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16th YEAR OF PUBLICATION.

The Canadian Mining Review

Established 1882

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

EDITED AND PUBLISHED BY

B. T. A. BELL,

Secretary of The Canadian Mining Institute,
Secretary General Mining Association of the Province of Quebec,
Hon. Secretary Mining Society of Nova Scotia.

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24 Coleman Street, London, E.C., England.

INDEX TO VOLUME XVII.

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INDEX—Continued.

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Established 1882

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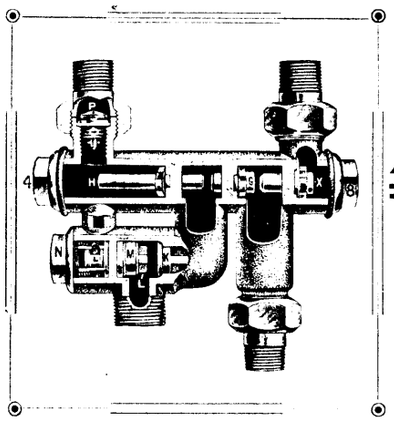

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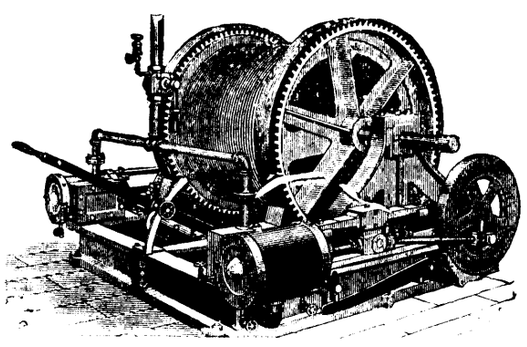

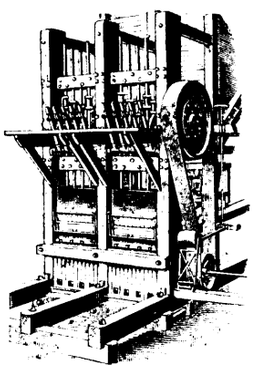

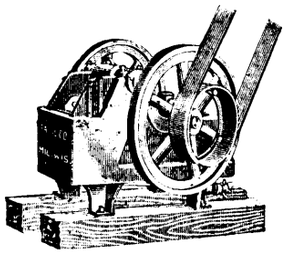

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PROVINCE OF BRITISH COLUMBIA.

Gold, Silver, Lead, Copper, Coal, Coke, Oil, Iron, Mercury, Platinum, Etc., Etc.

THE MINES OF BRITISH COLUMBIA HAVE PRODUCED OVER $100,000,000.

AMOUNT AND VALUE OF MATERIALS PRODUCED 1895 AND 1896.

	Customary Measures.	1895.		1896.	
		Quantity.	Value.	Quantity.	Value.
Gold, Placer	Oz.	24,084	$ 481,683	27,201	$ 544,026
" Quartz	Oz.	39,264	785,271	62,259	1,244,180
Silver	Oz.	1,496,522	977,229	3,135,343	2,100,689
Copper	Lbs.	952,840	47,642	3,818,556	190,926
Lead	Lbs.	16,475,464	532,255	24,199,977	721,384
Coal	Tons	939,654	2,818,962	846,235	2,327,145
Coke	Tons	452	2,260	615	3,075
Other materials			10,000		15,000
			$5,655,302		$7,146,425

Production for 1890, $2,608,608; for 1896, $7,146,425.

GOLD.

Gold-bearing lodes are now being prospected in many parts of the province, and at Rossland magnificent ore-chutes of very profitable gold-copper ore are being mined and smelted, the Le Roi having paid to date, $675,000 in dividends, with a large and increasing amount of ore in sight as the workings attain greater depth, while systematic development on other properties is meeting with excellent results, mining having just fairly begun in this camp. Little doubt can now be entertained that Rossland will become a heavy producer of gold, and that excellent properties now only await sufficient and abundant capital to become paying mines, to further aid in which the facilities for cheaper transportation and smelting are being now supplied. At NELSON and at FAIRVIEW, CAMP MCKINLEY, GREENWOOD, CENTRAL and other camps in the southern part of Yale, important work is being done on the quartz ledges there, several new mills being under erection.

Exploratory work is also in progress in EAST KOOTENAY and in LILLOOET, ALBERNI, and on the Gulf islands and along the coast line of the mainland, as well as in other parts of the province.

In CARIBOO, several large undertakings, involving a large amount of capital, are at work exploring both modern and ancient river channels, the Cariboo Hydraulic Mining Co., on the Quesnelle river, proving, on development, to have in a channel of the latter kind, a great gravel deposit of exceptional richness, while other parts of this district now offer every inducement to capital.

Into CASSIAR, OMENICA, and the great area to the north, as well as Cariboo, there now promises to be a great exodus of explorers, incited by rich diggings now being mined in the YUKON, as on the KLONDYKE, to the north, and river and creeks long reported to be gold-bearing will now be made accessible, and well tested.

SILVER-LEAD.

