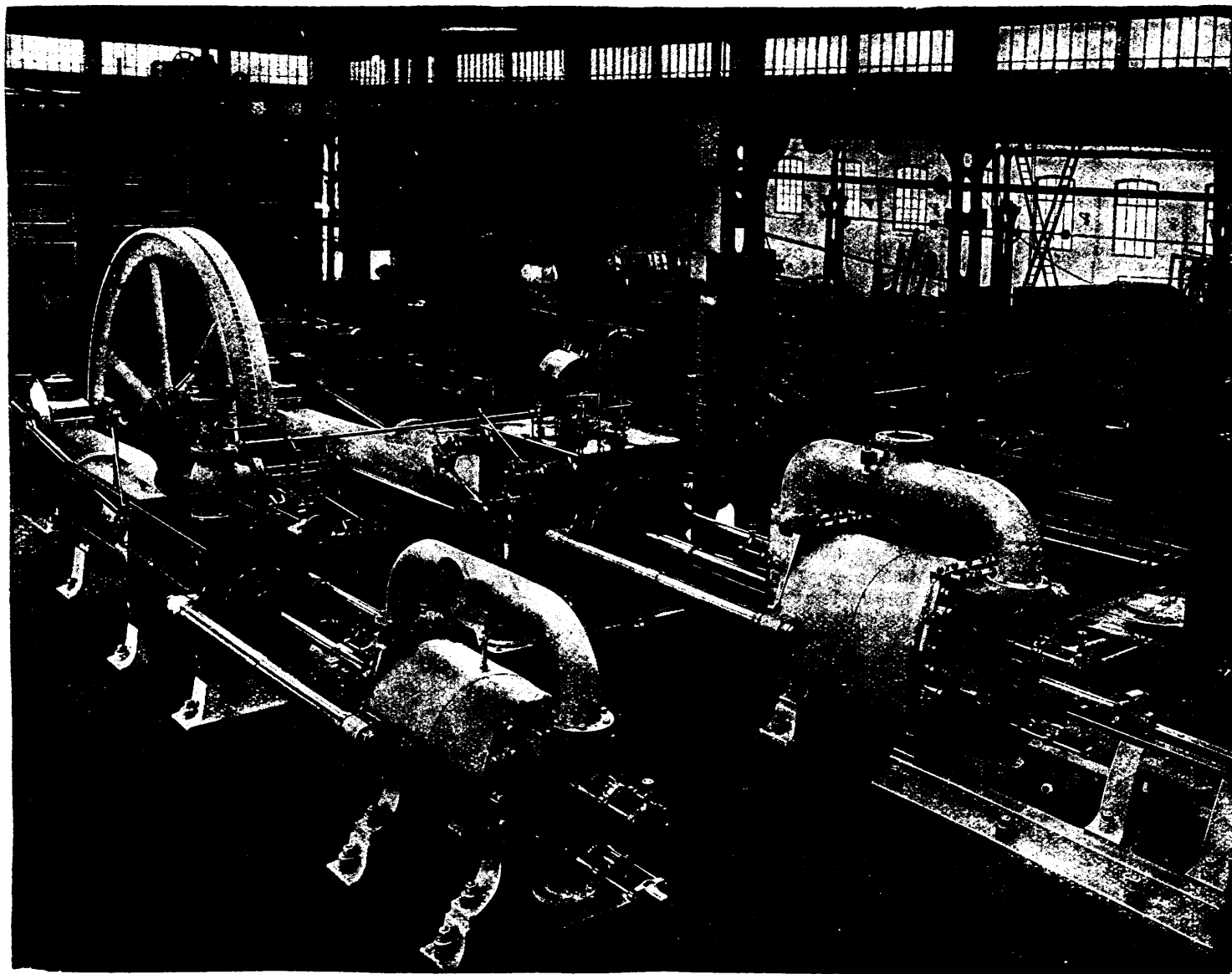
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AGGREGATE POWER AT WORK, ABOUT 550 IN NUMBER, EXCEEDS 250,000 H. P.



WALKER BROTHERS HAVE RE-MODELLED OVER 100 AIR COMPRESSORS
ORIGINALLY CONSTRUCTED BY OTHER MAKERS.

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S. PEARSON & SON, CONTRACTORS.

MESSRS. WALKER BROTHERS, PAGEFIELD IRONWORKS, WIGAN.

DEAR SIRS,—We are pleased to confirm what we told you verbally the other day, viz: that we consider the Air Cylinders and Valves of your Compressors to be the best for such work as we have been carrying out on the above Contract.

One of your Engines ran for almost a year without stopping, and it gives us great pleasure to thus testify to the good qualities of the plant which we purchased from you.

We are, Dear Sirs, Yours faithfully. (Signed) pro S. PEARSON & SON, E. W. MOIR.

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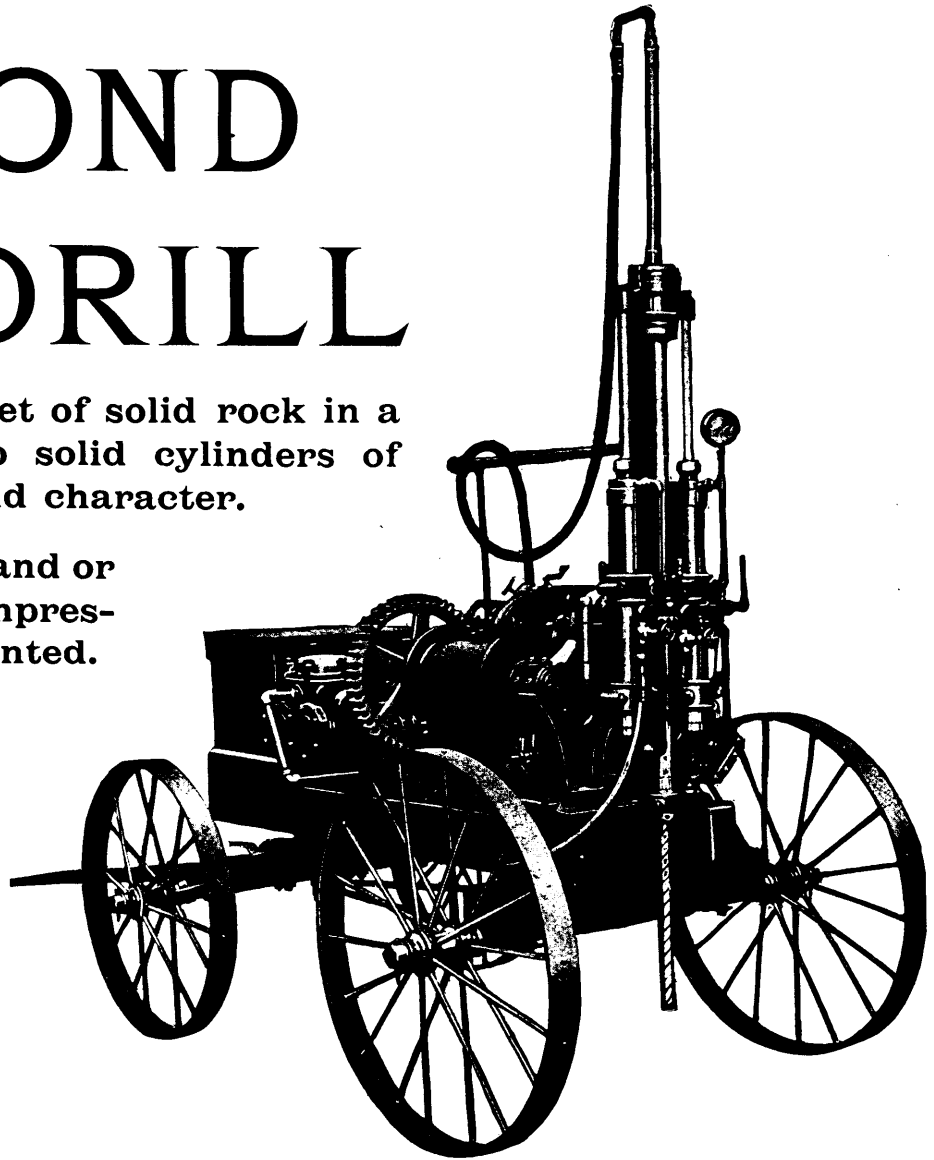
makes economical mining and the deepest hole can be drilled at the smallest cost by a

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It can cut through 2,500 feet of solid rock in a vertical line. It brings up solid cylinders of rock, showing formation and character.

Made in all capacities, for Hand or Horse-power, Steam or Compressed Air—mounted or unmounted.

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Two 2½-inch Sullivan Drills working on 900-foot level of the Congress Mine, Congress, Arizona.

With one of these Drills, one man can do as much work as six men with hand hammers.

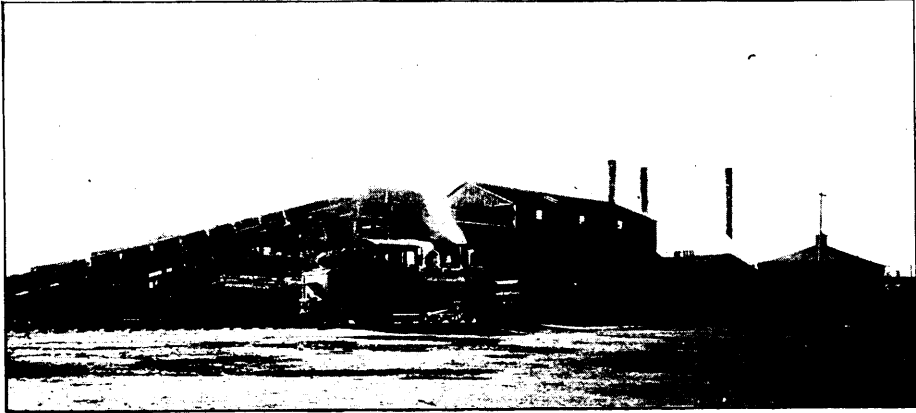
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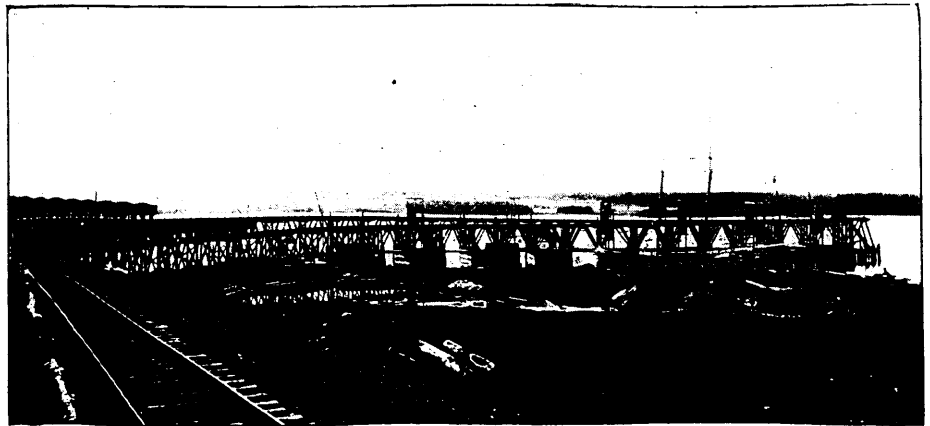
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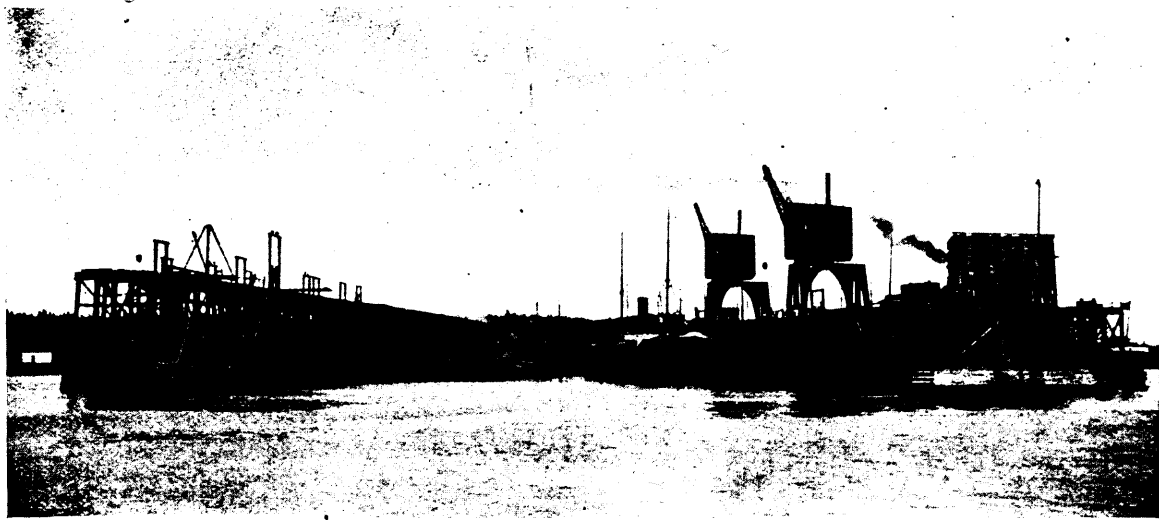
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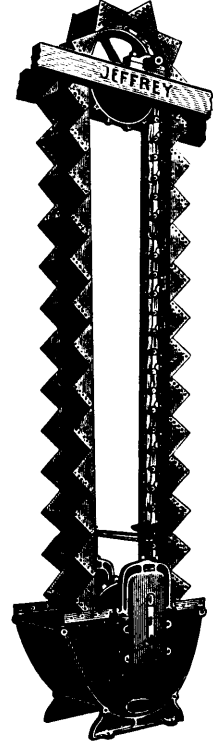
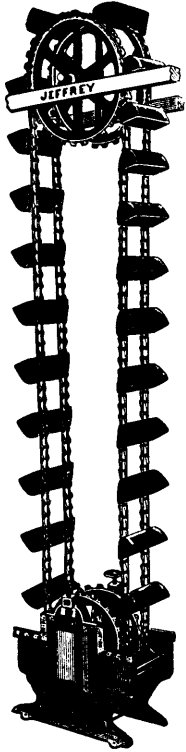
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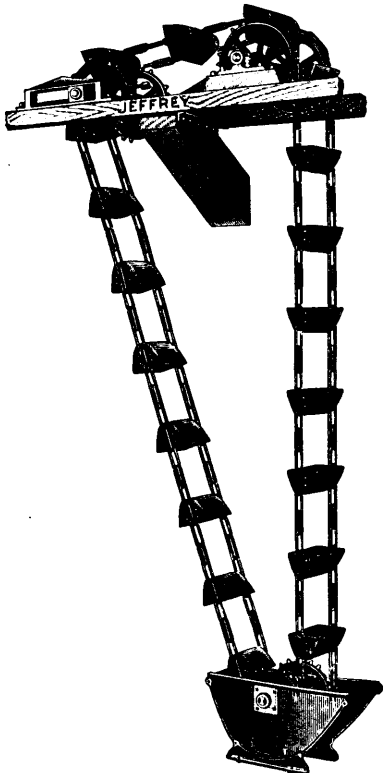
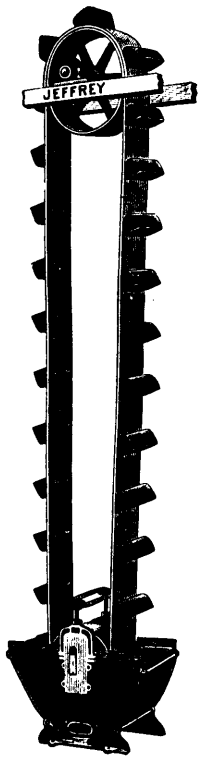
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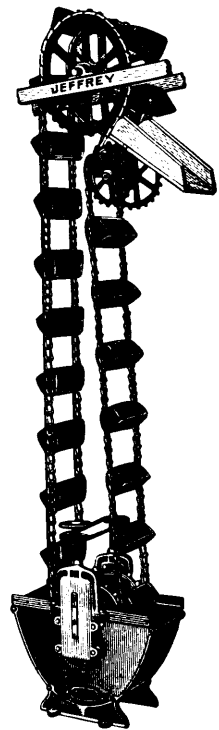
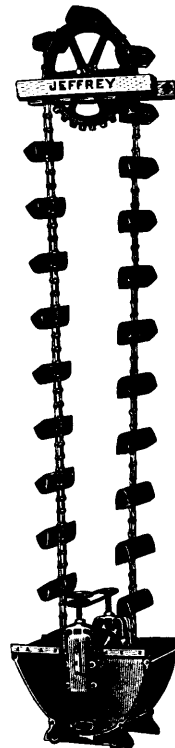
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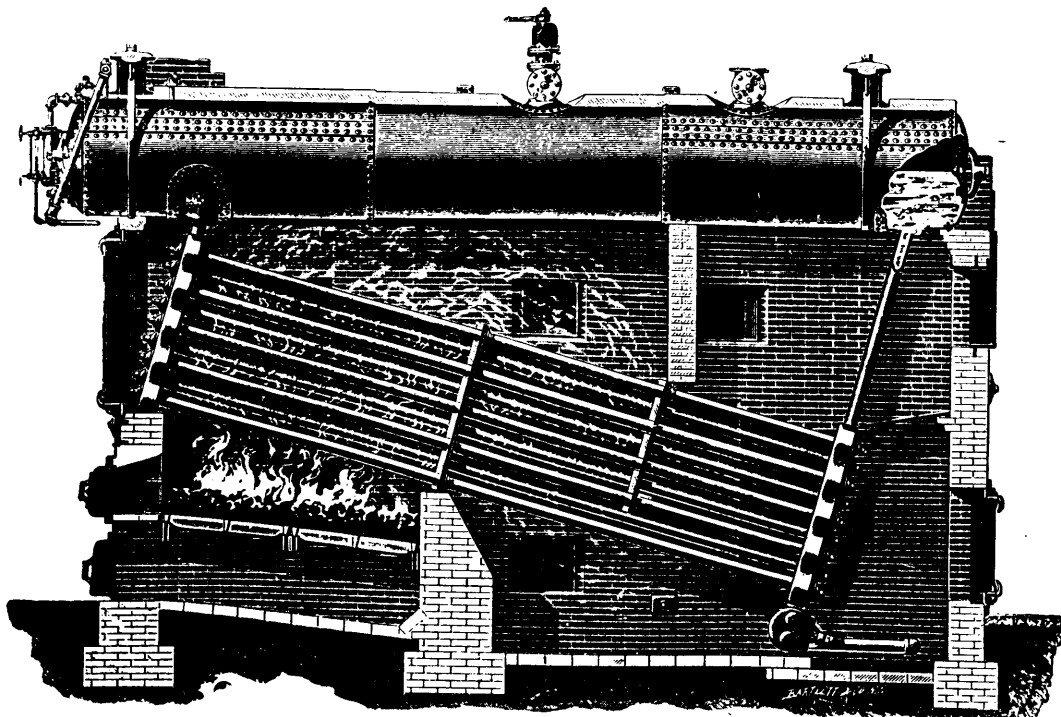