Despite the drop in the price of silver, the SLOCAN mines are being much more extensively worked, while the shipments of high grade ore are constantly increasing, the higher price of lead more than compensating for the lower silver values. The production for 1897 will much exceed that of 1896, as such mines as the "Slocan Star," "Payne," "Ruth," "Whitewater" and other mines increase their output.

At NELSON, the "Silver King" or Hall mines is shipping constantly a large amount of silver-copper ore, and the LARDEAU, TROUT TAKE, ILLECILLEWAET districts, on further exploration, promise to become rich districts. In EAST KOOTENAY large bodies of silver-lead ore will be mined on completion of the railroads now under construction.

COPPER.

Copper is being produced to a limited extent at ROSSLAND and NELSON, but the large deposits of at present low-grade ore in the BOUNDARY CREEK district will be fully tested when the railroad, now almost assured, is constructde. Prospecting is being done at KAMLOOPS, along the west coast of the mainland and of Vancouver island, as well as at many other points, and TEXADA is producing high grade bornite ore.

COAL AND COKE.

The large collieries on VANCOUVER ISLAND are producing about a million tons of coal annually, and at COMOX an excellent coke is now being produced, much of which is shipped to the inland smelters. The great deposits of coking coal in East Kootenay, at the CROW'S NEST PASS, are now being opened, as the C P.R. is now being built to the Columbia river to supply the great mining regions with cheap coal and coke.

SMELTERS AND RAILROADS.

The smelting industry is now beginning to assume large proportions, as preparations are being made to treat the ores of this province within her own borders, a most important factor in the increasing prosperity of this country, entailing as it does, and will, the employment of much capital and many men. The extension of the railroad systems to different parts is now in progress, and the next few years will see many parts in which the prospects for good mining are excellent, made easy of access, while ores can be shipped with facility to the smelting centres, where the assembling of the various interfluxing ores will make possible the treatment of all British Columbia ores at home.

CAPITAL.

Capital can now find here excellent and many opportunities for investment, if proper business care and the experience of qualified men are utilized, as the values placed on mines and undeveloped properties have reached a reasonable basis.

MINERAL LANDS.

Mineral lands are open to location to any person over eighteen years of age, who has obtained a free miner's certificate, and perfect titles to lode claims can be easily secured after $500 worth of work has been done per claim. A great extent of territory has yet to be prospected.

YUKON GOLD FIELDS.

As the KLONDYKE and other gold fields in the Yukon in British territory is reached mostly via British Columbia, all SUPPLIES and OUTFITS obtained at VICTORIA, VANCOUVER, ASHCROFT, KAMLOOPS, etc., can be taken in FREE OF DUTY, which otherwise WILL HAVE TO BE PAID if not purchased in CANADA.

For information, Reports, Bulletins, etc., address

W. A. CARLYLE, M.E.,
Provincial Bureau of Mines,
VICTORIA, B.C.

The HON. JAMES BAKER,
Minister of Mines,
VICTORIA, B.C.

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

—AND—

PRECIOUS STONES.

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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. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

16th YEAR OF PUBLICATION.

The Canadian Mining Review

Established 1882

Official Organ of the Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor and Proprietor. Published Monthly. OFFICES {Slater Building, Ottawa; Metropole Building, Halifax; Windsor Hotel, Montreal.

VOL. XVII., No. 1. JANUARY, 1898. VOL. XVII., No. 1.

A Hopeful Sign.

In the midst of the excitement and reckless misstatements concerning Canadian mines, which have obtained to such a large extent during the last twelve months, we have often been afraid that the press of our country was becoming blind to the best permanent interests of the Dominion by refraining from comment upon such of those ventures as were known to be bad, or at least uncertain and shady in their character; but we are very glad to note during the past few weeks a decided awakening in this respect, and must express our gratification at the decided stand which one or two British Columbia papers have made, looking to the future good fame and name of their province.

Particularly noticeable in this respect are recent articles in the British Columbia Mining *Critic* and in the Vancouver Weekly *News-Advertiser*. In a recent issue of the latter an editorial says: "It would almost seem as if the people of Canada are to be held up to ignominy and shame before their kinsmen in the old country. Scarcely before the ink is dry on articles in the London Press, denouncing the association of members of the British Columbia government with speculative mining schemes, that an incident occurs in London which shows how business men there regret the manner in which commerce and politics are mixed up together, even in connection with the Dominion government itself." After referring to the meeting of the Klondyke, Yukon & Stewart Pioneers, Ltd., of which Col. Domville, M.P., is the managing director, it goes on to quote from the speech of the chairman of the company, giving his reasons for delight and satisfaction with the prospects, showing that, because Col. Domville was "a prominent politician" and "a devoted supporter of the present cabinet, the company was more than favorably situated to avail itself of the influence his position commands." This chairman assured his hearers that this fact was of the greatest importance, "for politics in Canada and politics in this country are very different."