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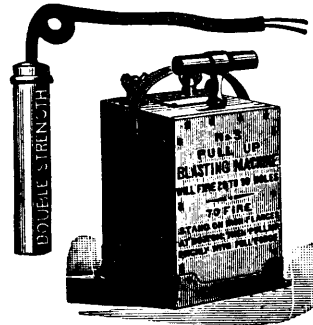
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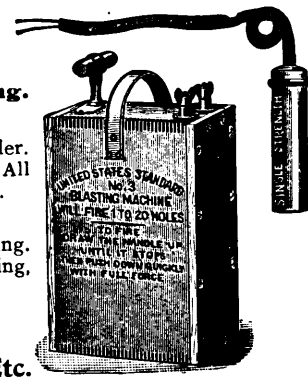
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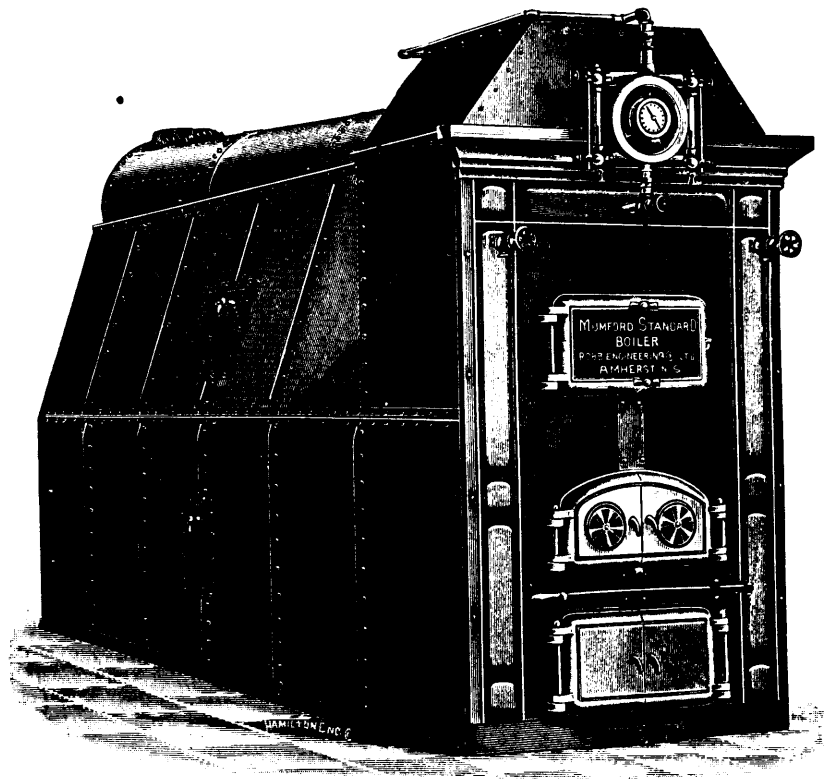
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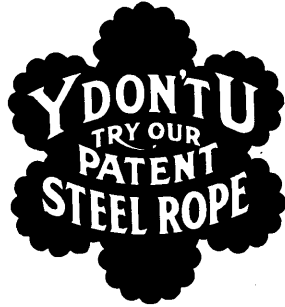
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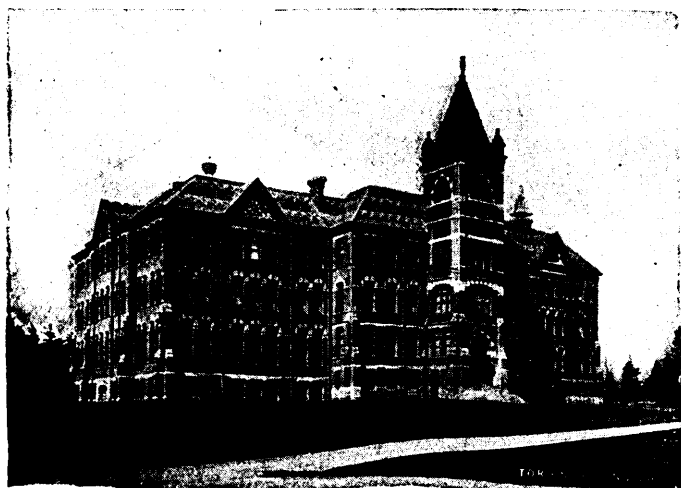
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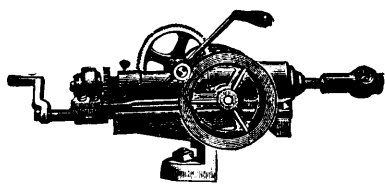
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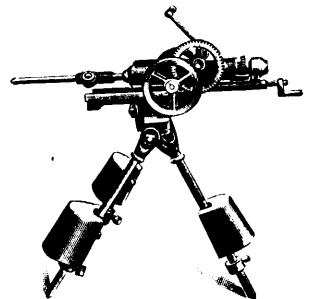
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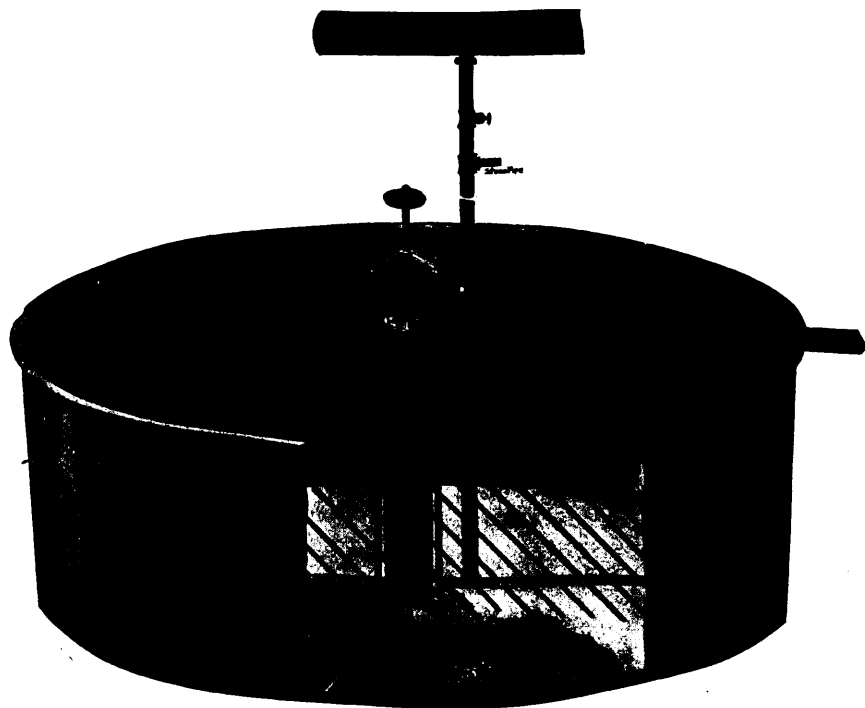
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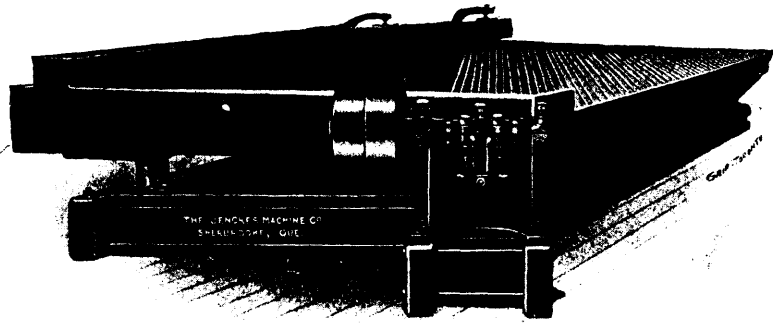
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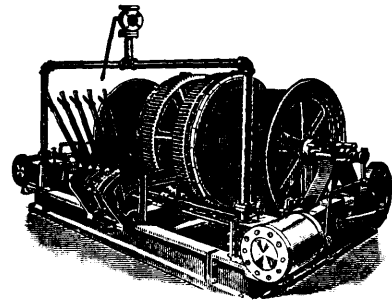
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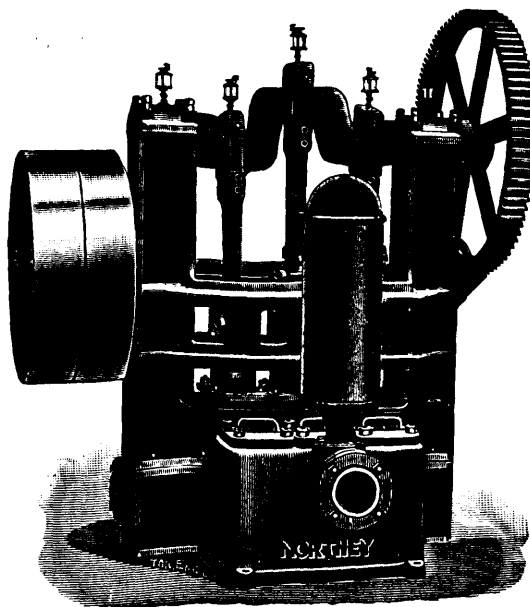
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The CANADIAN MINING REVIEW

Established 1882

THE OLDEST AND ONLY OFFICIAL MINING AND ENGINEERING JOURNAL PUBLISHED IN THE DOMINION OF CANADA.

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MAY, 1903.

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The Future of the Dominion Coal and Steel.

Just a year ago we discussed at considerable length the prospects of Dominion Coal in particular and, more briefly, of Dominion Steel, and the result of our forecast with reference to the former has been almost exactly borne out by the year's trade. We estimated the profits on Coal for the year at \$2,500,000 and we argued that at all times Coal would be able to earn its eight per cent. guaranteed dividend and leave a respectable surplus of four to five per cent. at least for Steel. We argued further that the agreement under which eight per cent. was to be paid was distinctly more favourable to Steel than to Coal and that while the latter was a gilt-edged investment with assured success, the former could only be regarded as in the experimental stage with an uncertain future. The events of the last year and, especially of the last few months, have verified our deductions to the letter. Coal has done well, and but for a regrettable accident in the fire at Dominion No. 1 mine would stand in a better position to-day than ever. Meanwhile, however, it is impossible to speak as hopefully of Steel and, while we are neither pessimistic nor alarmist, we may be permitted to point out that the conditions surrounding this industry are such that unless a fundamental change can be made it is hard to say what may happen. That both concerns have sustained a serious loss by the resignation of Mr. Cornelius Shields cannot for a moment be denied, indeed, coming at what may almost be considered a crisis in their history it is a loss which is almost irreparable and may be fraught with serious results. It is an open secret that Mr. Shields is the only manager who has been in charge of either of these concerns with sufficient individuality and free scope to *manage*. His predecessors have more or less been handicapped by conflicting influences and divided counsels. Mr. Shields went there master of the situation and no one can conceive of him holding the position under any other conditions. It is a position which calls for just as strong a man to succeed him and if the firm grip which he has exercised over the Company's affairs is relaxed by a successor less experienced or less determined, then, whatever may become of Coal, it is certain that the Steel end of the industry will never know success. In connection with the latter the same mistakes which characterized the early days of Dominion Coal have been repeated. Rosy optimism, reckless and extravagant expenditure and miscalculation as to results have characterized the inception of the Steel Works. We are told on the best authority that these works if recommenced to-day could be erected and developed to their present stage of efficiency for two-thirds of what they have cost, which means an unnecessary expendi-

ture of several millions and is a heavy financial burden for the concern to carry. That this should be so is not to be wondered at when we consider how nearly all the estimates of the prospectus, and the early reports of the management have failed to materialize. For instance, our readers will well remember the important speech of Mr. A. J. Moxham before the Board of Trade, at Toronto, some two years ago, when he stated that pig iron would be produced at Sydney for \$5.00 to \$5.50 per ton; as a matter of fact the cost of pig iron at Sydney to-day is from \$10.00 to \$11.00, and it is doubtful if it will ever be produced below this figure. In view of this fact there is little wonder that the Directors find themselves driven to abandon the idea of manufacturing steel rails, as it would be quite impossible, even if other conditions were favourable, to compete with American or German manufactures, and to make the rails from an \$11.00 pig. But other difficulties have developed, notably a marked decrease in the value of the Belle Isle ore, which at one time averaged 55 per cent. of metallic iron but has fallen to 43 per cent. and sometimes even less. This involves not merely the necessity for importing large quantities of higher grade ore at a cost from \$5.00 to \$7.00 per ton delivered at Sydney but by so largely increasing the percentage of silica it diminishes the productive capacity of the furnaces. The expressed intention of the Company to turn their attention to the manufacture of structural steel, instead of rails, is a clear indication of their opinion on this subject and, whilst undoubtedly this branch offers better chances, it is certain that in normal conditions of trade structural steel from the States will be so cheap as to exclude the possibility of manufacturing at Sydney without heavy protection. This, of course, may be secured, but the present attitude of the Government may be taken as clearly indicating their disinclination to extend protection to their iron products. The recent provision for the duty of \$7.00 on imported rails and the safeguards with which the Government have seen fit to surround the provision affords little encouragement for the belief that they will extend protection. We have discussed this matter with some of the best iron and steel experts in the country, and the general opinion is that the whole subject of the steel manufacture at Sydney has undergone a change, since practical working has demonstrated that the basis of the industry, viz. pig iron is to cost double the original estimate. With a \$5.00 pig iron the contention of Mr. Whitney and Mr. Moxham as to the possibilities were probably justified. We were never among those who believed that a \$5.00 pig iron could be produced at Sydney; we must confess, however, that we were not so pessimistic as to anticipate the cost to be \$11.00. Since the budget speech of Mr. Fielding there has been a generally expressed opinion

that the Dominion Steel Company would benefit by the duty on rails and would at once make provision for this branch of manufacture. This, no doubt, is an important matter for consideration, and will probably receive attention during the next few weeks, but when we remember that before the present boom steel rails sold as low as \$15.00 at works in the States, and were delivered at \$17.00 on the Great Lakes, being made from a pig which cost in the neighbourhood of \$7.00 to \$7.50, it does not look as if the conditions would warrant hasty conclusions, but even if this difficulty could be overcome it is hard to see how the far greater and fundamental one of an unsuitable ore is to be met; with high silica and the maximum of phosphorus in the Belle Isle ore we do not believe that a rail can be made which would come up to Mr. Fielding's stated requirements as to quality. On the other hand, if a sufficient quantity of high grade ore, low in phosphorous and sulphur is imported to enable the Belle Isle ore to be used, then the cost will be proportionately raised. Altogether Mr. James Ross and his colleagues have before them a problem of the utmost difficulty which, for its solution, demands the able and most experienced experts that can be found. One can hardly bear to contemplate the possible consequences to the Maritime Provinces of any serious check in the development of this industry, and for that reason every effort should be made to ensure its success. If the Steel Works are to be a failure the effect on Coal would also be serious, as it would not be easy, even if possible, to establish a market to replace the local consumption guaranteed by this important enterprise.

The output of coal during the present year would be entirely satisfactory but for the unfortunate accident at Dominion No. 1. That the largest and most economic mine, with a capacity of 3,000 tons of coal a day should not merely be closed, but flooded, creates a situation of the utmost seriousness. It may be true that the increased development at the other mines will ensure a total production during the coming year equal to that of last year, but the production would have been a million tons more which would have meant at least \$750,000 additional profit. There are conflicting reports as to the length of time during which Dominion No. 1 will be out of commission. We deprecate some of the official statements which have been made; they minimize both the difficulty and the loss beyond what is defensible. We have the best authority for stating that whilst small sections of the mine can be worked within a short time, practically the whole of the mine will be non-productive during the present year. One has only to accept the figures which have been put forward by the management, as for instance that 500,000,000 gallons of water will require to be pumped out of the mine, to see that given the most favourable conditions it will take a whole year to restore it to its original condition. The cost of doing this must run into six figures, and if we add the deprivation of tonnage, it will be seen that the loss during 1903 will fall not very far short of \$1,000,000.

In spite of this the coal dividend is not in any danger, which only serves to show how good a bargain the Steel Company made, but the latter will suffer severely, as at the present crisis they can ill afford to spare so large a sum from their revenue. Altogether we hold that Mr. James Ross, of whose financial ability no one holds a higher opinion than ourselves, will have to live right up to his reputation if he succeeds in steering this twin concern to a position of security and success. There is only one way in which he can do this, even if it be possible to do it at all, and that is to place the absolute control of both concerns, either unitedly or separately, in the hands of strong competent and experienced experts. He has already a large number of excellent subordinate officials especially in the coal department; these only require a suitable head and the result will be entirely satisfactory. As far as steel is concerned he has some good men but he still needs

the master grip. Meanwhile it is to be regretted that the situation is complicated by rumours which would appear to have at least some foundation, to the effect that several of the most prominent Steel men have parted with the whole or practically the whole of their stock, and that there is a constant shifting of control on that account. This is a condition which cannot make for stability, or success, and unless the impression is removed that this stock is held chiefly for speculative purposes the difficulty of making Steel a permanent industry is vastly increased.

Imports of Mining Machinery.

The imports of free and dutiable mining and smelting machinery for the first quarter of the present year compared with 1902, are as follows:—

MONTHS	1903			1902		
	Free	Dutiable	Total	Free	Dutiable	Total
January	\$ 77,298	\$ 7,676	\$84,974	92,984	2,549	95,533
February	30,106	1,587	31,693	43,123	2,380	45,503
March	83,535	11,534	95,069	55,255	2,629	57,884
Total	150,939	20,797	211,736	191,362	7,558	198,920

The principal sources from which this machinery has been imported were:—

MONTHS	UNITED STATES		GREAT BRITAIN		Other Countries	TOTAL.
	Free	Dutiable	Free	Dutiable		
January	\$75,235	\$ 7,676	\$ 417	—	\$1,646	\$84,974
February	29,467	1,587	639	—	Nil	31,693
March	82,680	11,534	158	—	697	95,069
Total	187,382	20,797	1,214	—	2,343	211,736

Mining Legislation in Nova Scotia.

During the session of 1903 the mining legislation of this Province was distinguished by what may be termed paternalism.

For years past the extension of the coal seams of Cape Breton under the waters of the ocean has been well known to the geologist and mining engineer. The stimulus of the "Whitney Syndicate" introduced this fact to the speculative element, and the waters of the ocean adjacent to coal-bearing land areas are covered by innumerable licenses. To give these properties a standing access was necessary. The Mines Act did not provide this and a pretty battle was waged before the Legislature until finally an Act was elaborated giving a fair measure of justice to the owner of coal on the shore as well as to the owner of submarine coal. It may well be understood that driving tunnels through another's coal area means not only the loss of a certain amount of coal but possibly, in addition, the creation of a state of affairs precluding the proper and economical working of the rest of the coal. Provision is therefore made for securing to the party invaded a proper award for indirect as well as direct damages. The importance of the measure may be gathered from the fact that mining experts say coal can be readily mined to a distance of six miles from the shore, and that, within this distance from the shore there are millions upon millions of tons of coal.

For a number of years past all enginemen in charge of engines used for raising or lowering men into and out of coal mines were required to pass an examination as to their knowledge of engines, boilers, etc. This requirement has now been greatly extended and the engineer running any stationary engine about a colliery, the inefficient or unskilful handling of which might tend to injury to life or limb, is required to be the holder of a certificate.

Provision is made for three grades of certificates, and for the issue of Certificates of Service to those now handling such engines.

It was not brought out that there had been such inefficiency shown by enginemen as to call for special legislation outside of those handling engines raising or lowering men. However, experience has shown that there is frequently a deficiency in the supply of certificated enginemen for the above purpose, and when all the enginemen in a colliery hold certificates, vacancies can be readily filled. As the measure is calculated to advance the status of enginemen the Government is entitled to commendation for passing it, especially as some system of education must be provided at a considerable expense.

In this connection it may be remarked that, while the Government of Nova Scotia provides educational facilities for overmen and underground managers in the collieries, it has hitherto not given facilities for the education of those desiring managers' certificates, although they are called upon to pass difficult examinations. In view of the expense of providing such advanced education, it might have been a good step for the Government to have provided a certain number of scholarships for those passing the best examinations for underground managers. These men could then attend a mining school for a couple of years, and finally pass their examination before the Provincial Board.

The gold mining industry also received attention. The gold mines of Nova Scotia have seldom exceeded four hundred feet in depth. The maximum depths were reached in the few cases in which pay streaks ran at heavy angles, and continuously. It is claimed that the domed, or anticlinal structure of the gold fields giving rich ground at distances from the anticlinal axis equivalent to an original depth of several thousand feet warrants the expectation that in the vicinity of the axis deep workings would reach equally rich ground. As yet, however, no company has been found wealthy enough to put this view to the practical test of a 2,000 feet shaft.

The theoretical view, it is fair to say, has been borne out by the fact that the enrichment of the quartz has continued to vertical depths of over 700 feet from the surface. In order to assist enterprising miners in the solution of this problem, which is of great importance to the future of this industry, the Governor-in-Council has been authorized to appropriate a sum of money large enough to assist in the sinking of three deep shafts. The position of the shaft so assisted is to be one approved of by the Governor-in-Council, and the sinking to be under its regulations. Such assistance will be given only in the sinking of a shaft below 500 feet from the surface and to a vertical depth not exceeding 2,000 feet, and is in no case to exceed half the cost of sinking.

This offer may be fairly considered a generous one, and no doubt any companies now in a position to ask for the subsidy will come forward.

If, however, none are prepared at present to ask this help, the knowledge that it is available will induce others to qualify for it. It may be said here that while the deductions of the mining geologist have for years presented the possibilities of deep mining, the labors of Mr. Faribault, of the Canadian Geological Survey, his careful examination of the different Nova Scotia gold districts, and his elaborate maps have made the matter plain to the miner and the general public.

CORRESPONDENCE.

Gold Dredging in the United States.

The Editor:

I have read with interest, and some amusement, the article on gold dredging in the U.S. by Mr. Ralph M. Montague. From the tone of some parts of it I fear Mr. Montague is what we call in this country "disgruntled" because, so far, he has not been taken at his own valuation. The part referring to the "young graduate from college" will doubtless be replied to by the gentleman attacked, who is well known here and who has done successful work. The parts of the article I particularly wish to notice are those referring to what the writer calls "the New Zealand type of dredge," as some six years ago I introduced this type from New Zealand into the United States and made a success of it. That this type of dredge is a success is evidenced by the fact that during the last six years the Risdon Iron Works of this city has built from my plans over forty dredges, and are still engaged in the manufacture. Under the circumstances I certainly think I am entitled to expose the errors and fallacious statements made in the article above referred to in regard to the so called "New Zealand dredge," but which is now known in this country as the "Risdon" dredge.

In spite of Mr. Montague's unsupported assertion to the contrary the advocates of the "Risdon" dredge do not admit that the dredge held by a spud is necessarily a better digger than the dredge held by lines. Indeed the advocates of the "American" type are not quite satisfied on this point, if we may judge from the fact that the last American type of dredge built has been fitted with head line drum and side line barrels similar to a "Risdon" so that it can operate either way. Many competent engineers believe that, for the general run of gold dredges, the resiliency given by the head line is of great benefit by reducing the heavy jars to which the dredge is subjected when held solidly in place by a spud to which there is no give. The "Risdon" type of dredge can certainly be more rapidly handled when changing position as no delay is occasioned by resetting the spud, the digging going on continually. Another advantage of the rope operated dredge over the "spud" lies in the fact that the stern can be moved independently of the bow, which advantage will certainly appeal to any one who has had before him the practical question of stacking tailings.

As to the comparison between the height to which the two types lift the gravel: Although Mr. Montague states that his ratio is for lifts alone, the actual power required in lifting the gravel is so little as to cut no figure in the total power consumed. Any reader would naturally understand him to refer to the actual power consumed by the bucket belt, and in this connection, his deduction, even granting his data is correct, is entirely misleading; he is either very disingenuous or else he is ignorant of the fact that the bulk of the power expended is not in lifting the material but in the friction of the bucket belt over the two tumblers, and in actually digging out the gravel. The power expended in the friction of the bucket belt is largely independent of the height the material is lifted, and the power expended in actual digging is entirely so. Without entering further into detail the intelligent reader can readily see that the figures given as representing the ratio of horse-power, viz:—23; 42.2 are wrong.

In comparing the H.P. expended and cost per yard of material lifted, Mr. Montague has selected the lowest cost ever recorded for the "American" type, and the highest for the "Risdon," which of course is grossly unfair and very misleading. A three cubic foot "Risdon" dredge takes about 50 H.P. and readily handles 1000

cubic yards per day. One dredge of the "Risdon" type, by actual measurement, averaged over 1000 cubic yards per day for a whole year including days when laid up for repairs; this gives 20 cubic yards per H.P. average, instead of only 12 and makes the cost 1.34 pence instead of 2.03 as stated by Mr. Montague. Seeing that Mr. Montague is so inaccurate in some of his figures his statement that the cost of operating the "American" type is only 1.04 pence must be accepted with caution.

In saving fine gold it is generally admitted that the sluice box type of gold saver, exemplified by Mr. Montague's "American" dredge is vastly inferior to the "Risdon" type. It may be interesting to your readers to know that the first "American" type of dredge erected in Oroville proved a failure, and that it has now been altered to more nearly resemble the "Risdon" type. The dredges now built by the original manufacturers of the "American" type have few of their original characteristics, and are every year becoming more like the "Risdon" dredge.

In mentioning the three "American" type dredges in the Boise Basin, Mr. Montague omitted to state that the Basic has been altered by the Risdon Iron Works, and since then has been a success.

Mr. Montague is undoubtedly correct in stating that the close connected bucket dredges as now built, all dig more than they can properly wash and handle. The dredging industry is rapidly coming to the fore as a safe and profitable investment, and knowing that an influential paper such as yours wishes to put only reliable information before its readers is my reason for writing the above.

I am, yours truly,

R. H. POSTLETHWAITE.

SAN FRANCISCO, 15th May, 1903.

The Frank Disaster.

Within 14 miles of the summit of the Crows Nest Pass, Canadian Pacific Railway, nestles the little town of Frank. The cause which gave rise to its existence may have been a tributary cause of the desolation that presents itself to the eye of the observer now. Coal has been known to exist in this district for many years past, but not till the magnificent prospects of the Crows Nest Pass Coal Co., Fernie, B.C., attracted public attention did the prospector's eye turn to the eastern side of the coal basin. It is now a little over two years since the vertical coal seam at Frank was located, and from that time till now, work has been vigorously carried on by a progressive company until the output had reached 1000 tons in one day. The coal seam, 12 feet thick, is nearly vertical, with a sandstone wall on one side and hard shales on the other. The seam follows the trend of the mountain in a south-easterly direction, the main gangway having been driven 5,600 feet with workings all the way into the face. The system of working is a combination of pillar and stall and long-wall work, the surplus coal only being taken from the chutes. The coal had all been loosened to the surface for about 3000 feet from the entrance and was ready to be drawn when the disaster happened.

The mountain which overlies the cretaceous coal measures is a carboniferous limestone and towered to a height of 3,000 feet above the level of the valley. This mountain, or mountains, forms the first main range of the Rockies, and is termed the Livingstone Range, the particular peak above the town of Frank being called Turtle Mountain. About 4 a.m. on the 29th April night work was being carried on as usual and the siding had just been emptied of its load of coal by a C. P. R. train crew. The train had pulled out to the yard sidings at 4.10 a.m. when a fearful rumbling of the mountain was heard, and in the grey dawn of morning the only living souls who saw Turtle Mountain descend into the valley were the train crew of the C. P. R.

The mountain fell, struck the river bed, and with the inertia gained by the millions of tons falling 3,000 feet it swept over the valley like a mighty wave carrying everything before it. As it travelled, it spread, and from a width of 4,000 feet falling out of the mountain, it formed a fan-shaped mass at the outside (1½ miles away) measuring over 8,000 feet. The area covered by this immense mass of limestone rock and a small portion of the cretaceous rocks where it broke, is over 900 acres. This area is covered to a depth of from 10 to 100 feet in height, across the whole valley, and reaches up to 400 feet on the mountain on the opposite side of the valley, 1½ miles away. The main line of the C. P. R. for 1¼ miles is wiped out of existence and covered over to a great depth. The Frank & Grassy Mountain Railroad is also wiped out for over a mile and filled up with debris.

At the time of the disaster there were working in the mine 19 men, and out of that number 17 were saved. The two lost being a driver and a trapper boy who, no doubt, were at the time out on the tibble, as there was a trip of empty cars standing near the mine mouth ready to go into the mine. The 17 men who were saved dug themselves out about 80 feet from the main entrance to the main tunnel. The information gained from them is that the mine is very little damaged, a few timbers only in the gangway having been broken. The first intimation they had of anything being wrong was a serging of the hanging wall, then a crushing and falling of coal all around them. They made their way towards the mouth of the main entrance but found it blocked, going back into the mine about 4,000 feet they attempted to ascend the air shaft but this exit was also blocked. Again making their way to the lower tunnel, or first opening of the mine, they found their exit blocked by the inrush of water from the river which had dammed back to a height of 40 feet above its original bed. Their only course now was to try and dig themselves out at the nearest point to the main entry where there was the least covering. This they accomplished in 14 hours after passing through 20 feet of coal and earth, then nine feet of limestone boulders. During all this day of the 29th men were braving the dangers of falling rock from the mountain trying to open out the main tunnel, but before this was completed the miners had saved themselves. The great loss of life was entirely confined to the outside. The rocks and mud completely wiping out all tibble work, machinery, &c., demolishing six cottages and a number of smaller shacks and tents, two rancher's houses and a railroad camp which was situated a mile and a quarter away from the base of the mountain. The total number of casualties as far as can be ascertained is 66, although there may be a few more Slavonians or Russian Poles who are not accounted for.

Some remarkable escapes were made by those living in the cottages that were demolished, one whole family coming out without a scratch, between mud and boulders, with scarcely a vestige of their home being left; another case where six of the family were killed and only three left to tell the tale without any harm coming to them. Incidents of bravery were numerous, especially notable being the seven miners who were trying to open out the main tunnel and save their fellow-workmen. Rocks from the mountain were falling all around them, and the general manager remarking that it was rather dangerous work, the only reply was "Damn it, there are fewer men here than what is inside," and on goes the brave work. One man whose brother was entombed in the mine made the attempt to cross the foot of the slide to reach the air shaft on the other side, but his daring act was in vain as the shaft was completely covered by debris. Another incident well worth remembering was the act of the operator and brakeman who crossed the slide not knowing what next might come, to flag the passenger train which was just about due. After all the excitement of the 24 hours following the disaster, the rocks were still falling from the

mountain and this caused an uneasiness among the citizens left. A meeting was called and three (3) men were appointed to ascend the mountain, examine into the cause, and report the conditions if still dangerous. This arduous ascent was made on 2nd May, and the report made to the representatives of the Dominion and Territorial Governments, President of the Board of Trade, C. P. R. officials and Canadian and American Coal Co. officials. The report was such that Premier Haultain immediately issued a preemptory order for the town to be vacated. This was accordingly done, and on the evening of 2nd May there was not an inhabitant left in the town. The mountain has been examined every day since and the conclusions that will be arrived at on the 11th May will determine if it is safe to again occupy the town. The indications are that the town will once more be populated as the broken portion of the mountains yet to come down will do so by degrees and not endanger life or property.

The C. P. R. have decided to go ahead with the reconstruction of the two miles of road wiped out, and in the course of a month all should be running smoothly again. The coal company have decided to open up their property again by sinking a slope on the coal immediately behind the town. The only loss to them, although heavy, is confined to machinery, plant, and stoppage of shipping; the actual loss in coal is small and the property will, in the course of eight or ten months, be as large a producer as before the disaster. With all the sadness caused by the loss of life in such a disaster there is always a humorous side to it and this happens in the conclusions that have been drawn as to the cause of the slide.

The first impressions were that a volcano had started in the mountain, some going as far as to say that they saw the flames and smoke, even pointing out the lava flowing down the side of the mountain.

The next thing was that of an explosion in the mine but this was soon exploded by the colliers showing up through the limestone boulders.

Others again said it was an earthquake and it started right in the centre of the valley where they saw rocks tumbling around like nine-pins.

Another propounded the theory of the tail of a meteorite striking the mountain "biff" and down she goes.

The most improbable theory was the three elements, coal, lime and water, forming a great body of acetylene gas, and off it goes by some unknown cause, removing mountains. Others again mixed up their ideas between lime and limestone, water mixes with the lime, expanding, and down goes another mountain.

To give the real cause, however, is a matter of conjecture as there may be the two tributary causes combined or only one of these acting.

Some fissure in the mountain, with the warm opening days of spring and a hard night's frost, as it was, may have caused the movement alone, or the loosening of the coal in the mine with very little support on the lower side caused the overlying mass to break away. These alone, or combined, caused the great rock slide at Frank which has awakened the world.

FRANK B. SMITH, B.Sc., M.E.,
Inspector of Mines.

CALGARY, 7th May, 1903.

The disaster which overwhelmed Frank is certainly the most weird and terrible one could think of. On the morning of the 29th, at about 4 a. m., a rock slide came down which covered with debris the whole width of the valley, and spread down along its length for a distance of nearly two miles, burying all and carrying all in its wild rush.

Turtle Mountain is about 2,000 feet higher than the flat or valley at its base. It overlooks, and one might say it towers above, Frank, standing bold and fearful as a sentinel.

Its slope is steeper towards the top, the last 1,000 feet having certainly an inclination of 60°. The formation is limestone, with a westerly dip of from 40 to 60°; in other words, the strata dip into the hill.

A look at the hill will now show a great gap or cavity. The portion which gave way would be represented by a mass of limestone at least 1,200 feet long by 1,000 wide, by 500 thick. This great mass, becoming detached in an instant, slid down with fearful velocity, carrying everything along with it, scooping out in its passage the boulders, filling the bottom of the valley and spreading these along its run, thus increasing, to a great extent, its destructive action.

This is easily proved by the fact that the outer edge of the debris is composed of more or less rounded sandstone boulders, while the actual rock slide is made up exclusively of limestone, and forms the centre.

The avalanche, as it came down, passed over the coal mine at Frank, buried up the main entry and all its communications with the surface. It carried away tippie, blacksmith shop, stable, six cottages belonging to the coal company, besides several shacks in the valley below the town. It covered about 1½ miles of the C. P. R. with a thickness of at least 100 feet of rock; also some ¾ of a mile of track belonging to the Frank and Grassy Mountain Railway, the property of the Lille Collieries, which operates a coal mine 4 miles up a tributary valley.

Under the slide are buried some 80 people, a great proportion of which are women and children, as all of the 6 cottages of the company were occupied. Among the missing are the few men at the tippie and loading cars. Very few of the bodies have so far been recovered.

At the time there were 19 men in the mine; two of them were near the mouth of the entry, and are missing. The other 17 were inside the mine.

These tell of a great shock and noise, a cracking and squeezing of timbers. Their first idea seemed to be that an explosion had occurred. They made straight for the mouth of the main entry, but found that caved in. They climbed up the rooms to some raise connecting with the surface; everything was blocked. They finally decided to make their way out through the outcrop coal. After digging some 50 feet they succeeding in reaching daylight 12 hours after the accident occurred.

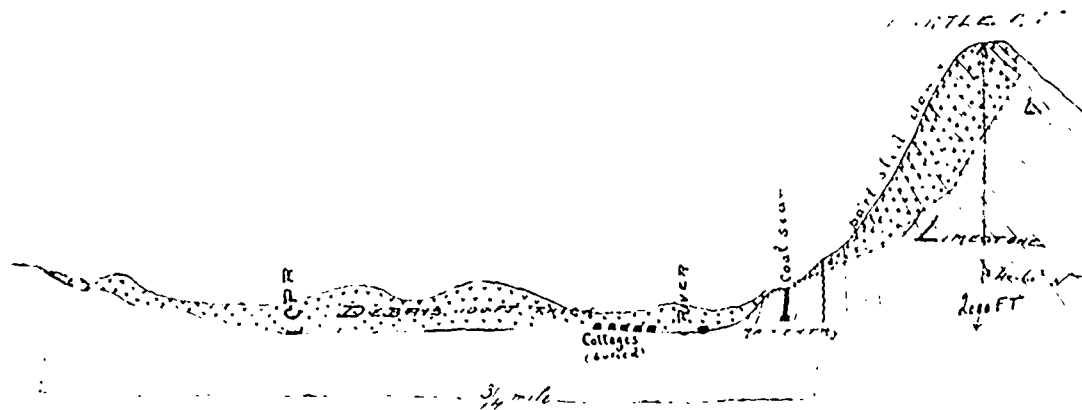
It happens that the seam where it outcrops along the side of Turtle Mountain is not covered by debris to any extent. The momentum of the mass of falling rock has carried it away and past the mine. The main entry itself, however, is deeply buried.

The blocking of the valley shut out all outlet for the river. It rose and formed a lake near the mine. Fortunately it has since found a channel, having reached the top of the debris, so all danger of flood is gone.

People awake at the time of the accident say there was a great noise, then a crash, accompanied by a trembling of the earth, as the mass of limestone slid into the valley beneath. Even at Lille Collieries, 4 miles distant, the shock was so great as to awaken everybody. All the following day rocks kept falling down in smaller masses. To-day, May 3rd, everything is quiet, but the danger, according to competent authorities, is far from past.

In order to ascertain the probability of any further sliding, a party was sent up to the summit of Turtle Mountain. This consisted of Mr. F. B. Smith, mine inspector; J. MacArthy, manager Frank

THE FRANK DISASTER.



SKETCH SHOWING ROCK SLIDE

AT FRANK, ALBERTA -

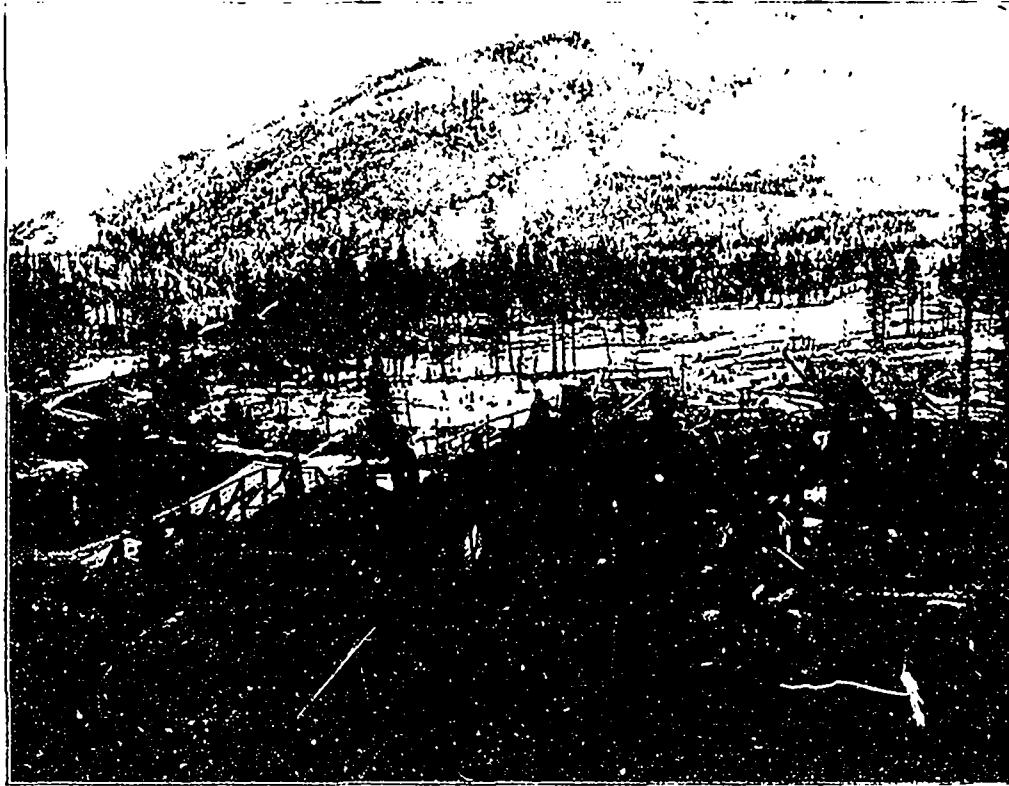
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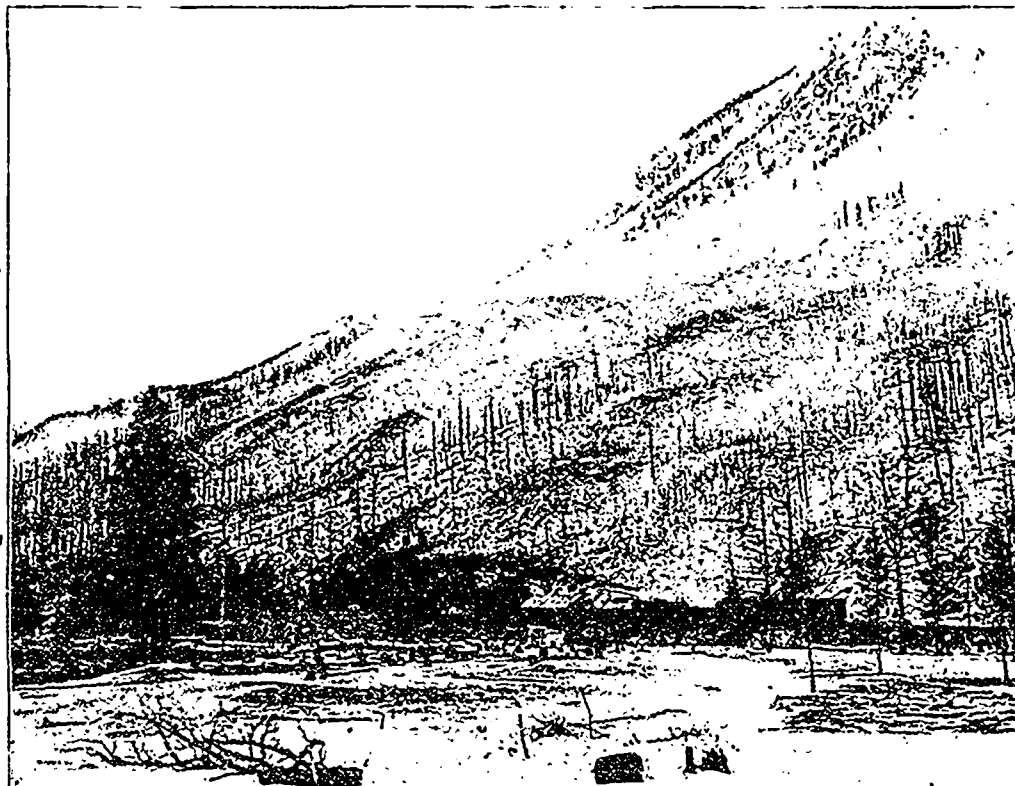


The Town of Frank, Alberta, showing location of Canadian-American Coal and Coke Company's Colliery before the disaster.