The *News-Advertiser's* remarks upon this speech and the inferences to be made from it are good, and show that there is a decided feeling among the best men in this country that both federal and provincial officers must be kept out of commercial ventures, for the preservation of official morality and the good repute of Canada abroad. Furthermore, this issue of the *Advertiser* contains a very trenchant and wholesome article upon that last huge financial elephant, The British America Corporation, Ltd., in which is shown very clearly that, despite the distinguished names on its board of directors, the prospectus has been issued in a great hurry, and contains decided misstatements of facts. It is well known *now* that this company has not purchased either the Alaska Commercial Company's business nor the Le Roi mine, and that their huge programme is one containing very few properties of merit, and certainly nothing to justify going to the public to ask for £1,000,000. Another very good point made is the huge commission (£500,000) of one-third of the capital stock of the company, which is given to the London & Globe Finance Corporation as its underwriting profit upon the flotation.

As early as the 2nd of December adverse comment upon this company's methods was made from London, especially regarding the extravagant assertions made by same of its brokers or promoters regarding the probable production of its properties in the Yukon district. The prospectus says that "claim No. 2 on Eldorado Creek, Klondyke, *is said* to yield £1,000 per running foot." How the investing public can be asked to subscribe to the shares of a corporation of which the directors have only *hearsay* information to offer, is beyond our ken, and to our mind savors more of the wild-catting which was a large factor in wrecking Western Australian schemes, than of a regulation British appeal to investors. This corporation, from what we can learn, really has acquired nothing but options. It is definitely announced that the two most important options mentioned in the prospectus, those regarding the Alaska Commercial Company and the Le Roi mine, have not been given. The other group of claims near Rossland comprise merely prospects, with the exception of the Nickel Plate and the Josie; the Christina Lake group has nothing proved upon it; the Nelson-Poorman group at Nelson was organized into a stock company, with a capital stock of $50,000, on the 25th of May last, but the efforts of its promoters to raise funds enough to provide working capital to continue the working of the mine were unsuccessful, and the group has been idle practically the whole of '97. The *News-Advertiser* very pertinently observes that the townsite lots at Dawson City and Fort Selkirk may be worth thousands of dollars to-day and not as many cents next year, and cannot therefore be regarded as valuable assets of any corporation. The bulk of the Yukon property mentioned in the prospectus remains to be located by an exploiting party that has yet to be sent out. The flotation of this company has been accompanied

by so much puffing boom, ceremony and eclat, that the reading of its prospectus in the light of facts known upon this side of the water is most disappointing. As the *Advertiser* says: "In the permanent interests of British Columbia, we could wish that in these pioneer schemes the information afforded in respect to them should be of the fullest and most correct description: on their success or failure depends in no small degree the character of the reception which will be accorded for years to come to other provincial enterprises in the London market"

Of equal value perhaps is the British Columbia Mining *Critic's* article upon the flotation of the Queen Bess Proprietary Co., Ltd., floated simultaneously with its half parent, the Duncan Mines, Ltd., but the greatest service which the *Critic* has done in this article is in its exposure of the fact that the reporting engineer, Mr. R. C. Campbell-Johnston, was interested in the sale of the property, being the original vendor to the promoters. We fear that such practice is but too frequently overlooked in speculative schemes, and in the interests of the public the practice of permitting the expert or reporting engineer to be in any way financially interested in the property to be floated cannot be too severely condemned. It would appear from the *Critic* that in this case Mr. Johnston originally transferred the properties for about £22,000, subsequently they were re-transferred to the Queen Bess Company for the sum of £85,000, a modest profit of considerably over £50,000 Sterling, of which £33,000 is in fully paid shares, and the balance, if it can be obtained, wholly in cash.

The business of the mining broker and of the examining or reporting engineer are so diametrically opposite in their nature that they cannot be carried on by one and the same individual without detriment, either to the brokerage side or the engineering side. It is within our own knowledge that this sort of thing has been frequent in British Columbia, and is being quietly carried on to-day to an extent not appreciated by the public. It is also a deplorable fact that this practice has been introduced into Canada by English engineers who have come out here. Men who have travelled through British Columbia have frequently met the engineer who, when approached by a client to make a report, has asked the question, "Do you want a report on the facts or a favorable opinion?" and again, "the report will cost you so many dollars, and so many paid-up shares in your company." The engineer who consents to take part stock for his fee is warping, perhaps unconsciously, his judgment and no report should be taken as reliable or credible for which the engineer, directly or indirectly, has a promise of further remuneration if the sale is effected. The *Critic* also comments most intelligently upon the reprehensible practice of measuring up ore bodies from exposures shown by short drifts and open cuts, exposing only slight depths on the deposits, and assuming the vein to be continuous as to width and value between these exposures: giving as "ore in sight" the figures obtained by multiplication of the various dimensions.

Some time since we commented in these columns upon those clauses in the Companies Act which relieve directors of responsibility when simply quoting reports from their engineers, and also upon the fact that although the directors are liable for misstatements of their own, no recourse was obtainable against the engineer's misstatements.

We are very glad indeed to note the birth of this spirit of criticism amongst the press of our sister province, and we congratulate British Columbia upon at last having one or two journals which appreciate the inevitable discredit that will be brought upon the province unless reputable journals put forth their best efforts to counteract the effect of the boom papers, and to show the foreign investor that such misrepresentations are not endorsed by those who are on the spot, and who have the best means of knowing the truth of any statements published

We regard it as one of the most hopeful signs of, and one of the surest factors in, the permanent progress of British Columbia that this spirit of honest criticism is manifesting itself

The Revision of the U.S. Mining Law.