THE FRANK DISASTER.



Showing Coal Chutes from mouth of the Colliery previous to the slide.



Showing Mine Entry, Railway, Coal Chutes, Coking Ovens, etc., before the disaster.

THE FRANK DISASTER.



Showing Turtle Mountain after the slide, the lower end of the Town completely submerged in the mass of rock.



Showing remains of back row of cottages and foot of mountain where entry to mine was located. Two or three miles of country completely covered with a mass of rock in many places to a depth of two hundred feet or more.

THE FRANK DISASTER.



Another view of the mountain after the disaster. Old Man River filled with rock. X shows where the miners worked their way out after a whole day's digging. XX shows where rescue party endeavored to release them.

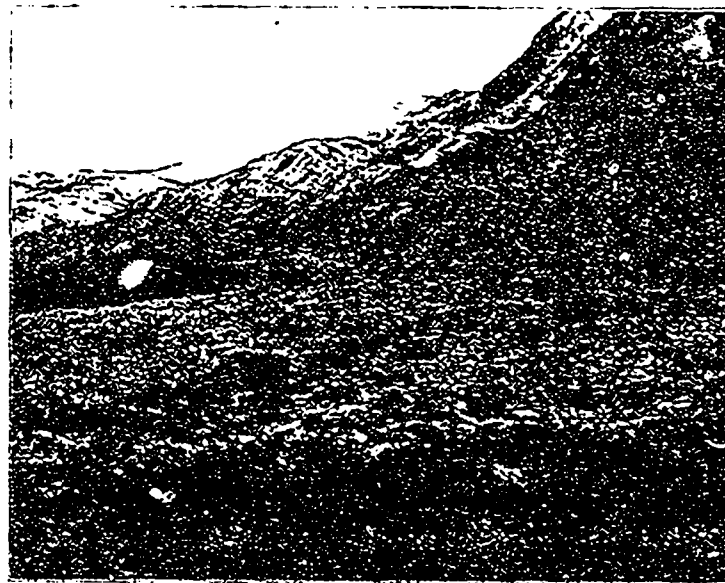


This view gives an excellent idea of the immense rock masses dislocated and hurled about one and a-half miles from mountain.

THE FRANK DISASTER.



Picnic and Ball Grounds, Frank, Alberta. Taken in September, 1902, on the first anniversary of the opening of the town.



The same after the disaster.

THE FRANK DISASTER.



General Manager McCarthy on top of the mountain examining into cause of continued rock falling.



Taken from the top of the mountain looking across the chasm.



Searching for bodies.

Mine (Canadian-American Coal and Coke Co.) and Mr. F. L. Byron. They found the summit of Turtle Mountain fissured in all directions, particularly that part overlooking Frank. Some of the fissures were of unknown depth and over 20 feet wide. As a consequence, everybody was strongly advised to leave town. The state has provided transportation free to anybody who wishes to leave. The result is that to-night the town of Frank is deserted.

Right here let there be a word said of the hospital corps. Amidst all the confusion and excitement attending the removal of the wounded and maimed, they kept a self control that was remarkable and precious; of the miners and business men who toiled hard and patiently over the debris of their ruined cottages, hoping and fearing for their dear ones' sake.

Traffic is completely blocked from the east. It will be at least two months before the C. P. R. can lay down a temporary track, and a great deal more before everything is in good running order.

As to the future of the Frank mines, no one can exactly tell. There is no positive evidence as to their condition. The men that were inside at the time say there was cracking of timbers and some fall of rock, but as all of them were nearly in the same part of the mine, their evidence is not one to be greatly relied upon.

There is no doubt there has been some falling of rock and some squeezing of the walls: in fact, the very movement of the walls was probably the primary cause of the accident, as will be explained later, though what the extent of the movement is nobody can at present vouchsafe.

All sorts of theories have been advanced as to the cause of the slide. That limestone mass fell down either because of natural disintegration at its base, until insufficient support was left for the great mass above, or because an empty space having been formed underneath it by the mining out of the coal, subsidence of the roof occurred, loosening and starting the superimposed strata. The last represents exactly the conditions obtaining at the mine. (See sketch.)

Here we have a vertical seam 12 feet to 16 feet wide, approximately parallel to the general stratification of the limestone in the hill above it: rooms averaging at least 100 feet long, running up the pitch to the outcrop, with 20 feet pillars between. At first the coal was allowed to stay in the rooms, keeping them full, the surplus only being drawn out, but lately a considerable number of old rooms have been partly emptied. As has been said before, nobody is yet in a position to assert there has been a general subsidence of the walls. This point cannot be settled until an examination of the mine is made. In any case the catastrophe involves large losses, both in life and property.

The mine was shipping on an average about 600 tons per day. The coal was conceded to be of excellent steaming quality. It could be mined exceedingly cheap, rather less than \$1.00 per ton, and found a ready market with the C. P. R. Whether an effort will be made to re-open the mine or not is unknown at this date. Other mines in the immediate vicinity are nearing the producing stage, and will be in a position to supply the demand for coal, which is rapidly making itself felt in the neighborhood.

RAOUL GREEN.

FRANK, ALTA., 11th May, 1903.

Mr. J. Obalski, Inspector of Mines, has issued his annual report reviewing the progress of mining in the Province of Quebec during the year 1902. Mr. Obalski very conservatively estimates the value of the mineral production during that period at \$3,000,000. About 5,000 persons are employed by this industry. Much serviceable information is given by Mr. Obalski concerning the asbestos, mica, chromite, graphite, copper and other working mines.

EN PASSANT.

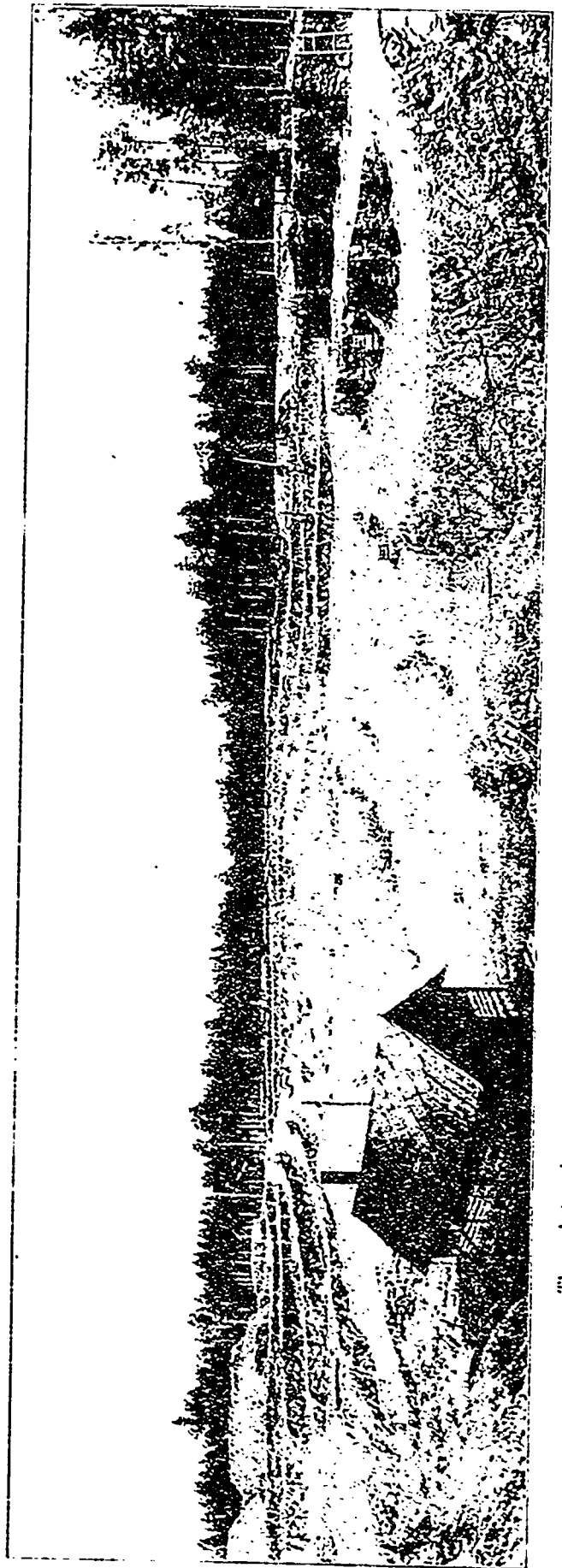
In view of the very regrettable abandonment of the proposed visit of the American Institute of Mining Engineers to British Columbia, the Canadian Mining Institute is endeavoring to get the American engineers to visit Toronto early next year. In this event a joint meeting of both organizations will be held and a series of excursions to the nickel, copper, iron and gold mining regions of Ontario carried into effect.

In this issue we reproduce the two very fine panoramic views of asbestos mining in Asiatic Russia. Mr. H. C. Riehle, mining engineer of the Union Asbestos Mines, Black Lake, Ont., to whom we are indebted for these photographs, gives the following particulars of this industry which, to some extent, competes with our own asbestos production in the Province of Quebec:— 'The views are of the "Corewo" and "Baron Girar de Soukanton" Asbestos Mines, situate in Asiatic Russia. These mines are remarkable for the fact that even with a production of 1500 to 1700 tons of asbestos per season, the mining work is all done without the aid of machinery or explosives. The rock is essentially a serpentine, but is quite decomposed to a depth of about 45 feet, so that it resembles a clayey gravel. The ground carries more asbestos to a given area than our Canadian mines, but the veins are not so heavy nor of so white a colour as our output. Again, our veins generally appear as "twin veins," while the Russian veins are only single veins. Mining operations are all carried on upon very antiquated systems, while proper milling plant, practically does not exist. Experiments in milling are, however, in progress, and are very vivid reminders of what occurred at the Quebec mines years ago. The working force at these mines numbers up to 1700 men in the season (*i.e.* each mine) and is recruited from the Russian Mujiks or peasants. The wages paid ordinary labour is about 37 to 38 cents a day, with free sleeping quarters. These mines also suffer from a scarcity of labour during the harvesting time, same as the Canadian mines do. Adjacent lakes will prevent these mines from ever attaining the depths of our mines owing to the very porous nature of the earth—the lakes being on nearly the same level as the mines.'

The announcement by the Finance Minister that the Government has removed the duties on mining machinery going into the Yukon and Atlin will be received with satisfaction by the operators in these somewhat remote but important mining regions of the Dominion.

Dr. Eugene Haanel, Superintendent of Mines, contributes to the annual report of the Minister of the Interior, an exceedingly interesting and valuable review of the progress of mining in the Yukon which we heartily commend to those of our readers who are interested in this productive gold territory. After very fully describing the various mines which he inspected last summer and commenting upon the improved methods of mining which are gradually superseding the older workings, Dr. Haanel concludes:— 'The first workings of the claims of Bonanza and Eldorado creeks by the cruder methods of earlier years have been so wasteful that it has been found to pay to work them a second time, and some claims have yielded, on second working larger returns than on first working. Many of these claims are now worked out 'from end to end and rim to rim, and are fit for nothing else than dumping ground.' No claims on the other creeks, as far as I could ascertain, are being worked a second time, nor is it likely that it would prove profitable to re-work them, since the methods of extracting the gold have greatly improved, and care is exercised to get out maximum percentage of the 'pay.' It must not, however, be

ASBESTOS MINING IN ASIATIC RUSSIA.



These photos give a panoramic view of the "Corewo" and "Baron Girar de S ulkanton" Asbestos Mines in Asiatic Russia.

overlooked that there are long stretches of creek bottom and gulches, which, being of too low a grade to be worked by ordinary placer-methods, can be worked profitably on a large scale by machinery. Many claims, which are 'good pay,' are held back for lack of water, awaiting the exhaustion and relinquishment of adjoining claims to enable the owners to take advantage of the water now being used by their neighbours. Still other claims are held back, awaiting improved conditions as regards transportation, labour and fuel. To this ground now lying idle must be added the hillsides awaiting to be worked by hydraulicking. But whatever generous estimate may be made as regards the quantity of gravel still to be worked in the Klondike, this gravel will be worked on a large scale by the more rapid methods of machinery, employing comparatively few men. It is quite probable that other auriferous regions may be discovered in the Yukon, which will develop into placing-mining camps,—we know very little as yet of the resources of the Yukon,—but such discoveries will simply shift the population to the new mining camp. That this is realized, and that it is understood that the Klondike as a mining camp must look for permanency to the discovery of paying quartz and in paying quantities is evidenced by the energy manifested by prospectors in searching for quartz. Very many quartz locations have already been staked and recorded."

The removal of the duty on mining machinery imported into the Yukon is a wise measure which cannot fail to stimulate the development of mining in the Yukon on a larger scale than has been.

The sixth annual report of the Crow's Nest Pass Coal Company reproduced elsewhere, shows, notwithstanding the losses entailed by the lamentable explosion and an unfortunate strike, which greatly retarded the Company's output of coal and coke, that substantial progress has been made. Four dividends of 2½% each, or ten per cent. for the year, were paid. To date the dividends paid by the Company have been:—

No. 1—	\$55,205 50
No. 2—	62,500 00
No. 3—	62,500 00
No. 4—	62,500 00
No. 5—	62,500 00
No. 6—	62,500 00
No. 7—	62,500 00
No. 8—	62,500 00

or total dividends of \$492,705 50

During the year ended 31st December, the net profits, notwithstanding the strike and explosion, amounted to \$171,285.50.

Vol. VI. of the Journal of the Canadian Mining Institute is rapidly being printed and will be in the hands of the members, it is hoped, early in July. This volume will contain about 600 pages and over a hundred illustrations.

The Lake of the Woods gold district has again to record another dismal failure, through mismanagement, in the winding up of the Mikado Gold Mining Company. The London *Critic* severely handles the directors of this concern in an editorial under date of 25th ultimo, from which we quote:—

"Colonel Engledue (C.B.B.), who presided at the meeting to consider these accounts in May, 1900, did not, of course, dilate to the shareholders on the bankrupt position of their undertaking. He fixed their attention on their holding of Mikado shares; and painted the shareholders prospects in *couleur de rose*. He announced that £1,400 had just been received as divi-

dend on the Mikado holding, and pictured profits coming in from this source at the rate of £3,000 per month, so soon as the mine was equipped with additional plant, to defray the cost of which the shareholders of the South African General Development Syndicate were to be asked to subscribe. The simple shareholders, as a matter of course, swallowed the honeyed words of their guinea-pig chairman, and instead of cursing the Board for the awful accounts presented, went away blessing them. Doubtless many of them also went home and wrote out applications for the new issue of Mikado shares.

"Since the meeting of May, 1900, the shareholders of the South African General Development Syndicate have received no further report and accounts from their directors; but as shareholders in the Mikado Gold Mining Company, they have been in touch with the syndicate's most attractive investment. It was a peculiar coincidence that, almost immediately after the dividend above referred to had been paid and some 22,500 new shares had been subscribed, the character of the Mikado gold mine changed. There was, to quote the last report of the directors, 'an unexpected fall in the value of the ore which could not be foreseen, as will be understood by those acquainted with gold mining.' The falsification of the roseate promises of Colonel Engledue and his henchmen will certainly be readily understood by all who have had the misfortune to be interested in their many unfortunate companies.

The Mikado property, so far from proving highly profitable in accordance with the directorial promises, has been mined at a serious loss. The dividends, to the amount of £2,250, distributed in the spring of 1900, when the new issue of 22,500 shares was being made, were clearly paid out of the capital inasmuch as had the mine development expenses been charged to revenue instead of to capital, there would have been a heavy balance on the wrong side of the accounts at that time. And the position at present is that the whole of the subscribed capital has been frittered away, besides some £50,000 of gold extracted from the property, and that the company, by reason of its liabilities, cannot go on unless further capital be forthcoming from somewhere. The directors tried to raise £12,500 by an issue of debentures in January last. But there was no response to their circulars offering the bonds, and it is to be hoped that they will meet with no more success with the proposals which they have now put forward to form a new company to take over the Mikado undertaking with a capital of £75,000 in £1 shares, credited with 15s. paid. Even if payable ore were again found on the Mikado property, the shareholders have no reason to believe, from their past experience, that it would prove profitable to any but the directors and officials. The obvious course, therefore, for the fleeced shareholders in the Mikado Company and its parent concern (the South African General Development Syndicate) is to have the wretched venture wound up—and the winding-up should be compulsory, under the supervision of the Court."

Just as we go to press we have received from The Carswell Company, Limited, of Toronto, an advance copy of the Hon. Archer Martin's handsome volume of "Mining Cases" decided by the Courts of British Columbia and the Courts of Appeal, from 1853 to end of September, 1902. This is, we understand, the first of what is to be a series of B. C. mining reports, revised and collected together in such a manner that the enquirer into the state of the law affecting mining rights and property can readily, conveniently and accurately inform himself on any branch of the subject without having, at great loss of time and labour, to wade through several series of disconnected reports, thus incurring the constant danger, even to the practitioner skilled in mining legislation, of overlooking some important decisions.

To facilitate reference and minimize the danger of mistakes, annotations and cross-references are given at the end of each case, and full explanatory notes where necessary. Great difficulty being constantly experienced in tracing up through many volumes of statutes, often un-indexed, the law applicable to mining claims located in different years under different laws, it has, at the request of many leading counsel, been decided to include, in the form of an appendix, a verbatim reprint of all mining statutes, so far back as to cover the title to every existing mineral claim in the province, and also a selected few of the earliest gold laws and proclamations, so as to show and explain the origin and development of B. C. mining legislation. Also there

has been compiled a table or list of every proclamation, ordinance, law, statute or regulation issued since the first one in 1853.

While, of course, this eminently serviceable work will have the greatest value to the legal profession, it will be of unquestioned usefulness to mining engineers and mine managers interested in British Columbia. The price of the book is \$20.00, bound in half calf.

The Ontario Bureau of Mines has issued a very timely bulletin on "Peat Fuel, its Manufacture and Use," by Mr. W. E. H. Carter, B.A.Sc., Secretary of the Bureau, who for this purpose visited almost all the peat factories of the Province and investigated the efficiency and cost of the machinery and methods made use of. Discussing the question of price Mr. Carter says. "The cost of producing 'machine' peat in Europe is from 85 cents to \$1.35 per ton; of peat briquettes \$2.15 per ton. As the detailed data set out in the following pages show, peat briquettes can be made in Ontario at about \$1.00 per ton of 2,000 lbs. Allowing a suitable margin for profit, interest on investment, etc., it is evident that compressed peat fuel can be sold at the place of production for \$3.00 per ton, and at a correspondingly greater figure if railway freights have to be paid. As a matter of fact, it has already been sold by one maker for two successive seasons at \$3.00 per ton, and beyond doubt in this price was included a fair profit. Putting the theoretical value of peat briquettes at two-thirds that of coal, at \$3.00 per ton their cost would be equivalent to anthracite at \$4.50 per ton, and at \$4.00 per ton to anthracite at \$6.00 per ton. Such figures at once bring peat fuel into the economic arena, as it may be doubted whether with the effective control now exercised by the trusts over the production and sale of anthracite, we are likely to see it again drop to a lower retail level than \$6.00 per ton. In the light of the facts brought out in this report, it will be surprising if the citizens of Ontario are not soon given their choice between compressed peat fuel and coal, instead of as at present being confined entirely to the latter." The report covers the ground very thoroughly and gives a great deal of useful information on the subject.