We notice a revival in the United States of the movement for a radical reform of the so-called "mining law." We say "so-called" because the provisions of the Federal "Revised Statutes," popularly denominated the Federal mining law, do not in any respect deserve that title. They have nothing to do with the industry of mining, which is regulated, so far as it is regulated at all, by the States themselves. They do not apply, even as regards the mineral lands owned by the Government, to the whole of the country, a large part of which is specifically exempted from their operation. In fact, they are nothing more than regulations prescribing, for a part of the country, the nature and conditions of the titles of occupants and purchasers of the public mineral lands.

On the other hand the territory effected by these regulations includes practically the gold and silver mines of the United States, and has been the scene of the most sensational, though not by any means the most profitable, or even productive, mining enterprises. Moreover, it is a region in which mining has been, on the whole, the leading industry—although in certain parts of it other occupations, such as the agriculture of Utah, wheat and fruit raising in California, etc., have contested this supremacy. And finally, this region under the operation of the regulations referred to has given birth to more extensive and costly litigation over mining titles than all the rest of the world put together—probably even more in the last twenty-five years than all the rest of the world since history began. Judged by the noise it has made, therefore, the Federal mining law deserves that dignified appellation, though its scope is limited and its force feeble, except for mischief.

Yet, strange to say, all attempts to amend this system in its radical faults have failed hitherto, and the present movement in that direction seems likely to meet no better fate. A committee appointed at the mining convention held last year in Denver has proposed a provisional report, suggesting a new code. Examination of this report shows that it is substantially the one proposed nearly twenty years ago by the U.S. Public Lands' Commission. That proposal fell absolutely dead. If we remember correctly, it was smothered in Congressional committee, and never reached the stage of public consideration in either House. There are no clear signs of any such change in influential public opinion as would now force Congress to a different attitude.

If it be true (as we think it is) that the law in question is multifariously bad, whence comes this opposition to a reform of

it? Perhaps the following statement may partially cover the situation:

1. The greatest evil of the law is its grant of extra-lateral rights to apex-owners. But this vicious feature is part of a system under which, as a whole, mining on the public lands has been immensely encouraged, in spite of the incidental wrongs, damages and inconveniences to mine-operators. The system, in our opinion, might have been made equally stimulating to enterprise without this objectionable provision, yet it is not surprising that the generation which has grown up under it should ascribe to the whole scheme, including its harmful features, and should inertly or actively resist a change. This view is an error, and it will continue to bring its penalties; but while it prevails, it is an element which must be taken into account. We see no way of overcoming it, except the slow old-fashioned method of persistent discussion, educating the public.

2. As a general rule, the parties on whom the mischief of the law inflict most direct injury are not those who can successfully wage an open warfare upon it. The uncertainties of mining titles, and the consequent ruinous litigations over them, are usually left to fall with greatest weight upon developed and productive mines, and these are almost universally held by corporations; and corporations are the natural prey of the unincorporated majority. Nothing equals the enthusiasm with which individual claim-owners welcome corporations as purchasers of their claims, except the enthusiasm with which they subsequently turn to rend their grantees. In the eyes of a short-sighted selfishness, a law which has at the beginning the intoxicating effect of a lottery, and which afterwards permits the plunder of the prize-drawers—a combination, as it were, of lottery and loot—is a beautiful arrangement for the impecunious adventurer. Of course this is also an error. Nothing is more certain than the folly of slaughtering "capital" in a region which continually calls for capital. But the penalty falls on the community so gradually as not to touch the conscience of individuals. Moreover, the defence of capital against such assaults is generally to fight the immediate issue, and rest upon the result. The law offers chances to greedy corporations, as well as to greedy individuals. And, finally, there is a growing tendency to avoid the most expensive litigation by compromise. A compromise agreement between dangerous neighbors, fixing a certain boundary between them, has all the effect, for that particular case, of a good law. It follows from all the above circumstances that nobody seems to have a direct interest, warranting energetic effort for the amendment of the law.

3. More important still, in this connection, is the fact that no change of the law could affect the vested interests which have grown up under it. Hence no owners of existing mines would be benefitted as to the security of their titles by the proposed change. The vast area of the public domain concerned is already widely covered with claims carrying extra-lateral rights, and correspondingly subject to such rights. This confusion no new law could remove. Hence the class directly interested in having a new law must be that of prospective mine-locators—a very vague contingent, and scarcely to be relied upon for powerful associated action. On the whole, therefore, the support of the reform must be, and seems to be, disinterested. It comes from intelligent persons, who perceive the evil effects of the present system and wish to amend it, even at this late day, for the sake of the future prosperity of the mining enterprise. They have no weapon but argument: with that they ought to succeed, and we hope they will.