Molybdenite—Its Occurrence, Concentration and Uses.

By J. WALTER WELLS, M. E., Kingston, Ont.

As the uses of mineral molybdenite are being extended the writer undertook some experimental work at the ore-dressing laboratory of the Kingston School of Mines to determine the different methods of concentrating its ores and it was thought that the results might be of interest to the members of the Canadian Mining Institute.

Molybdenite when pure contains 60 p. c. molybdenum and 40 p. c. sulphur and may be represented by the formula MoS_2 . A sample selected by the writer from an Ontario specimen carried—

Mo.....	58.56 p.c.	S.....	38.34 p.c.
SiO ₂ ..	0.32 "	Fe.....	0.79 "

It is commonly found foliated, massive in scales or finally granular. Sometimes it is found in nature as hexagonal crystals more or less tabular or as short tapering prisms horizontally striated.

The cleavage is basal, the laminae being very flexible but not elastic. It may be easily cut with a knife the hardness being 1 to 1.5. Its specific gravity is 4.7. The lustre is metallic and the color a lead to silvery gray. It is opaque, and very greasy leaving a gray-blue trace on white paper. It closely resembles graphite in softness and physical structure but gives a bluer trace on paper and shows sulphur reaction with soda on charcoal. The difference in graphite and molybdenite was pointed out by Scheele in 1778.

Heated on charcoal molybdenite gives a strong odor of sulphur with the oxidizing flame coating the charcoal with molybdenum dioxide which is yellow while hot and white on cooling. If the white coating

be touched with a reducing flame it gives a beautiful blue color along with a copper-red. Molybdenite is infusible in the blow-pipe flame imparting a greenish-yellow color to the flame. It oxidizes in the open tube giving sulphurous fumes and a yellow sublimate of molybdenum dioxide. It is decomposed by nitric acid and more readily by a mixture of nitric acid and potassium chlorate, leaving a white residue of molybdenum dioxide, soluble in water, the solution when reduced with zinc and sulphuric acid turning a blue, green and finally on olive brown.

OCCURRENCE OF MOLYBDENITE IN CANADA.

Molybdenite seems to be a common mineral in Canada judging from reports. It is commonly found associated with other sulphides such as pyrite, pyrrhotite, and chalcopyrite. At the Giant mine, Rossland camp, British Columbia, the gold values seem to depend on the amount of molybdenite present. According to Hon. C. H. McIntosh as reported in *Rossland Miner*, Feb., 19, 1903, a sample of ore from the Giant mine rich in molybdenite sent to Vivian & Co., Swansea, England for analysis carried the following:—

Molybdenum.....	24.20 per cent.
Nickel.....	trace.
Cobalt.....	1.00 "
Bismuth.....	.19 "
Arsenic.....	1.80 "
Sulphur.....	23.00 "
Copper.....	trace.
Lead.....	trace.
Zinc.....	nil.
Antimony.....	nil.
Silica.....	35.00 "
Iron-metallic.....	12.00 "
Lime, magnesia, etc.....	2.30 "

99.49

Gold—4.14 ounces per ton of ore.

Silver—1.2 ounces per ton of ore.

Molybdenite is often found in quartz veins where its presence does not indicate the presence of gold according to assays made by the writer. It is a common accessory mineral in granites, gneiss, pegmatites, etc. The report of the Canadian Geological Survey note the following localities where molybdenite may be found:—

1. At the mouth of Burnt Hill brook, a branch of the south west Miramichi, New Brunswick, where the molybdenite was found in quartz veins cutting schistose rocks but not in commercial quantity.
2. In quartz veins at various point along the Atlantic coast in Cape Breton.
3. In quartz veins cutting granite near Gaspereaux Station, New Brunswick.
4. In quartz veins at Pennfield, Charlotte County, New Brunswick, 2 miles north of the post road on Trout brook where the quantity is said to be considerable.
5. In syenite near Gaspereaux river road in New Brunswick
6. At lot 12, 12th concession of Templeton, Quebec, intermixed with pyrite.
7. At lots 1 and 2, 3rd range of Aldfield Township, Pontiac County, Quebec.
8. At lot 69, 4th concession of Egan Township, Ottawa County, Quebec, where there is said to be a large deposit associated with pyroxene, mica, pyrite, etc, carrying 7.5 p. c. molybdenum dioxide.
9. At lot 7, 9th range of Ross Township, Renfrew County, Ontario, where a vein carries molybdenite associated with apatite, scapolite, titanite, pyrite, etc.
10. In Matawanchan Township, Renfrew County, Ontario, the locality being not well defined.
11. At lot 22, 2nd range of Ross Township, Renfrew County, Ontario, where a quartz vein in gneiss is said to carry considerable molybdenite.
12. At Quarry Island, Rainy River District, Ontario, where the gneiss as country rock shows specks of molybdenite.

13. Around Lake Nipissing, Ontario, as an occasional constituent in quartz veins.

14. A specimen is reported from upper Cowitchen river, British Columbia.

15. In association with copper ore at a locality between Jarvis, Inlett and Howe Sound, British Columbia.

16. In the Atlin district it may be found as an accessory constituents of gneiss and in quartz veins especially at the head of Volcanic creek.

17. Float carrying considerable has been found in the vicinity of Great Slave lake.

According to the Inspector of Mines for Nova Scotia specimens of molybdenite may be found in that province of Gabarus, Hammonds, Plain Bedford, Lower Musquodoboit, New Germany and New Ross.

The Inspector of Mines for Quebec reports molybdenite in workable quantity in quartz veins at Quetcho-Manicougan: at lot 17, 15th concession of Leeds Township, Megantic county: at the northern part of 13th range in Calumet Island.

According to the reports of the Bureau of Mines for Ontario molybdenite may be found more or less abundant at the following localities:—

1. Lot 3, 8th concession of Miller Township, Frontenac County.

2. At Black river, Lake Superior region where a considerable quantity is reported.

3. At lot 14, 5th concession of North Crosby, Leeds Township.

4. At lots 26 and 27 in 6th concession, Monteaule Township, Hastings County.

5. Near Farquhar lake in lot 3, 1st concession of Harcourt Township, Haliburton County, where a considerable deposit has been opened up by the Haliburton Land and Immigration Co. of Toronto. Five veins traversing pyroxenite as country rock have been exposed carrying molybdenite with pyrrhotite, tremolite, pyrite, mica and sphene. The total exposure is 300 yards long and 80 yards wide on which test pits have been sunk. Average samples from this property carry about 2 p.c. molybdenum.

6. Several localities are reported where the molybdenite appears to be only an accessory mineral in country rock or pegmatites.

The writer also knows of the following important deposits not mentioned as they are but recently discovered:—

1. At the centre part of lot 5, 11th concession of Laxton Township, Victoria County, Ontario, near Mud Turtle lake. Development work done by the owner, Mr. J. Webber, Toronto, shows a vein about 15 feet wide cutting crystalline limestone. The vein has been stripped for 40 feet by an open cut and shows molybdenite in large and small flake associated with pyroxene, calcite, quartz, black mica, pyrites, a few specks of pyrrhotite and hornblende. A 50 lb. sample submitted to concentration tests as further described carried 3.28 p.c. molybdenum.

2. At the south part of lot 5 in the same locality as (1) where a narrow vein carrying molybdenite may be traced 5. Three pits sunk about 30 feet apart show molybdenite in considerable quantity and fairly rich. The associated minerals are quartz, calcite, pyrite, molybdenum ochre due to weathering action and pyroxene.

3. On the farm of T. Dwyer, Sheffield Township, Addington County, there is a mineralized zone carrying pyrrhotite, pyrite, hornblende, calcite, quartz, pyroxene, black mica, etc., in which foliated masses of molybdenite occur some of the masses being 6"x6" while it may be as fine flakes.

Development work done by the owner, Mr. A. M. Chisholm of Kingston, has produced a pile of 1,000 tons of ore and the deposit does not seem to be exhausted. Average samples selected by the writer carried 2.8 p.c. Mo and 260 lbs. of selected ore subjected to concentration carried 3.90 p.c. Mo.

4. A deposit is known to occur near Granite crossing, British Columbia, where the C. P. R. crosses Kootenay river. Five claims have been taken up by Mr. T. L. Stamford of Nelson, on a vein mostly quartz traversing altered granite as country rock. The molybdenite occurs as fine flakes in the quartz and there is more or less of reddish felspar present. A 20 lb. sample from this locality submitted to concentration tests by the writer carried 1.5 p.c. Mo.

Molybdenite is reported to have been found in considerable quantity at Rencontre, Fortune Bay, Newfoundland.

A deposit has been found near the White pass Tunnel above Skaguay in the Yukon Territory carrying considerable molybdenite with high gold values.

CONCENTRATION TESTS ON CANADIAN MOLYBDENITE ORES.

Molybdenite has come into industrial use only within the last few years on a large scale so that there is practically no literature regarding the methods of concentration or dressing its ores. As it is a common mineral in Canada and its industrial uses appear to be increasing, some commercial method of extracting the mineral from its ores is needed. Accordingly the writer submitted several samples to concentrating tests at the ore-dressing laboratory of the Kingston School of Mines with the object of finding a simple and efficient method of concentrating molybdenite from the low grade ores.

Sample A comprised 260 lbs of ore from a deposit in Sheffield Township, Addington County, Ontario, already noted. Plate 1 is a characteristic specimen showing the flakes of molybdenite segregated in the matrix. The sample carried about 50 p.c. pyrrhotite, 10 p.c. pyrite intermixed with calcite, black mica, quartz, pyroxene, etc. The sample carried 3.90 p.c. Mo. equivalent to 6.5 p.c. molybdenite. All

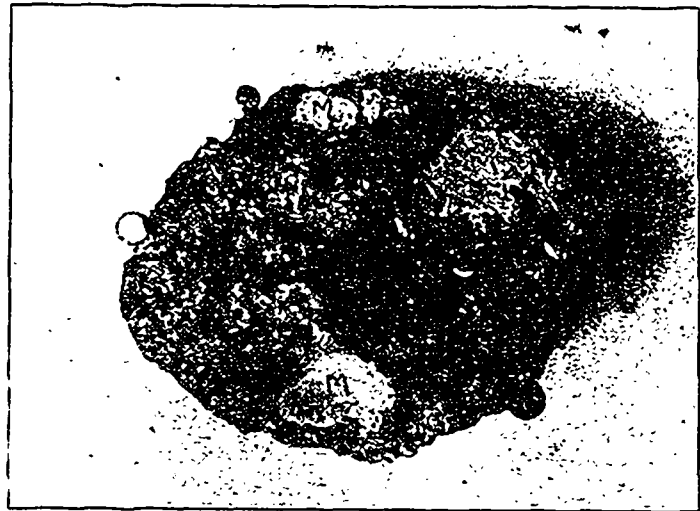


Photo showing Molybdenite in flakes (M) found in Pyrrhotite.

of the molybdenite was in the form of small scales or segregated masses as the ore was selected to see what could be done with the fine flakes. Hand picking of the large flakes is obviously the easiest method of securing a marketable product but the removal of the fine flakes is more difficult.

The sample was crushed in jaw crusher, passed through rolls and screens with slots of 0.20" diameter. Molybdenite as large flexible flakes not reduced in size by rolling was picked from the screen. Such ore weighing 3 lb. carrying 54.3 p.c. Mo equivalent to 90.05 p.c. molybdenite.

The ore was then crushed in the rolls to finest possible size and passed through the screen of 0.20" diameter delivering an oversize weighing 3.5 lb. consisting of mica and molybdenite with a few particles of pyroxene. Neither mica nor molybdenite were much affected by passing through the fine rolls owing to the flexible and laminated structure.

A few particles of the molybdenite had particles of pyrite and pyrrhotite imbedded in the soft flakes. The ore passing 0.20" screen was passed to screen delivering product of 0.10" diameter and finer while the oversize consisting of mica, molybdenite with a few particles of rock weighing 4 lb. in all was removed. The ore reduced to 0.10" size was passed through a Wetherill magnetic separator removing 134 lbs. of almost pure pyrrhotite as a magnetic product showing by analysis:—

Fe.....	60.30 per cent.
Sulphur.....	38.97 "
Nickel.....	0.34 "
Molybdenum.....	traces.
Cobalt.....	traces.
Platinum.....	traces.
Copper.....	traces.
Gold.....	0.04 ounces per ton of ore.
Silver.....	traces.

The tails from the magnetic separator carry:—

Sulphur.....	5.49 per cent.
Nickel.....	traces.
Molybdenum.....	0.46 "
Copper.....	traces.
Gold.....	traces.
Silver.....	traces.
Platinum.....	traces.

The tails from the magnetic separator passed through a straight line hydraulic separator delivered heads carrying—

Sulphur.....	5.08 p.c.	Molybdenum.....	0.34 p.c.
--------------	-----------	-----------------	-----------

to a Wilfley table while the tails consist largely of mica, crushed particles of rock with a few flakes of molybdenite.

The Wilfley table give a head product weighing 11 lb. carrying—

Sulphur.....	41.93 p.c.	Molybdenum.....	1.32 p.c.
--------------	------------	-----------------	-----------

being mostly pyrite fit for making sulphuric acid. The middles from the Wilfley samples as being returned to the table for retreatment carry—

Sulphur.....	3.64 p.c.	Molybdenum.....	0.12 p.c.
--------------	-----------	-----------------	-----------

While the tails carry—

Sulphur.....	2.74 p.c.	Molybdenum.....	0.10 p.c.
--------------	-----------	-----------------	-----------

neither being of any commercial value but showing that the Wilfley table is adapted to the ore for removing the pyrite if it is necessary or profitable to do so. The object of removing the pyrrhotite as one product was to get an ore of nickel if possible but there is not sufficient nickel present to make it worth, while so that probably the pyrite and the pyrrhotite might better be separated on the Wilfley as an ore of Sulphur.

Attempts were made to remove the molybdenite from the Magnetic separator tails using a modified form of the Elmore oil process mixing the ore with heavy oil and passing to a spitzkasten where the rock should fall allowing the particles picked up by the oil to float off. The oil seemed to have a selective action on both the pyrite and the molybdenite so that no clean product could be got: besides the larger flakes of molybdenite were not picked up by the oil.

The oversize from the 0.20" screen was treated in a hand jig calculated to give the same results as a Hartz jig. A sample carrying 55 p.c. molybdenite and 45 p.c. mica gave a product carrying 35 p.c. molybdenite with only a small loss as floating particles in the tails owing to a large size of the particles.

A cleaner separation of a similar sample was obtained by treating in a Wetherill cross-belt separator for weakly magnetic material removing the black mica as a magnetic product leaving molybdenite 90 p.c. pure.

A few flakes of molybdenite go into the magnetic heads owing to imbedded particles of pyrrhotite in the soft molybdenite due to the fine crushing of the rolls. It was found that the imbedded particles of pyrrhotite could be removed by treating in tumbling barrels.

The oversize from 0.10" screen carrying 48 p.c. molybdenite, 45 p.c. mica with a little hornblende or pyroxene was treated in a

hand jig giving a product carrying 70 p.c. molybdenite with a considerable loss as slimes.

Oil concentrating was tried on a similar sample with poor success as the larger particles of molybdenite were not picked up by the oil.

Magnetic separation gave the best results as all the mica was removed leaving molybdenite 91.10 p.c. pure. The same trouble of magnetic pyrites imbedded in the soft molybdenite was noted.

As molybdenite resembles graphite in many physical characteristics it was thought that a scheme of crushing and treating with Hooper pneumatic jigs such as used in treating flake graphite would give a clean product, but unfortunately the writer had not the use of one of these air jigs. Graphite has a specific gravity of 2.1, while that of molybdenite is 4.6 so that in some cases it may be seen that molybdenite cannot be separated clean from some of the associated minerals of the same specific gravity. The makers of the Schule dry concentrator successful on the ordinary run of ores report to the writes that they have not been successful so far in removing molybdenite from a gangue of hornblende and mica.

The following scheme of treatment being the result of experiments is probably the most suitable for this ore:—

- Hand cobbled ore.
- ↓
- Jaw crusher (0.50")—Hand picking of large flakes of molybdenite detached.
- ↓
- Rolls (0.20")
- ↓
- Screen (0.30")—→oversize—(mica and molybdenite.)
- ↓
- Screen (0.20")—→oversize (mica and molybdenite also a little rock.)
- ↓
- Screen (0.10")—→oversize (mica, molybdenite, rock matter.)
- ↓
- Screen (0.05")—→oversize (mica, molybdenite, rock.)
- ↓
- Wilfley table to save the Pyrite and Pyrrhotite as an ore of Sulphur.

As none of the oversize products from the screens were of commercial grade, experiments were made to ascertain the simplest method of cleaning them.

The oversize from 0.20" screen was pulverized to pass 0.05" screen and passed to Wilfley table which delivered a head product



PLATE II.— Showing flakes of Molybdenite (M) in Pyroxene, etc.

assaying 50.4 per cent. Mo and comprising 32 per cent. of the molybdenite in the sample, the remainder escaping into the tails owing to the flaky nature of the ore. Retreatment of the middles from the Wilfley did not yield a clean product so that there will likely be a small loss in treating the oversize products from the screens by the Wilfley which for commercial purposes is probably the best method of cleaning up the oversize products. It is certain that the Hartz jig is not adapted to this purpose. With the object of checking off the results obtained in cleaning up the oversize products by the magnetic

separator a sample was sent to the Testing works of the Wetherill Separating Co., New Jersey, and the report as follows shows that this can be readily done although the manager was modest enough to report that the separation cannot be done on a practical basis owing to the high current required and the low capacity of the machine due to the necessary slow speed of the belt-conveyor. Personal observations would lead to writer to believe that the magnetic separator is as cheap and efficient as the Wilfley for cleaning up the oversize products provided a cheap means can be got for removing the embedded pyrrhotite from the larger flake of molybdenite. The smaller sizes of molybdenite do not show the grains of pyrrhotite fastened to the molybdenite so that only the larger sizes will need agitation in tumbling barrels. One advantage of the magnetic separation is that the oversize products do not need regrinding to finer size in a ball-mill as required in the Wilfley table separation.

MAGNETIC SEPARATION OF OVERSIZE PRODUCTS FROM SCREENS.

Separation was made at Testing work of Wetherill Separating Co., Newark, New Jersey, by George Ernst, assistant superintendent, and analyses by the writer.

Character of ore.—Oversize from screens consisting of molybdenite, pyrite, pyrrhotite, pyroxene, black mica, calcite, quartz.

Object of the test.—To secure molybdenite of commercial grade carrying at least 50 p.c. Mo.

Separator used.—Type E being the Rowand Cross belt machine as shown in plates 4 and 5 delivering magnetic heads, magnetic middles and non-magnetic tails.

Sample A.—Passing through 5 mesh screens to 10 mesh.

Sample B.— " " 10 mesh.

Product.	Nature.	Pile Dist. inch.	Amp.	Wt. of product grams.	Size	Mo in	Grade	Ex-
					Treat- ed	product.	p.c.	tract- ed.
					p.c.	p.c.	p.c.	p.c.
A 1 Magnetic heads.....	Mica, Pyroxene .	½	4	7.5	76.94	0.33	.....	.....
A 2 Non-Mag. tails.....	Molybdenite, Quartz, Py- rite.	½	4	2.0	21.06	56.3	93.6	93.4
B 1 Magnetic heads.....	Pyroxene, Pyrrhotite.	½	2	3.0	30.00	0.32	.....	.....
B 2 Magnetic middles.....	Mica, Pyroxene.	½	4	6.0	60.00	trace	.....	.....
B 3 Non-Mag. tails.....	Molybdenite, Calcite, Quartz.....	.....	.....	1.0	10.00	53.8	89.6	99.4

Sample B consisted of 40 lb. of ore from the Webber property in Victoria County, Ontario, already noted. Plate 2 shows a characteristic sample the flaky ore being in evidence. The sample carried quartz, calcite, pyroxene, mica, pyrite, hornblende and flakes of molybdenite of different sizes. Red oxid of iron and yellow oxid of molybdenum were found on the surface exposed to weather. The ore crushed, rolled and sized gave the following product:—

1. Hand-picked molybdenite weighing 8 ounces and carrying 55.2 p.c. being 92 p.c. pure.
2. Oversize on 0.30" screen weighing 2 lb. and carrying 4.58 p.c. Mo equal to 7.6 p.c. molybdenite.
3. Oversize on 0.20" screen weighing 10 lb. carrying 2.70 p.c. Mo equal to 4.5 p.c. molybdenite.
4. Oversize on 0.10" screens weighing 2 lb. This sample was included with the fines the total weighing 25 lb. and carrying 1.78 p.c. Mo equal to 2.90 p.c. molybdenite.

Oversize 2 was recrushed and screened yielding 1.25 ounces of 90 p.c. ore on the screen.

Oversize 3 was recrushed yielding 5 ounces of molybdenite 91 p.c. pure. All the fines from retreatment of the oversizes along with the fines from first screening were ground in ball-mill finer than 0.05" and passed to a Wilfley table delivering 10 ounces of molybdenite with pyrite and a little mica being 75 p.c. pure by assay. The middles from the Wilfley assayed 1.60 p.c. Mo and the tails 0.44 p.c. Mo showing that a small quantity was lost.

Altogether 24.25 ounces of molybdenite of commercial grade were saved as a result of the above experiments being about 72 p.c. of the molybdenite in the original sample. No experiments were made with the magnetic separator or oil separation.

Sample C consisted of 20 lb. of quartz and red felspar with small flakes of molybdenite scattered through as shown in plate 3. The sample carried 1.5 p.c. Mo equal to 2.5 p.c. molybdenite.

The sample crushed, rolled and sized gave no clean ore on any of the screens so that the whole sample was ground to pass 0.05" screen. A portion was treated in a Vezin hand jig as it was thought that as the

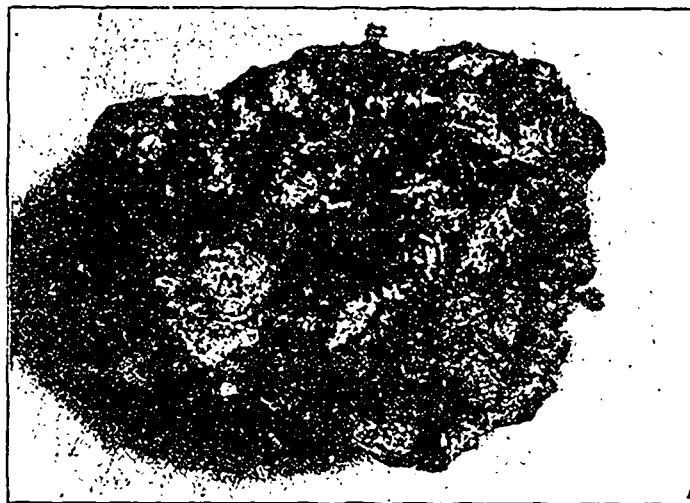


PLATE III.—Showing fine flakes of Molybdenite (M) in quartz.

specific gravity of molybdenite being 4.6 while that of felspar is 2.7 a clean separation would be possible in the jig but the flakes of ore seemed to be caught by upward pulsations of water so that no separation was possible.

12 lb. of the sample treated on the Wilfley table gave 1 lb. of concentrated ore carrying 6.84 p.c. Mo equal to 11.4 p.c. molybdenite, being a saving of only 38 p.c. of the value in the ore. This was due to loss as float in the tails as the fine particles of molybdenite seemed to be caught by a slight current of water and carried into the tails.

The molybdenite in the concentrates was readily removed by oil-separation as the selective action was very noticeable.

No constituents of this sample could be separated out by magnetic separation.

Sample D from the deposit in Harcourt Township, Ontario, already noted was examined but resembled sample A so closely that no attempts were made to concentrate it as in all probability it would act the same as A. The small experimental work on these ores have shown that no standard method can be used on molybdenite ores. Each ore is a problem by itself, only to be solved by experimental mill tests.

METHOD OF ESTIMATING MOLYBDENUM IN ITS ORES.

Several methods of estimating molybdenum in alloys and ores have been published and the writer made comparative tests on the different methods the results of which are irrelevant in this paper but will be submitted to chemical journals for publication. The writer devised the following rapid volumetric method for estimating molybdenum in

its ores being a modification of the estimation of phosphorus in iron ores by titration with potassium permanganate:—

Mix 0.20 to 1 gram of the ore according to richness with 6 times its weight of sodium peroxid and fuse in a nickel crucible for 10 minutes using a bunsen burner. Caustic potash may be added if the ore is very siliceous. Platinum crucibles must not be used as the peroxid attacks platinum also nickel but the latter is cheap.

The melt dissolves quickly in water acidulated with sulphuric acid, ammonia is added and the solution boiled to precipitate the ferric oxid, etc., Filter, add chemically pure zinc free from iron and sulphuric acid to reduce the molybdic acid to a lower form the clear solution turning an olive brown on reduction, but the reduction should be continued for 10 minutes after the olive-brown color shows in order to be sure that all the molybdic acid is reduced. Filter off excess of zinc with glass wool being careful to allow no particles of zinc to go into the solution. Titrate the olive brown solution to colorless and permanent pink using potassium permanganate standardized for iron or phosphorus. Subtract the amount of permanganate required to make a blank solution a permanent pink. The ratio of molybdic acid to iron is 0.8816 according to Blair's Chemical Analysis of Iron, page 62 and molybdic acid carries 66 p.c. Mo so that Fe value multiplied by 0.666 gives the Mo in the ore when 1 gram is used for analysis.

Van Furman states in his book on Practical Assaying page 102 that the ratio of molybdic acid to iron is 0.9076 but the writer chooses to follow Blair's figures.

All compounds reduced by zinc and sulphuric acid to a lower state must be removed. Among these are iron, titanium, vanadium, uranium, tungsten, chromium. The nickel taken up from the crucible apparently has no influence on the reactions according to blank determinations made by the writer. Qualitative tests were made on the Canadian samples of molybdenite tested showing that iron was the only interfering constituent present in more than traces.

This method was checked off by the electrolytic method which is certainly the most accurate but very slow and concordant results were obtained in nearly every case, although the volumetric method gives low results unless carefully done.

All the estimations of molybdenum given were done by this method which is recommended as a very rapid and quite accurate method.

INDUSTRIAL USES OF MOLYBDENITE AND ITS PRODUCTS.

The mineral molybdenite is the source of the metal molybdenum and the various chemicals used in the arts.

Metallic molybdenum free from sulphur may be made from molybdenite by heating in an electric furnace according to experiments conducted by M. Guichard reported in Comptes Rendues.

The molybdenite used carried—

Mo.....60 per cent.	S.....39 per cent.
Fe.....0.75 "	Si.....0.40 "

Heated in an electric furnace in carbon tubes with a current of 350 amperes and 50 volts, the sulphur was partially eliminated. With 950 amperes and 55 volts complete fusion was obtained and the sulphur completely driven off. The resulting metal analysed—

Mo.....91.5 per cent.	Fe.....2.1 per cent.
-----------------------	----------------------

total carbon—6.9 about $\frac{1}{4}$ of the carbon graphitic. A method of making molybdenum electrolytically is described by H. Moissan in *Bulletin de la Societe l'encouragement de l'Industrie Nationale*, June, 1895.

300 parts of molybdic oxid heated with 30 part of carbon in a carbon crucible by an electric current of 800 amperes at 60 volts for 6 minutes, produced the metal free from carbon carrying by analysis—

Mo...99.98 per cent.	Carbon .0.00 per cent.	Slag .0.18 per cent.
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Complete fusion of the charge should be avoided to prevent the fused mass attacking the crucible. The metal thus obtained is soft not

scratching glass, is easily filed and polished, malleable when hot. It oxidizes at 600° C volatilizing as molybdic oxid even before melting.

Combustion with oxygen produced vivid incandescence. When the reduction of molybdic oxid is made in the electric furnace with an excess of carbon, carbides of molybdenum are formed, the point of saturation being 5.87 p.c. carbon corresponding to the formula Mo_2C . When saturated with carbon the metal is intensely hard and more fusible than the pure metal.

Pure metallic molybdenum is silvery white in color, has a density of 9.01, is malleable like iron and is readily forged when hot. The pure metal is somewhat infusible, can be filed and will not scratch glass but if heated for some time in contact with carbon at about 1500° C cementation takes place and the metal is very hard after cooling. After the process of cementation it may be hardened by quenching like steel. A definite carbide, Mo_2C is known having a specific gravity 8.9 very hard and rather infusible.

The metal, molybdenum, is now being used to make molybdenum steel which is said to be replacing tungsten and chrome-tungsten steels. Tests made by Prof. W. Von Lipin of St. Petersburg and reported in *Stahl und Eisen*, 1897, No. 14, showed that the molybdenum steel in a general way but is less effected by tempering and annealing. High heating makes it very hard while annealing makes it softer than

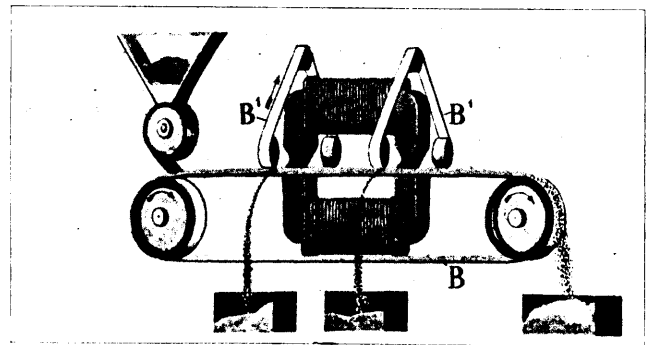


PLATE IV.—Reprint of a diagram of the Wetherill Magnetic Separator by F. O. Schnelle, published in a paper read before the Association for the Advancement of Industry (German). This machine separates mica, hornblende and pyrrhotite as magnetic products from molybdenite.

the tungsten steels. It can stand heating also tempering in water better than tungsten steel showing no fissures which tungsten steel often shows. It does not break could short as easily as tungsten steel and stands a forging and hardening better.

Experimental work has been done since that date by steel makers but little information is published. It is a well known fact however that tool steel carrying about 4 p.c. Mo is very tough and has the valuable quality of being self-hardening. It is used in shops where machine tools are pushed to their utmost capacity as self-hardening tool steel holds an edge at speeds which would draw the temper all out of carbon steel. Molybdenum steel according to trade reports is now being used to make all kinds of cutters as it can be machined to any shape.

Reports state that the excellent grade of armor plates made by the Krupp Works in Germany carries molybdenum along with tungsten and other rare metals. An excellent grade of steel for armor plates is said to have been made at the Creusot Works in France by using 3 p.c. Mo along with an equal amount of Chromium.

A discussion as to value of molybdenum in steel-making is irrelevant in this paper but for the convenience of those wishing to follow up the subject a list of technical articles dealing with special steels is included in the review of literature.

Molybdenum is sold both as the metal, as ferro-molybdenum alloy for use in steel-making.

The best molybdenum is quoted at \$1.82 per pound for 96 p.c. pure grade, Ferro-molybdenum (50 p.c. Mo) is quoted at \$1.25 per pound.

There are no metallurgical works in Canada producing the alloys nor is the ore mined or shipped except in very small lots but if the demand for the ore continues no doubt some of the richer deposits will be worked. According to official statistics 32,000 lb. of ferro-molybdenum carrying 50 p.c. Mo was produced in the United States during 1900.

About 15 tons of molybdenite were mined in the United States during 1901, but the output for 1902 is likely to be increased.

Molybdenite to be of commercial value must carry at least 50 p.c. Mo and be free from copper. Such ore sells for about \$400 per ton but as the market is somewhat limited overproduction would lower the price. The future of the industry of mining molybdenite depends on the new uses of the metal as the chemical industries absorb only a small quantity made up mostly into chemical reagents and dye chemicals although the use of aniline dyes has largely replaced its use in the dyeing industry. A small quantity is used in pottery works for making brilliant blue colors in the glaze.

REVIEW OF LITERATURE REGARDING MOLYBDENITE AND ITS COMMERCIAL PRODUCTS.

1. *Stahl & Eisen*, vol. 22, pages 579-589.—Discusses the making of tool steel for rapid lathe work. A full discussion as to tool steel especially self-hardening and their use in lathe work is given in the same journal, vol. 22, pages 454-456.
2. *Echo des Mines*, vol. 29, page 1197.—Gives a review of the use of ferro-molybdenum as made by electro-metallurgical processes.
3. *Journal of Franklin Institute*, vol. 153, pages 161-178.—Describes the process of making tool steel by Taylor-White method used at Bethlehem steel works.
4. *Baumaterialienkunde*, vol. 6, pages 227-229.—A criticism of the Taylor-White tool steel.
5. *Mining Journal*, vol. 72, pages 657-658.—Shows how the metals such as molybdenum are being used in the steel trade.
6. *Zeitschrift des Vereines Deutscher Ingenieure*, vol. 45, pages 1609-1610 also pages 1377-1386.—A full description of quick cutting tool steels.
7. *British Patent*, No. 738 of 1900.—Gives the composition of the Taylor White tool steel showing that it may carry from 1 p.c. to 5 p.c. Mo.
8. *Verhandlungen des Vereines Zur Beforderung des Gewerbefleisses*, 1900, pages 179-189.—Describes the Taylor-White tool steel, and its practical value.
9. *Stahl & Eisen*, vol. 21, pages 169-176 and 215-220.—A discussion of tool steels.

The literature as to occurrence of the ores in Canada are already mentioned. There is practically no literature as to the concentration of molybdenite ores.

PAYNE CONSOLIDATED.

The following is excerpted from Manager Garde's report to the directors at recent meeting of shareholders.

With the encouraging prospects of finding ore in lower levels it would be extremely desirable to consider the question of exploring the mine below tunnel No. 8. One commendable plan would be to continue tunnel No. 8 for about 300 feet towards west, until directly under the crest of Payne Mountain, and at this point to sink a central shaft, approximately 350 feet deep, from where three new levels Nos. 9, 10 and 11 could be driven, as indicated on map in dotted lines. The results would undoubtedly be the opening of new ore reserves within two years, at which time the present ore reserves probably would be exhausted. To accomplish this it would be necessary to install an electric hoist over the shaft, together with an adequate pumping plant, also driven by electric power. If this plan was adopted it would be necessary to increase the present power plant by installing a sub-power-station at Carpenter Creek, where the Company now holds water rights to the extent of 500 miners inches. A plant of this kind could be

conveniently operated in conjunction with the present power plant and pole line to the mine, as this feature was taken into consideration last year, when installing the present plant.

ORE IN SIGHT, STOPP FILINGS, DUMPS, ETC.

From last year's report it will be observed that the estimated total tonnage of back fillings contained in old stopes at the mine, together with all dumps, etc., amounted to approximately 100,000 tons, which may be accepted as a correct figure. Of this tonnage one third, or 33,000 tons, has been successfully concentrated in the mill during the past year, thereby leaving a reserve of 67,000 tons on hand. With the increased concentrating capacity, this can all be milled within the next twelve months, and will at the same ratio of concentration produce about 2,000 tons of high grade silver-lead concentrates, and 4,000 tons of 60% zinc-blende. To this reserve can be added the estimated quantity of concentrating ore found in other parts of mine amounting to about 20,000 tons, which on account of being of a higher grade than the fillings will require about six months to concentrate.

From the above it will be seen that a total reserve of 87,000 tons of concentrating material is available, also that under favorable conditions this can be concentrated during eighteen months of continuous operation. It is, however, more likely to cover a period of two years, especially if there should be more material on hand in old stopes and dumps than estimated.

RECAPITULATION OF ORE RESERVES.

During the past two months the London lead market has advanced approximately 25% over quotations over the balance of the year, and you are now getting \$60.00 per ton, net smelter returns, for silver lead concentrates, with present prices of silver 49 cts. per oz., and lead \$2.00 per cwt. (smelter settlement.) This valuation is, therefore, figured in the following estimate of total ore reserves. Improvements in the concentrator and the benefits that will be derived from the new Magnetic Zinc Separating Plant has also been considered in the same estimate. Furthermore it would seem that the Dominion Government necessarily will have to decide on placing an adequate import duty on lead for the protection of the Canadian lead industry. The Government can hardly disregard the united petitions from a section of the Dominion that under favorable conditions is able to add more than any other part of Canada, to its general wealth.

In the United States the lead producer is now receiving \$3.90 per cwt. against \$2.00 (or less) in Canada. With your 60% lead ore, equal to 1,200 lbs. of lead, this price brings \$24.00 per ton, less 10% loss in smelting or a total of \$21.60. From this amount a \$15.00 freight and smelting charge, besides all cost of mining and general expenses, has to be deducted. It will therefore readily be seen that there would be little or no profits in lead mining, were it not for the high values of silver in the ores.

CONCENTRATOR REPORT.

It is with considerable gratification that I am able to state to you that the concentrating plant completed on the 1st of May, 1902, has been an unqualified success from the start, even with the extremely low prices that have governed the metal markets during the entire year.

Referring to my special report and estimate on concentrator plant, of November 3rd, 1901, submitted for your approval prior to erection, you will find by comparison with the actual work performed:—

1st. That the ratio of concentrating fillings has been 32 tons into 1, which is better than estimated, and that the tonnage of concentrates produced has consequently been increased in the same proportion.

2nd. The estimated mill capacity of 125 tons per twenty-four hours, has been exceeded by 35 tons.

3rd. In regard to the value of concentrates. These were based on silver at 57½ cents per ounce, but during the year this price depreciated to 49 cents, nevertheless the smelter returns show the average price received from smelter returns to be \$49.11 or equal to the estimated price, which is due to the higher grade of concentrates produced in the mill. In place of averaging 94.8-10 ozs. of silver and 54% lead to the ton, the average has been 103.8 ozs. of silver, and 60% in lead, thus making up for the lower metal quotations. The net earnings of concentrator were \$35,706.06, plus \$3,000.00 for value of zinc on hand, equal to \$38,706.06. If prices had remained staple in place of going down, \$58.21 or \$9.10 more would have been received per ton of concentrates, and the net profits increased by \$11,365.00 equal to a net total earning of \$50,000.00.

4th. In regard to the zinc-blende by product, it will be observed that 1,391 tons have been produced in the mill during the year, representing \$11,329.87. This amount compensates in a measure for the lower prices of metals.

5th. Regarding the tonnage and class of material put through the concentrator, approximately one-third was taken from the dumps, and two-thirds from old and new stopes. The net tonnage of silver-lead concentrates produced was 1,247. The gross tonnage put through the mill was 40,028 tons.

The estimated tonnage in reserve is approximately 87,000 tons, thus the concentrator will have a supply on hand for not less than 18 months and more probably two years.

One difficulty experienced in operating was a shortage of water during two months of the dry season, which held the capacity and efficiency of the mill back to some extent, and for a short time the mill could only be run on one shift. This feature will be overcome before the dry season sets in this year. Fifty miners inches water have recently been granted us, made up partly from an adjacent stream, and partly from mine water running out of tunnel No. 8. The intention is, at an expense of about \$2,000.00 to flume the water from the north side of the mountain to south side, thereby making it available for power and wash water purposes. With this increase of water I do not anticipate any difficulties in keeping the mill up to its full capacity all year round, especially as the past year proved one of the driest on record in the Slocan.

The plant was put in during the "hard times" when the prices of metals went lower than ever, and if it could prove a success under such adverse conditions there seems hardly any doubt that previous records can be surpassed, providing prices come up again, as the tendency appears now.

MAGNETIC ZINC SEPARATING PLANT—(NOW UNDER CONSTRUCTION).

Until recently all zinc ores in the Slocan, whether associated with galena or found otherwise, had been entirely disregarded and neglected as a mineral of any value.

In the upper ore-zones only a small quantity of zinc-blende is generally associated with the Galena, on which the smelters in the earlier days, placed no penalties. Different conditions existed in a number of the mines located at lower altitudes, where the Galena was highly disseminated with a zinc-blende that carried good silver values, but nevertheless could not be sold to advantage and was therefore avoided.