Meanwhile, we must be permitted to congratulate ourselves that Canada has made no such fundamental mistake as the "Apex-law." Nothing that has been unwisely done in the Dominion with regard to mining or mineral lands is irreparable. The system of the United States embodies some features of liberality and freedom which we may study with advantage; but its wretched fiasco in this one particular can serve us only as a warning object lesson. The utter absence among us of such litigation as has cursed the Rocky Mountain and Pacific States and Territories for a quarter of a century is a comfortable proof that we are right in following the practice of the world, instead of the erratic whim of a small and (in this respect) unfortunate part of the world.

English Company Methods.

One of our Australian exchanges contains a criticism on English mining company methods, which is so pertinent to many of the cases on this side of the water, that we re-produce some of the ideas contained in our contemporary's article.

It has been for generations a matter of notoriety that the directors of London corporations absorb large fees in return for their presence at meetings of the company. The old practice of giving a guinea for each meeting attended was the origin of the sobriquet "guinea-pigs," a term familiar to all having any acquaintance with English finances. This practice, we are sorry to say, has survived with the passing years, and is fully as much in evidence to-day as it has ever been.

In reference to the extravagance shown in some of the English owned mines situate in Australia, note is made of the London expenses of one group of four mines, amounting to over $43,000, of which the directors' fees alone consumed one-half. We referred in our December issue to an article in the *Financial Bulletin*, which complained that Nova Scotia mines could not be worked profitably because of the "large directors' fees and office expenses" attendant upon a company formed in London; and also the same, to a certain extent, of British Columbia promotions. Not the least curious feature in connection with these heavy London office expenses, is the fact that the shareholders or the public get so very little information in return for the lavish expenditure of money. It is well known that the best class of financial newspapers on the other side are always very willing to publish items respecting the progress or working of undertakings, whether of a commercial or mining nature, and one would expect when salaries and directors' fees run up, as in the case specified above, to £7,000 sterling, that if there were anything to report about these properties the shareholders would get it at the earliest possible moment. It would seem as though the motive inferred by our exchange may be credited, viz., that amongst directors and company officers there seems to be "a disposition to make a mine a bonanza for its officials," regardless of the interests of the shareholders. This might be a good point for the shareholders of the Lillooet, Fraser River and Cariboo Gold Fields, Limited, to investigate. It would also be interesting to know what are the directors' fees and the official expenses of the Gold Fields of British

Columbia Company, and we note that in the recent report of the Hall Mines, Ltd., the London expenses are in excess of £4,000.

There are many things to admire, but there are more things to deplore, in the London methods of organizing, promoting and carrying forward mining operations in foreign countries Beginning at the beginning, the large and excessive profits (whether share or cash is immaterial) given to the underwriters of a company: the considerable sums for the rent of an elaborately fitted office in the city, with its salaried Secretary and staff of three or four clerks, and, worst of all, its London board of salaried directors, who attempt the management of a property from three to six thousand miles distant, by means of meetings, called on receipt of a cablegram from its manager, but too often delayed two or three weeks after receipt of such cable. It may not be out of place to say that the one thing which has made American mine owners the most successful men of their class in the world has been the policy of *managing nothing at arm's length* We venture to say that no English investor would care to have a bank or big commercial undertaking thousands of miles away managed in London, the resident head officer of such undertaking being compelled to submit all matters of policy, even in emergency cases, to the London Board, yet this is the policy which the investor insists upon when he goes into a mining venture in the colonies. A correspondent to the *Financial News* pertinently observes: "It has been the custom to blame promoters, mining engineers and experts, but what about the directors? How many of them are really fit and proper persons to be entrusted with the interests committed to their care, and with sums of money nearly equal to the revenues of a small kingdom?" We fancy that it would be analogous to Mrs. Partington's attempt to mop back the Atlantic Ocean from her door-step, if one should attempt to convince the British investor that his methods are wrong; yet the cases are numerous where the resident manager of a mining company, with its capital in the hundreds of thousands of pounds, has been obliged to cable to London before he could incur an expenditure, even in an emergency case, exceeding £200. We know of mines idle for weeks because the resident manager was waiting for authority from London to purchase the requisite pumping machinery, and other cases could be cited of just as ridiculous a character.

The ordinary London director of a mining company knows just as much about business and about mining as a newsboy knows about banking and finance, and we firmly believe that the abolition of these fee-hunting directors (whose chief recommendation in many cases is that they are the sons of their titled fathers, and therefore have a handle to their names) is one of the patent reforms in the management of English corporations abroad.

THE METALS OF CANADA.—At the Imperial Institute on the 13th inst., Professor Roberts-Austin delivered a lecture on the metals of Canada. Lord Strathcona occupied the chair, and Sir F. Abel and Professor Dunstan were also present. In the course of his lecture, which was illustrated by a huge geological map of the Dominion, 30 feet long, he said that the vast continent of British North America was rich from end to end in minerals and metals, the principal metals being gold, silver, copper, nickel and iron. Having described at some length the richness in gold of the Yukon and Klondike districts, he urged that, while people contemplated the riches of those districts they should not forget the great importance of iron and steel.

EN PASSANT.