An attempt was made a few years ago to ship 1,500 tons of zinc to Swansea, England, but stranded on account of the sudden death of the promotor. After this unsuccessful effort the zinc ores were left on the dumps, or went through the tailraces as so much waste.

In the meantime the percentage of zinc kept increasing in the Galena in nearly all the mines, and necessitated the smelters placing a 10% limit on zinc, with a penalty of 50 cts. per unit above same. In a number of instances the penalty was severely felt, as only a few mines were in a position to keep within the limit, and a number of properties with 25 and 30% zinc in the Galena could not, for this reason, be operated to advantage.

During 1902 the zinc limit was changed from 10% to 8% and it became evident, more so than ever, that something had to be done to overcome the continually increasing penalties. Encouragement was therefore offered by myself and some of my confreres, which soon resulted in making satisfactory progress towards solving the zinc question, at least as far as your properties are concerned.

While constructing your concentrator in the fall of 1901, provisions were made to save zinc values, and an accumulation of several hundred tons of 43 to 45% zinc concentrates were made between June, 1902 and January, 1903, with the hopes of securing a market. This lot has now been disposed of in Kansas, and netted over \$3300.00. You will readily appreciate that this first attempt in the zinc business was fairly good for a starter, when remembered that the zinc was produced as a mere by-product.

In the meantime I found by careful experiments and tests that a far higher grade of zinc-blende can be made by giving the ores a slight roast, whereby the (Spathic) iron is partly converted into an oxide of iron, in which form it becomes an artificial magnetite, and can be eliminated from the blende in magnetic separating machines with fields of intensified magnetic force.

As soon as this important feature has been fully demonstrated, my proposition to erect a plant for treating 40 tons of zinc ores per 24 hours in this manner was presented to you, and upon receipt of your prompt decision ground was broken on the 1st of February, and the necessary machinery ordered at once.

The above plant is expected to be completed in June, providing all the machinery can be obtained within the stipulated time. The machinery

comprising roasting furnace, magnetic separators, screens, elevators, fine rolls, etc., will be placed in a building 40 feet wide by 60 feet long. This building is a west end extension of the present concentrator.

The finished product which will run approximately 60% in zinc, and 16 to 20 ozs. in silver, will contain only a small percentage of iron, and less than 2% in lead.

With the prospects of being able to produce 6,000 tons or more of zinc from present ore reserves in the mine, during the next eighteen or twenty-four months, I am able to predict a bright future for zinc, and it will be readily seen that the revenues from this by-product from now on will be an important factor to contend with.

REVIEW OF PAST YEAR.

In regard to the future of the Payne Mine I shall forbear from making promises that necessarily will have to depend on future developments, as well as fair prices for silver, lead and spelter. At the same time I beg to call your attention to certain features that compare favorably with conditions three years ago. At that time tunnel No. 5 had little or no ore exposed in the floor, while to-day the main vein with pay-ore has been proved to a depth of 360 feet below No. 5, and 900 feet below the apex.

I have stated in my last year's report, and I desire to repeat that the true fissure nature of the Payne vein with its banded arrangement of minerals, is both characteristic and favorable for deeper prospecting. Lean strata such as found in all mines, and of which No. 5 tunnel is an example, must be expected, also a hard formation, which will have to be counteracted by the exclusive use of power drills. Subterranean water, will, no doubt, make its appearance further down, but can be overcome.

Zinc-blende is now disseminated with the galena to a far greater extent than heretofore, and one of the most important features of the past year has, therefore, been the happy solution of concentration and separation of zinc-blende from the galena, whereby a valuable by-product is added. I have mentioned elsewhere that the constantly increasing percentage of zinc seriously threatened to increase penalties imposed by the smelters, but with the present system of milling it will readily be seen that this feature has been entirely overcome. All ores of a complex nature can now be concentrated into a silver-lead product of an even higher grade than the former clean shipping ore, while the zinc-blende is yielding a by-product of high commercial value. By having the present complete and successful concentrating plant installed and paid for, together with the Magnetic Zinc Separating Plant, now under construction, you will be in an excellent position to handle all concentrating ore bodies that in depth may possibly replace the former lenses of clean galena, and inasmuch as the zinc-blende must necessarily be separated from the galena when the 10% zinc limit is reached, the feature of concentration, not alone overcome smelter penalties, but improves the silver-lead product, and adds the zinc-blende as a valuable by-product.

I can furthermore assure you that the extra cost of concentration—including a legitimate loss of values in milling—is readily offset by the lesser cost of mining, and expensive hand-sorting in the stopes.

All concentrating ore will hereafter be extracted from wall to wall, regardless of high or low values, and no material that pays to concentrate will be permitted to remain in the mine or go to the dumps. Hand-sorting of clean ore will not be done in the mine as heretofore, but in broad day light at the concentrator, before entering the mill. This constitutes a part of the crusherman's duties. Prior to sorting, all fine material is screened out through a special trommel while large pieces of ore and waste are sorted out by the crusher-tender, thereby accomplishing a material saving. I am quite convinced that the ensuing year, by the above method of mining and concentrating, together with the introduction of additional machine drills will show a material reduction of all operating expenses.

CROW'S NEST PASS COAL.

The following is excerpted from the proceedings of the recent annual meeting of shareholders:—

"The coal produced during the year 1902 amounted to 442,049 tons, as compared with 425,457 tons in 1901. Of this tonnage 191,605 tons were sent to the Company's ovens, and produced 121,000 tons of coke, as against 125,085 tons made in 1901, while the balance, 250,444 tons were disposed of as merchantable coal.

During the year the Company's pay rolls amounted to \$1,111,068.18, as against \$911,407.15 in 1901, while the additions to plant and the development work at Coal Creek, Fernie, Michel and Morrissey amounted to the

large sum of \$1,030,180.58, of which machinery and supplies came to \$729,617 76.

The Company's four mines at Morrissey yielding 700 tons a day were all opened up during 1902. To make it possible to take from these entries large quantities of coal involves the installation of much machinery, and the doing of large permanent development work which cannot be accomplished quickly. There is necessarily a large expenditure of time as well as money. The same remarks apply to the new mines at Michel and Coal Creek, now in good coal, and besides these there has been a good deal of re-arrangement necessary to the workings of some of the older mines.

But this great amount of permanent development work done during the year, and the increased facilities provided by the new plant installed, entitle the directors to rely on a material increase in the output, which is now steadily increasing, and a larger output means a wider margin of profit.

The number of men actively employed in the Company's works at the end of the year was 2,039, as against 1,312 on the same date 1901.

The amount paid in royalty and tax on coal to the British Columbia Government for the year is \$22,350.10, and tax on coke \$9,719.37, or together \$32,069.47.

The demand for coke has increased during the year to the full capacity of the existing ovens, but it is expected the additional ovens being built will quite meet the requirements, not only of the Canadian but American smelters. To meet the expected demand for coke, five hundred new ovens are in course of construction, the larger number being built at Morrissey, at which place up to the present time there have been none.

During the year the Crow's Nest Southern Railway Company has constructed a line from Midway on the International boundary line, where it connects with a line of railway from Jennings, Montana, on the main line of the Great Northern Railway to Morrissey Junction, and a branch has been built up to the Company's mines at Morrissey. This gives to the Company direct communication with U.S. points, at which it is expected to market in the future a considerable proportion of the increased output.

By reference to the Profit and Loss Account, it will be observed that the sum of \$517,017.41 was brought forward from the year 1901. This amount was made up from two sources: (1st) A premium of 60 per cent., or \$300,000 paid in during the year 1901 as premium on \$500,000 new stock, issued and taken up by the shareholders, and (2nd) from surplus earnings of the Company not disbursed to the shareholders, \$217,017.41.

The net profits as a result of the year's operations amount to \$171,285.80, and as the disbursements during the year for dividends amounted to \$250,000.00, it was necessary to draw upon the previous surplus earnings of the Company above mentioned to the extent of \$78,714.20.

The directors feel that this result is really a most satisfactory one, having regard to the fact that the Company's chief producing mines were closed down from the 22nd of May to the end of the year, involving a net loss of 1,000 tons of coal a day, and to the protracted strikes which stopped all production for considerable periods of time.

On the 22nd of May during the second working shift a serious explosion occurred, involving the greater portion of Nos. 2 and 3 mines at Coal Creek, killing instantly 130 of the Company's employees. An inquest was held, but after fourteen days of patient attention to the evidence adduced, the jury were not able to fix the initial point of the explosion. The Government of British Columbia appointed the Provincial Mineralogist and two mine managers from Vancouver Island to examine into and report upon the explosion. These gentlemen made a thorough investigation of the mines, and agree that the catastrophe was brought about by an initial explosion of gas at the working face of McDonald's level in the extreme deeps of No. 2 mine, the gas coming from a "blower" or "feeder" which had been uncovered shortly before the explosion, and from which gas was oozing in considerable quantities more than a week after. How impossible it is to tell what lighted up the explosive mixture of gas and air can be gathered from the official report of Provincial Mineralogist Robertson, of B.C., who says: 'The initial cause will probably always remain a mystery, and is at best only a matter for speculation, although it is almost certain to have been a naked light of some sort which set fire to the gas.'

Your Board paid all funeral expenses and relieved against immediate suffering, and felt disposed to deal generously with the bereaved families, but immediately after the inquest, 120 notices of action were served on the Company by the relatives of deceased miners, and 32 writs issued, so that the Company has found it impossible to carry out its intentions as above expressed. None of the actions have as yet been brought to trial. An order

has been made by the Court for the trial of a test case, which is to govern in the 32 actions already commenced.

In this connection I would call your attention to the fact that on the 19th and 20th of May, Archibald Dick, Government inspector of Mines, examined the mines in question and reported "everything in good order."

Under the Coal Mines Regulation Act of B.C., a committee of miners have the right to inspect the mines in the interest of the employees, and report in writing over their own signatures. On the 8th of May a committee of the Miners' Union appointed to inspect No. 2 and No. 3 mines, after going over the whole of the area involved in the explosion, gave the following certificate. "We, the undersigned, appointed by the Gladstone Miners' Union No. 76, of Fernie, B.C., visited No. 2 and No. 3 mines, as set apart by the Act, and found them all clear of gases and in good condition, with the exception of want of timber in section No. 2 mine. Signed, Thos. Addison, Thos. Stevens."

Between the 25th of June and the 4th of August the miners at Coal Creek were on strike, and later on the miners at Michel, and still later the miners at Morrissey went on strike; but in all cases the matters in dispute were adjusted satisfactorily to all parties, and the men resumed their occupation.

On the 11th day of February, 1903, all the men inside and outside at all the Company's mines, having formed a new union, ceased to work, but have never notified the Company they have struck, or waited upon the Company with any demands, or given any reasons for their actions. The Minister of Labor sent his Deputy to Fernie to try and arrange matters, but he was unsuccessful. The Provincial Mining Association of British Columbia have appointed a committee of six to endeavor to adjust matters, which committee is expected to reach Fernie to-day. In this connection it is well to point out that the miners in the Company's employ are the best paid miners in the world, their average earnings for the last five months amounting to \$4.71 per day of eight hours, divided as follows:—

At Morrissey, all mines.....	\$4.64 per day
At Michel ".....	4.87 "
At Coal Creek ".....	4.63 "

The 50,000 acres of coal lands to be conveyed under the Statute of 1897 to the Dominion Government were selected by the Government in May last, and the conveyance provided for.

The Directors have thought it wise to open a town site in the neighborhood of the Company's mines at Morrissey, and a plan having been prepared for this purpose, offerings will be made to the public as soon as spring arrives.

The differences between the Company and the Government of British Columbia with regard to the Company's town site at Fernie were amicably adjusted by the means of legislation obtained at the last session of the Legislature of British Columbia.

It has been thought advisable to dispose of the Company's stores, the possession of which by the Company has been made a matter of continuous unfavorable comment, although quite unfairly. The stores do come into competition with the trading public, and this source of irritation will, by the sale, be removed.

DOMINION STEEL.

The following report was submitted to the shareholders at the annual meeting held at Montreal on the 14th instant:—

By the terms of the lease entered into between this Company and the Dominion Coal Company, Limited, which was duly ratified and approved by the shareholders of the two Companies, the Dominion Iron and Steel Company, Limited, has leased the entire property of the Dominion Coal Company, having entered into possession thereof as at 1st March, 1902.

The fiscal year of the Dominion Coal Company formerly closed on 28th February, and that of the Dominion Iron and Steel Company on the 30th April in each year, but it was considered advisable by the Directors of the two Companies in order to simplify the keeping of accounts that the fiscal year of both Companies should be concurrent, and the by-laws of the Companies were accordingly amended to the effect that the fiscal year of both Companies should terminate on the 31st December in each year.

The report which your Directors have therefore to present embraces only eight months' operations of the Steel Department and ten months' operations of the Coal Department (the leased property).

The Directors would point out that while there is a surplus on the Company's operations for these periods, after paying dividend on preferred stock of \$309,612.88, there have been expenditures on capital account amounting to \$1,730,887.43, which expenditures in the case of the Steel Department were following out the general plan for the completion of the plant, and in the case of the Coal Department were chiefly for development work at the mines and for shipping facilities all of which have greatly enhanced the earning capacity of the Company's properties.

STEEL DEPARTMENT.

The output of pig iron for the eight months was \$148,399 tons or an average of 18,550 tons per month. The output of steel billets was 81,513 tons, or an average of 10,189 tons per month. The result of the operation of the Company so far is to prove that its plant is able to produce pig iron and steel, which meets the most exacting requirements of its customers. These include nearly all the important manufacturing plants in Canada and some of the largest locomotive works and plate mills in the United States.

COAL DEPARTMENT.

The sales for the ten months amounted to 2,836,321 tons, an average of 283,632 tons per month as compared with 2,276,270 tons for the corresponding ten months of the previous year, an average of 227,627 tons. Development work has been fully carried out and the prospects for the present year are excellent.

Notwithstanding the unfortunate fire at Dominion No. 1 Colliery in March last, now it is believed extinct, the output from January 1st to May 1st in the current year is 966,097 tons as compared with 881,714 tons in the same months of 1902.

Financial Statement ending December 31st, 1902.

Earnings Coal Department 10 months	\$1,977,328 10
Less 10 months rent	1,333,333 33
Net	\$643,994 77
Earnings Steel Department 8 months'	309,886 90
Total	\$953,881 67
Less—	
Bond Interest 8 months'	\$265,376 94
General Interest 8 months'	112,225 17
Sinking Fund 8 months'	33,333 34
	410,935 45
Net Operating Earnings	\$542,946 22
Less—	
Preferred Stock Dividend, 8 months'	233,333 34
Surplus	\$309,612 88

ASSETS.

Property	\$33,465,257 17
Cash and Accounts receivable	2,491,675 23
Raw and Manufactured Material on hand	2,229,072 82
Insurance Taxes, S. S. Hire, &c., paid in advance	52,896 01
Coal Rental, 2 mo. paid in advance	266,666 67
	\$38,505,567 90

LIABILITIES.

Bonds	\$ 7,946,000 00
Common Shares	20,000,000 00
Preferred Shares	5,000,000 00
Cape Breton Real Estate Debentures	360,880 00
Dominion Rolling Stock Debentures	270,879 96
Mortgages	72,000 00
Notes and Accounts Payable	4,274,733 26
Interest, Dividends &c., accrued and not due	204,469 85
Contingent Fund	66,991 95
Profit and Loss	309,612 88
	\$38,505,567 90

CAPITAL EXPENDITURE.

Expended for new construction Steel Department, for 8 months from May 1st, 1902 to January 1st, 1903	\$864,626 46
Expended for new construction Coal Department for 10 months from March 1st, 1902, to January 1st, 1903, as follows:	
At Collieries	\$631,714 74
At Montreal	9,044 02
At Quebec	502 21
	641,260 97
Other Capital Expenditures as follows:	\$1,505,887 43
St. John Wharf Property	100,000 00
Sydney and Glace Bay Railway Capital Stock	125,000 00
	225,000 00
	\$1,730,887 43

DOMINION COAL.

The following report was submitted to the shareholders at the annual meeting held at Montreal on the 14th instant.

"By the terms of the lease entered into between this Company and the Dominion Iron and Steel Company, Limited, which was duly ratified and approved by the shareholders of both companies, the latter Company has leased the entire property of this Company for a rental of \$1,600,000, payable quarterly, having entered into possession thereof as at 1st March, 1902.

In order that the fiscal years of both companies should coincide, it has been deemed expedient to alter the date of the close of the fiscal year of this Company from 28th February to 31st December in each year; and accordingly the present report embraces a period of only ten months.

Dividends at the rate of eight per cent. per annum have been paid on the Common Stock of the Company commencing 1st April; dividends on the Preferred Stock and interest on the bonds of the Company and general expenses have also been paid, leaving a balance of \$64,859.88 to be carried forward.

Annual Statement for Ten Months ending December 31st, 1902.

ASSETS

Property Account	\$20,446,256 02
Sinking Fund Investment (\$111,800 U.S. 4s. costing)	124,317 62
Sinking Fund Cash (deposited with New England Trust Co.)	8,298 89
Cash under Art. IV. (deposited with New England Trust Co.)	6,792 95
Notes receivable (Dominion Iron and Steel Company, Limited)	385 000 00
Cash	6,141 07
	\$20,977,306 55

LIABILITIES.

Common Shares	\$15,000,000 00
Preferred Shares	3,000,000 00
First Mortgage Bonds (\$4,500 drawn, not yet presented for payment)	2,594,000 00
Rent (January and February paid in advance)	266,666 67
Bond Interest (accrued September 1st to January 1st)	51,780 00
Profit and Loss	64,859 88
	\$20,977,306 55

PROFIT AND LOSS.

Ten Months' Rental	\$1,333,333 33
Interest	28,007 78
	\$1,361,341 11
Less—	
Preferred Stock Dividend 10 months'	\$ 200,000 00
Common Stock Dividend 9 months'	900,000 00
Bond Interest 10 months' and Premium on bonds redeemed	143,996 55
General Expense 10 months'	52,484 68
	\$1,296,481 23
Balance	64,859 88
Sinking Fund for 10 months'	130,824 50

The Frank Disaster.

(By W. BLAKEMORE, Fernie, B.C.)

One of the most terrible and unique disasters which has ever overtaken a little town occurred at Frank on the 30th ult., furnishing a result which cannot be adequately described in words and must be seen to be believed. With the picturesque and sensational aspects I have nothing to do. There is however a side of the case which is of great public interest and especial interest to your readers and with that I purpose to deal.

A word may be said as to the area affected and the terrific force generated by the mountain slide. The dislodged rock spread itself out fan shaped across an area of 1,000 feet and extended for a mile and a half to the north of the mountain. From east to west across the broadest part of the slide measures two miles, and I estimate that the average depth of rock spread over this whole district is 30 feet. Taking this calculation by the size of the cavity left on the mountain side, which is approximately 25,000 feet long, 2,000 feet high, 200 feet thick, it will be seen that upwards of 100,000,000 tons of rock have been dislodged. Estimating certain natural conditions, and taking a meanheight of the fall at 3,000 feet a careful mathematical calculation will show that the fall generated a force equal to one thousand and million horse power generated continually for two months. I make this calculation simply to show that the force is one which the imagination

fails to grasp and which sufficiently explains how it was possible for the whole mass of rock to be transferred nearly two miles on an elevation 500 feet higher than the base of the mountain. It also explains why the packing of the rock was so solid, this being due not only to the tremendous force generated, but to the resistance offered by the rapidly rising ground.

The special aspect to be solved, which is of importance to the mining world, is the consideration of the evidence afforded as to the cause of this truly terrific disaster. In order to arrive at this I made a careful examination of the scene after the disaster, and also had the advantage of a personal interview with some of the imprisoned miners with experts who have been upon the ground since the occurrence, and with residents of the town, and I am able to form a fair statement of the cause. The first impression, as telegraphed on the morning of May 1st, attributed the calamity to a volcanic explosion or possibly to an earthquake. Probably from the inherent possibility of either theory the facts of evidence veto both suggestions. The former theory was abandoned within a few hours, there being not the slightest shred of evidence to support it, and it being absolutely an invention of the fertile brain of a penny-a-liner. The earthquake theory is attributed to the fact that the slide in its rush produced a concussion in the air and a loud report but this is sufficiently accounted for when the mountain is viewed in broad day light, and the fact that there were no rumblings or tremors and that not a pane of glass was broken in the town is sufficient evidence that this theory must be abandoned. When such a gigantic land slide occurs it demands absolute evidence, and if we find all the conditions necessary to account for the result produced, then to seek for any fantastic theory is to ignore the obvious for the obscure. I find an unanimity of opinion that the slide was induced, if not produced, by the mining operations of The Canadian American Coal Company, and for reasons, which to my mind appear quite clear, I have to endorse this opinion. We will first take evidences of the surface, which would seem to account for this cause, with its effects. The slide is adjacent to the workings of the mine. These workings were carried on in a seam of coal fourteen feet wide and practically vertical. The seam ran parallel with the mountain, N.W.S.E., and had crept along the lower half of the mountain at an elevation ranging from zero to 1,000 feet. The lower half of the mountain was covered to a depth varying from 20 to 50 feet, with debris. Behind and above this the mountain tower looms perpendicular. It will thus be seen that the coal seam formed a natural support or toe for the foot of the mountain and that the removing of it would have a similar effect to the cutting away of the lower edge of the mud slide or the partial under cutting of the face of coal. This process had been continued for a longitudinal distance of about three quarters of a mile and to a vertical height, above the main entrance, to approximately 500 feet. When the slide came away the upper part of the workings were carried with it and the imprisoned miners dug their way, through the fallen rock, at a point 150 feet from the entrance of the mine. Where originally the cover was more than 100 feet the length of the slide across measures exactly with the length of the workings from which the gravel has been extensively removed. Assuming that the removing of the natural barrier was the cause of the mountain giving way established the connection between the workings and the slide.

The next important evidence is that a series of crevices were discovered by the experts who ascended the mountain shortly after the slide. One

of these crevices is described as being more than one thousand feet long and fifteen feet wide at the top, and the depth so great as to be unmeasurable. A miner, none other in fact than a well known Nova Scotian, informed me that when hunting on the top of Turtle mountain last fall he found several crevices running length wise behind the present slide and that they were then wide enough to necessitate his jumping in order to cross them. Some of the imprisoned miners told me that for many months past they had heard rumblings in the mine and that these rumblings were not produced in the seam, but evidently farther back. They state further two very important facts, namely: that there was a "squeeze" throughout the mine which frequently buckled and burst the timber set in one night. The sets were from 20 inches to two feet square. The other most significant fact which they relate is that numerous flakes of rock had been forced from the wall next the mountain into the road. One piece which they measured several months ago was 80 feet by 15 feet wide and five feet thick. It is certain that such a rock burst as this could only have resulted from an incipient slide. If to these circumstances be added the statement of the same men that know the system of working adopted that there was a vertical man way from 300 to 400 feet, the pillar of either side of it 20 feet wide, and that between these points the whole of the coal was breasted out, it is easy to understand from these assumptions how conclusive the other evidences are as to what actually occurred. The whole thing may be summed up as follows: The removal of the natural support by the system of working which left a very small percentage of solid coal to protect the walls. The slight but gradual crumbling of the strata on the hanging wall of the mountain side evidenced by rumbling and the numerous breaking away of flakes of rock. Finally the production of numerous crevices at the back, with the continual diminishing of the support until either by a natural process of disintegration or as a result of some sudden shock in the mine, such as a blast, it moved away in a moment carrying death and destruction in its wake. As far as I am able to judge, any other explanation enforces improbabilities if not impossibilities.

Taking all the conditions into account I do not think it possible to work this coal safely by any system as the texture of the limestone in the mountain is such that the slightest interference with it would surely bring it down. The slide has left a very singular looking peak immediately behind the town, and at the back of this peak is a deep crevice. I assume the common opinion that this peak will fall. It will probably do so within a year or two in consequence of the rain and snow filling the crevices and after loosening the rock it will certainly do so if assisted by any artificial movements of the strata.

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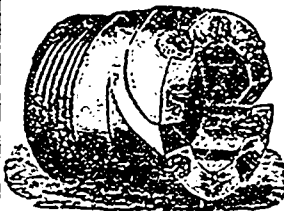
COMPANY NOTES.

Nova Scotia Collieries, Limited.—The promoters are offering for subscription in London 100,000 6 per cent. debentures, and 100,000 ordinary shares. The preference shares will receive an additional dividend, after 10 per cent. has been paid on the ordinary, should the profits suffice. The area acquired by the company consists of 16,640 acres in the county of Inverness, Cape Breton, Nova Scotia, and it is estimated by the Government Inspector of Mines for that province to contain many million tons of coal. The company has already been offered a contract to supply 200,000 tons of coal per annum for a period of 10 years, on which an estimated surplus of £9,000 per annum is shown, after paying the interest on the preference shares and 10 per cent. on the ordinary. Of this issue, 50,000 preference shares have been underwritten for a commission of 5 per cent. cash and 15 per cent. in ordinary shares. The owner of the property receives £90,000 in shares or cash from the promoting syndicate, who receive £142,500, which they agree to take entirely in shares if required.

London and British Columbia Gold Fields.—The report of the London and British Columbia Goldfields, Ltd., to 31st December last, states that the very serious fall in the price of lead and silver during the period under review has had a disastrous effect on the company's large share holding in the Whitewater, Ruth, and Enterprise Companies, and the assessment on the shares of the Ymir Company through its reconstruction involved a heavy liability to preserve this interest. The effect of this, and the delay in completing the Kettle River Power Company's works makes it now necessary to provide additional capital to satisfy immediate liabilities and to enable the directors to preserve the company's valuable assets. The Ymir shares and Kettle River debenture stock and shares have great prospective value, and the preservation of these assets alone would make it particularly desirable that some financial arrangement for this purpose should immediately be carried out. In addition to these assets, however the company's interests in the silver-lead properties belonging to the Whitewater, Ruth, and Enterprise Companies should be favourably affected by the recent and rapid appreciation in the price of silver, and also by the new legislation which, it

is hoped, will be enacted by the British Columbia Government for an improvement in the conditions affecting the markets for the sale of lead. In order to facilitate the dealing with the company's liabilities, the chairman who was in New York at the latter end of last year on personal business, visited Montreal and spent several days in conference with Mr. Fowler, with a view, amongst other things, of disposing of some of the Kettle River debentures, but, owing to the condition of markets in Canada and to the Crow's Nest coal strike and other causes there has been no opportunity up to the present of doing this without undue sacrifice, but now that the Kettle River Company is actually supplying power to the towns' mines, and smelters in the district, and is earning a revenue, the value of its debentures and shares is being rapidly enhanced. It is necessary, however, to provide funds for satisfying the company's immediate liabilities, to enable the directors to preserve the large number of shares which represent its principal assets, and after most careful consideration it has been decided to recommend that the company be reconstructed with a liability of 4s. per share, the payment of which will be spread over as long a period as possible. The directors, having subscribed largely to the last issue of shares, are themselves very large shareholders, and as such regret the necessity for the scheme now proposed, but they are prepared to provide their proportion of the assessment. Resolutions for giving effect to this proposal will be submitted at an extraordinary general meeting convened for the 15th inst.

Intercolonial Coal and Coke Company.—This company has been incorporated under Washington laws, with \$3,000,000 capital, par \$1, to acquire coal properties at Blairmore, district of Alberta, 45 miles east of Fernie, on the Crow's Nest Division of the Canadian Pacific Railway. The coal area is about seven miles in length, and there are nine veins on the property, four of which have been prospected. The aggregate width of these four seams is something over 60 ft. A. C. Flumerfelt is president, and H. N. Galer assistant general manager of the Granby Company, treasurer. The stock has all been subscribed for by Granby stockholders, so that while it is independent of the Granby Company, it will be closely allied with it. The construction of 100 coking ovens will be commenced at once and the output of the mines will be sold to independent smelters and railways, in addition to the Granby Company.



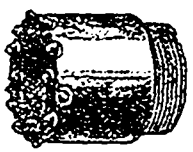
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BY

B. T. A. BELL

EDITOR CANADIAN MINING REVIEW
SECRETARY CANADIAN MINING INSTITUTE ASSN.

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(A) To promote the Arts and Sciences connected with the economical production of valuable minerals and metals, by means of meetings for the reading and discussion of technical papers, and the subsequent distribution of such information as may be gained through the medium of publications.

(B) The establishment of a central reference library and a headquarters for the purpose of this organization.

(C) To take concerted action upon such matters as effect the mining and metallurgical industries of the Dominion of Canada.

(D) To encourage and promote these industries by all lawful and honourable means.

MEMBERSHIP.

MEMBERS shall be persons engaged in the direction and operation of mines and metallurgical works, mining engineers, geologists, metallurgists, or chemists, and such other persons as the Council may see fit to elect.

STUDENT MEMBERS shall include persons who are qualifying themselves for the profession of mining or metallurgical engineering, students in pure and applied science in any technical school in the Dominion, and such other persons, up to the age of 25 years, who shall be engaged as apprentices or assistants in mining, metallurgical or geological work, or who may desire to participate in the benefits of the meetings, library and publications of the Institute. Student Members shall be eligible for election as Members after the age of 25 years.

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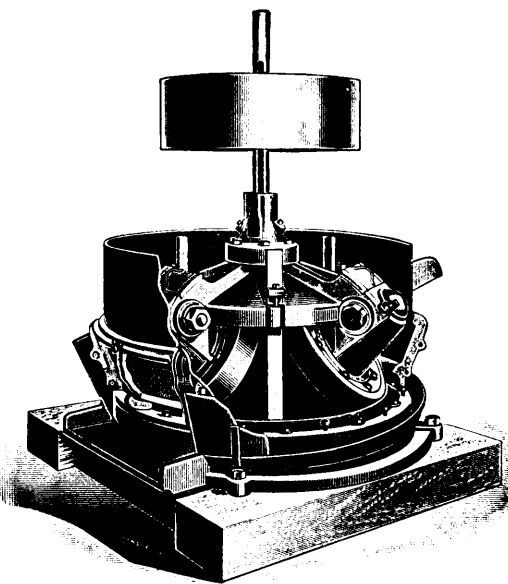
PUBLICATIONS.

Vol. I, 1898, 66 pp., out of print.
Vol. II, 1899, 285 pp., bound red cloth.
Vol. III, 1900, 270 pp., " "
Vol. IV, 1901, 333 pp., " "
Vol. V, 1902, 700 pp., " "
Vol. VI, 1903, 600 pp., now in press.

Membership in the Canadian Mining Institute is open to everyone interested in promoting the profession and industry of mining without qualification or restrictions.

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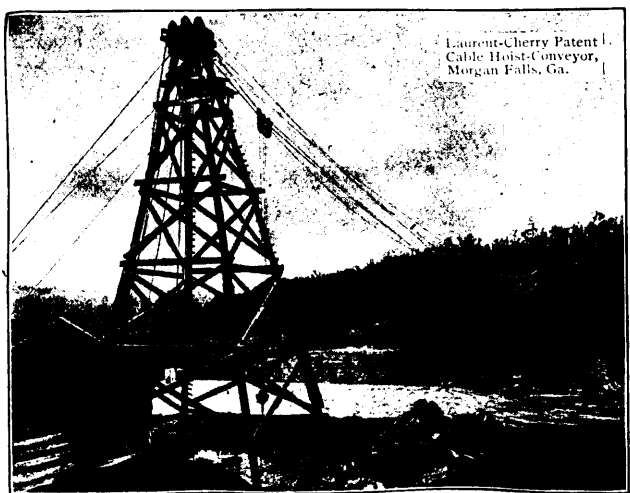
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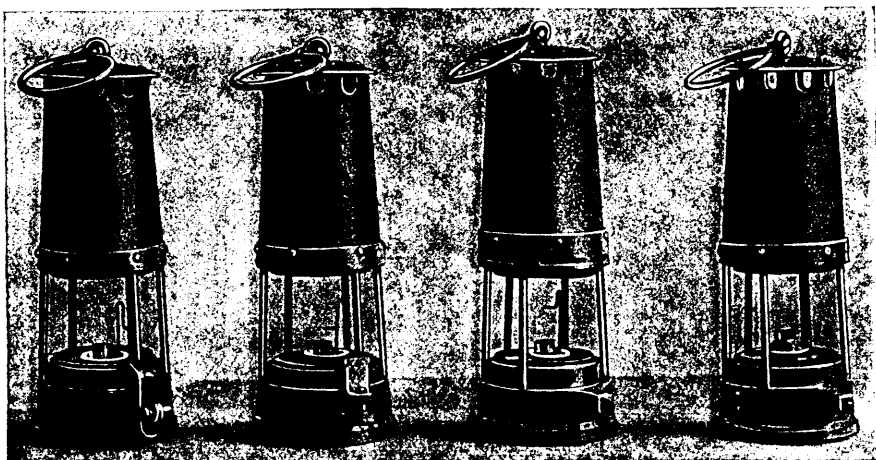
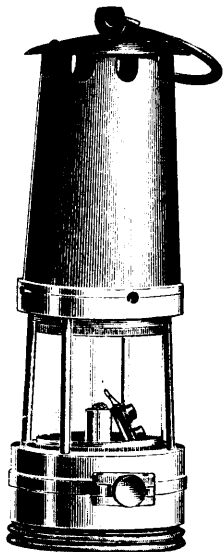
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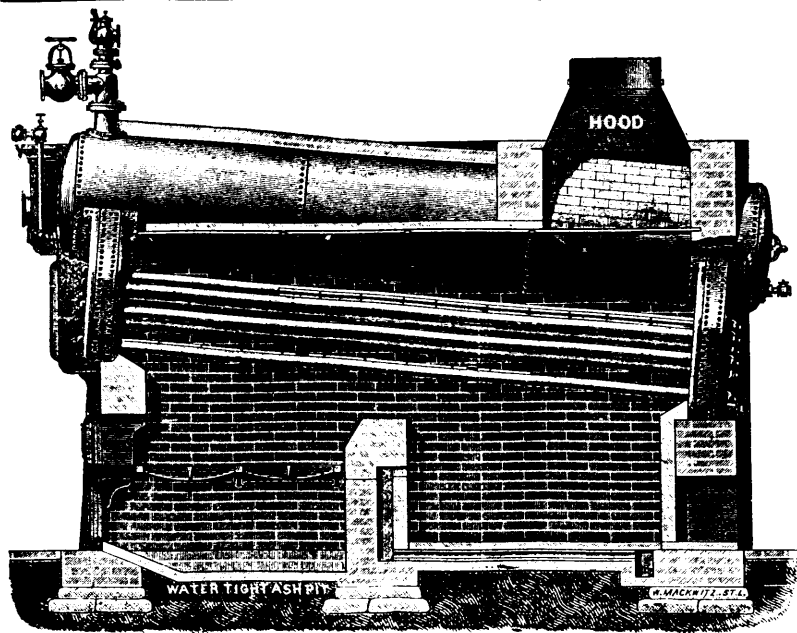
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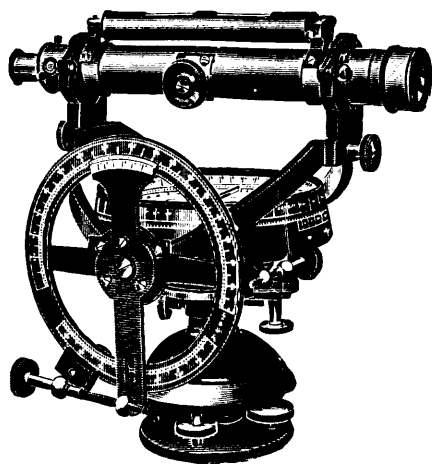


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The Mining Law gives absolute security to Title, and has been
specially framed for the encouragement of Mining.

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 and 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 mining 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 or 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 the mine of the mineral extracted after deducting the cost of mining it.

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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 annually 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 acquire 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. A. DRYSDALE,

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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.

Ontario's Mining Lands..

THE Crown domain of the Province of Ontario contains an area of over 100,000,000 acres, a large part of which is comprised in geological formations known to carry valuable minerals and extending northward from the great lakes and westward from the Ottawa river to the Manitoba boundary.

Iron in large bodies of magnetite and hematite ; copper in sulphide and native form ; gold, mostly in free milling quartz ; silver, native and sulphides ; zincblende, galena, pyrites, mica, graphite, talc, marl, brick clay, building stones of all kinds and other useful minerals have been found in many places, and are being worked at the present time.

In the famous Sudbury region Ontario possesses one of the two sources of the world's supply of nickel, and the known deposits of this metal are very large. Recent discoveries of corundum in Eastern Ontario are believed to be the most extensive in existence.

The output of iron, copper and nickel in 1900 was much beyond that of any previous year, and large developments in these industries are now going on.

In the older parts of the Province salt, petroleum and natural gas are important products.

The mining laws of Ontario are liberal, and the prices of mineral lands low. Title by freehold or lease, on working conditions for seven years. There are no royalties.

The climate is unsurpassed, wood and water are plentiful, and in the summer season the prospector can go almost anywhere in a canoe. The Canadian Pacific Railway runs through the entire mineral belt.

For reports of the Bureau of Mines, maps, mining laws, etc, apply to

HONORABLE E. J. DAVIS,

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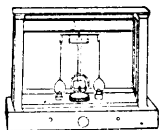
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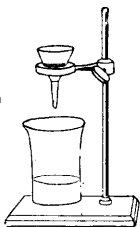
Director Bureau of Mines,

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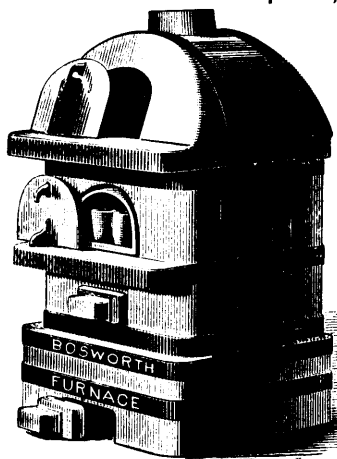
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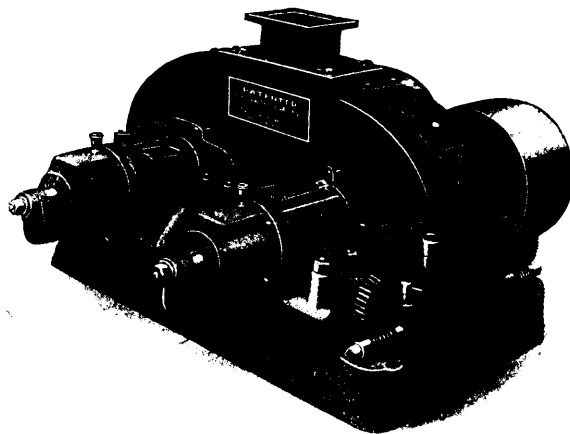
Munktell's Swedish Filters.

OUR 1897 CATALOGUE ON APPLICATION.

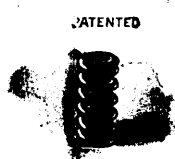
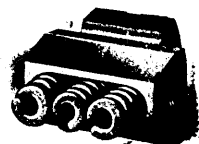
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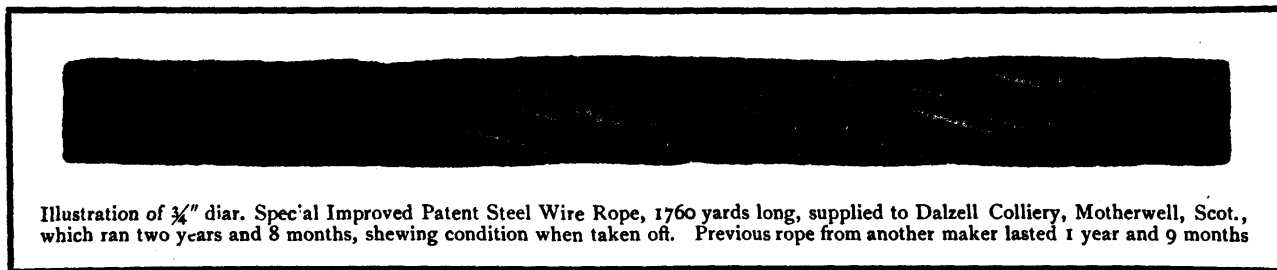
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