The editor of the REVIEW being absent in British Columbia attending the meetings of the Federated Canadian Mining Institute (B.C. Branch), this issue of the REVIEW has been published earlier than usual, and before the receipt of our correspondence from the various mining districts of the Dominion.

The Council of the Federated Canadian Mining Institute have deemed it expedient to postpone the meetings of the Institute to the 2nd, 3rd and 4th March, having reason to believe that this date will be most conducive to the largest attendance of visiting members. In the meantime contributors of papers, who have not already done so, are requested to send their manuscript to the Secretary as quickly as possible, in order that they may be printed in ample time for distribution in advance of the meeting.

An important meeting of the British Columbia branch of the Institute (the British Columbia Association of Mining Engineers) will be held in the Hotel Badminton, Vancouver, on the 18th and 19th January, for which the executive have prepared a liberal programme of papers for discussion The following among others are entered on the syllabus:—"Mining Law and its application to Development of Mines and Mining Districts," by Frank C. Loring, M.E., Spokane; "Notes on some West Kootenay Ore Deposits," by Mr. J. C. Gwillim, B. A. Sc., M.E., Slocan City, B.C.; "Odd Notes on Mining," by Mr. A. H. Holdich, Nelson; "The Possibilities of Smelting in British Columbia," by R. A. Hedley, Nelson; "Mining Machinery in the Slocan," by Howard West, A.R.S.M., New Denver. Other contributors include Mr. W. A. Carlyle, M.E., Provincial Mineralogist, Victoria, Col. T. H. Tracey, M. Can. Soc. of C. E., Vancouver; and Mr. M. A. Bucke, M.E., Kaslo, B.C. The annual dinner of the Association will be held in the Hotel Badminton on the evening of the 19th instant.

The REVIEW will be represented at these meetings and a *verbatim* report of the proceedings will be given in our February number.

In addition to the cash prizes offered by the General Mining Association of the Province of Quebec to mining students, for original papers presented at their annual meeting, we are authorized to announce that the value of these will be enhanced this year by the donation of a handsome gold medal by Mr. James King Quebec, one of the owners of the King asbestos mine at Thetford. The entries to date for this competition include:—

1. Notes on the Ventilation of a Deep Metal Mine as affected by seasonal changes of temperature. By Mr. John E. Preston (McGill).
2. The Moebins Process for Parting Gold and Silver as carried on in the Guggenheim Smelting Works. By Mr. Percy Butler (McGill).
3. Coal Cutting and Transportation, with special reference to Cape Breton Mines. By Mr. T. A. McLean (McGill).
4. Amalgamation. By Mr. M. B. Weeks (School of Practical Science).
5. Chlorination. By Mr. H. S Carpenter (School of Practical Science).

6. The Cyanide Process. By Mr. W. W. Stull (School of Practical Science).

These papers will in all likelihood be read on the evening of Tuesday, 1st March.

The syllabus for the Federated meetings, in March, contains thirty-three papers for discussion—which is certainly a record for any similar Canadian organization.

The local "boom" press of the Ontario gold fields thinks that district has a grievance against the REVIEW because of the publication of Mr. H. V. Winchell's article on the Rainy River section.

The REVIEW reminds its readers that a precisely similar feeling was shown by the old *Rossland Miner*, the *Toronto Globe* and *World*, and other boomsters, when the REVIEW told some truthful but unpleasant facts about the fictitious bolstering of Trail Creek mining companies in 1896, yet the history of 1897 shows that the attitude taken by the REVIEW was the correct one, as many holders of ten cent shares in Toronto and and other cities of Ontario now know to their financial discomfort, and as is evidenced by the communications in the *Globe* of December 4th. The special correspondence in that issue from Rossland and Trail Creek is a complete endorsation of the REVIEW's prognostications made in December, '96, and January, '97. Nevertheless, the attitude of the REVIEW was not derogatory to the intrinsic merits of Trail Creek as a *district*, but to the *methods* employed in drawing attention to it, and the fictitious values ascribed.

Our articles upon Ontario's fields are in precisely the same spirit; Mr. Winchell clearly points out the gross incapacity of the management prevalent, and with such management financial failure is inevitable. It is the object and duty of every reputable mining paper to ascertain the truth and publish it, as regards mining matters in which the public is interested or is asked to become interested. The REVIEW'S reputation during the sixteen years of its existence has been in consonance with these principles, and it will endeavor to sustain its reputation.

Records for mining and milling gold ores at very low costs are frequent in the columns of our exchanges. In our December issue we noted the detailed costs of the Spanish mine in California which has particularly favorable conditions. A new comer is the *El Plomo* mine in Costilla county, Colorado, which with a small stamp mill reports a total cost of $1.32 per ton. The Alaska-Treadwell's lowest record is about $1 per ton.

The Mining and Scientific Press of San Francisco in a recent issue contains an admirable letter from Mr. Almirin B. Paul, entitled "English Capital in American Mines." Mr. Paul gives many instances of failure of English corporations formed to work property in California and Nevada, and the reasons therefor. The concluding paragraph reads as follows: "If English investors will allow themselves to be led into unprofitable ventures, it is all their own fault, as there are any number of individuals in these latter days, having enough knowledge of vein structure, value of ores and of extraction of the metals, to steer clear of bad ventures. Mining of today and of twenty years ago is as different as is one dollar from five dollars."

As the subject of deep mining of auriferous quartz veins is often brought up nowadays, it will be interesting to our readers to know the following depths which some of the prominent mines of California have reached. The Kennedy is yielding profits at a depth of 2,200 feet, the Empire has reached 2,100 feet, the North Star 2,000 feet, the Omaha and Providence 1,700 feet each, the Maryland 1,600 feet, and the Keystone, Zeila, Wildman, Utica, Champion and several others depths ranging from 1,100 to 1,400 feet.

The B. C. Companies Act came into force on the first day of January, 1898. This Act requires companies organized outside of the Province to register on or before the first of January, and imposes a fine of $50 a day for each day after the first if registration is not made. The fee for registration varies with the capital of the company, being a little over $400 for a million dollar company. We fancy that the majority of the mushroom companies organized in '96 and '97 during boom times will be out of business by the first of February.

The average mining correspondent is either born with, or rapidly acquires, the art of romancing, to use a polite term for lying. He is given to report some fabulous strike of "ten feet" of ore, more or less, assaying in the hundreds of dollars per ton. As a matter of fact some one single specimen *may* have assayed as stated and the vein *may* be ten feet wide, but usually the amount of material in that ten feet which will assay the figure given is less than 1%. The accuracy of the information given in a mining paper's notes is well measured by the way in which reports of such finds are worded.

The futility of attempting to value a free milling proposition by means of assaying hand samples is well known to competent engineers, but the public may not know that some abominable expert work is done on the hand sampling of ores containing free gold. The coarser the gold is, the more likely are the results to be inaccurate, as gold is never evenly distributed in any rock. We know of cases where hand samples taken from a mine have assayed as high as $2,000 to the ton but where the average value of the material to be mined did not exceed $12 per ton. We think that the failure of the Golden Cache mine to realize promises as to the value of its quartz may very probably be ascribed to this pernicious habit of attempting to value a free gold mine by small samples.

The *Western Mining World* prints the following as expressing the feelings of a bereaved grass widower in Dakota: "My wife Sarrah has left my ranche when I didn't Doo a thing Too hur and I Want it Distinctly understood that any Man as takes hur in and Keers for hur on mi account will get hisself Pumped so full of Led that Sum tenderfoot will locate him for a mineral clame. A Word to the Wise is sufficient and orter work on fools."

It is not often that we find that most excellent publication the *Canadian Gazette* (London) tripping in its proof-reading and in its figures, but we cannot let pass the editorial in its issue of December 9th in which it deals with A. J. McMillan's lecture on British Columbia before the Imperial Institute, without calling its attention to the fact that lead and copper are not measured in ounces but in pounds. The chief error in the *Gazette's* article is in the following sentence where speaking of British Columbia

it says: "A country whose gold production jumped from 63,000,000 to 89 000,000 ounces in one year." Where, may we ask, can such figures be found of any country? The gold production of British Columbia really increased from 63,348 ozs. in 1895 to 89,460 in 1896, and the *Gazette* probably meant the same figures, but decimal points are important, especially in these days of wild and irresponsible flotations

Some of the Westralian Chambers of Mines are agitating for the annulment of the MacArthur-Forrest cyanide patents. A committee from the Kalgoorlie, Cue, Norseman, Mt. Margaret and Coolgardie Chambers have the matter in hand and propose waiting upon Sir John Forrest to present their views; it is also contemplated drafting a bill to revoke the patents.

A syndicate, mainly composed of the brothers Maclaren, the well-known Canadian lumber people, have a bill before the Ontario Legislature asking for incorporation under title of the Canadian Consolidated Copper and Nickel Company and a petition has been fyled by them in the Department of Justice, Ottawa, praying for the cancellation of the charter of the Canadian Copper Company on the grounds that they have failed to fulfil the conditions of their charter, we understand in respect to the establishment of a nickel refinery in Canadian territory. When fuller particulars are available we may have something to say about this, but in the meantime it appears to us hardly likely that the Dominion Government will disturb the extensive mining and smelting operations carried on at Sudbury by the Company. By the way, we have a shrewd suspicion that Mr. S. J. Ritchie, of Akron, Ohio, whose services as a director of the Canadian Copper Company were dispensed with a year or two ago, is the Nemesis behind this action.

Eleven mining and science graduates of McGill University celebrated Christmas at Slocan City, B.C., and at 1 a.m. were able to walk up a steep raw-hide trail in the dark. Models of sobriety in a young mining country.

A novel application of the hydraulic press has just been made in the sinking of shafts in Germany. In order to sink a shaft with continuous tubbing, an arrangement has been adopted for forcing down the tubbing rings by means of hydraulic presses. An iron ring is bedded in the brickwork lining flush with the inside and a little above the bevelled edge, and another ring is added on the top of the brickwork, both rings being connected together by strong tie rods, while the upper ring offers a substantial abutment for the thrust of the hydraulic presses, arranged at intervals round the inside of the brickwork. This arrangement greatly strengthens the lining, it also affords a good guide for the tubbing rings which slide inside it.

It is well understood that the fine coal-dust which is blown from the tubs as they travel along at some ten miles an hour against a strong current of air is deposited on the sides and timbers of the mine, and there forms a dangerous accumulation, quite as dangerous as gas when shots are fired. To obviate this danger, an automatic device has just been designed and patented, the object of which is to damp the coal and dust on the tops of the tubs before they are carried to the main haulage roads, and there exposed to the air currents. The damping arrangement, which is illustrated in the *Iron and Coal Trades' Review* of November 12. consists of a small tank, when other sources of supply are not available, containing water, placed at a suitable level above the tubs, and preferably near the flats or landings where the tubs start. The water is carried to a perforated pipe so arranged as to deliver a spray of water to cover the area of the laden tub as it passes under. There is a valve in the tank worked by the tub as it travels along the rail. For this purpose at the point where the spray is fixed, the tub wheel passes over a bar actuating a lever connected with the valve in the outlet pipe, and the speed of tub is regulated so as to give a sufficient quantity of water to each tub as it travels along. By this means all excess of water which might damage the roadways or ropes is avoided, as might otherwise be the case where the whole of the main roads are watered The arrangement has been found to work most satisfactorily at the Browney Collieries, Durham where it has been fitted up.

The directors of the Hall Mines, Limited, have issued their report for the year ended the 30th of September. The accounts for the period then ending show a surplus income over expenditure amounting to £30,357, which, together with £1,930 brought forward from 1896, makes a total of £32,287. Out of this amount the directors have paid the preference dividend, and have written off £5,489 for depreciation, and they now recommend a dividend of 10 per cent. on the ordinary shares, leaving £47 to be carried forward. We have also received a circular dated the 4th inst., in which the directors state that the results of the company's smelting operations for the five weeks ended 31st December, as follows: 5,796 tons of ore treated gave 317 tons of matter, containing, approximately, 146 tons copper, 92,170 ounces silver, and 238 ounces gold. We hope to notice this report more fully in our next number.

A recent diatribe of the Rat Portage *News* is hardly worthy of notice, and we only mention it in order to give the lie to a statement which it contains reflecting upon the circulation of the REVIEW among the mining men of the Lake of the Woods and Rainy River districts. Now, if the editor of the *News* has any money to put up with the manager of the Bank of Ottawa in his own town—say a modest sporting bet of an hundred dollars which the winner will donate to the Public Library, Rat Portage—we will be pleased to cover it, and not only prove the utter falsity of his statement, but show beyond a peradventure that our circulation is of a substantial and influential character, embracing the leading working mines, mine managers, mining companies and mining engineers of these districts. We are free to confess, however, that the REVIEW does not cater to the curbstone promoter and the "boomster" bar-room loafer, for whose idiosyncracies Rat Portage bears a somewhat unsavory reputation, and to whom doubtless the *News* is more congenial reading and its columns more readily useful to their art of catching the unwary "sucker."

FIRE IN A NOVA SCOTIA GOLD MILL.—The mill of the Cochrane Hill Gold Mining Co. was partially destroyed by fire on December 15th. The loss is about $10,000. The mine is owned principally in Halifax, but negotiations have been going on to dispose of it to a Boston syndicate.

CORRESPONDENCE.

Mr. Horace V. Winchell and the Rainy River District.

It is indeed a great condescension of Mr. Horace V. Winchell to descend from Olympus among us poor mortals, to interest himself with our earthly affairs and to tell us at last what evil and wrong doers, what false priest and pharisarian, and what poor toilers-miners and millers, we are. Poor moralist, you lent your ear to Cabale, but you never rested on the ægis of Athena! Your preaching and writing is too diaphanic, not to be understood by the seeing; but you do not find here such men as you did over in Minnesota; you cannot belittle, with a few mistakes, what is good here, and make us believe that it is not so. The district of Rainy River will flourish long after Atropos has determined your material existence, when I hope that the Stygean River will bestow on you oblivion and rest, and not like Sisyphus be condemned to continue your earthly uphill work.

It is true the Rainy River district has been before the public about three years now, but what is the real reason that we do not see more mines working and paying at the present time? Is it really an overbooming of the district? Or wrongly reported statements of the newspapers? Or has the outside mining world convinced itself of the non-existence of gold? Not one of these is a well founded reason. The real causes are: First, the bad practise—shall I say American practise—of opening up mines with a few hundred dollars, and without the faintest knowledge about local geological, petrographical and industrial conditions, but unfortunately always with an overdose of self-confidence in these things. We have seen this on the "Little American," on the Lyle Mine, on the Lucky Coon, and even the Foley; near Rat Portage we had the Gold Hill, Black Jack, the Eldevir and Treasure and a few others. Everyone was worked by Americans, strangers to the country and to any other condition here, but who knew more about it than the one who was perfectly at home there. This is the principal cause, and has done more injury, and has retarded the development of the country more, than any other. A second reason is, and has been, the poor commercial condition of our next door neighbors who labored and suffered under the reaction of booming times; the speculative inclinations, which are so well developed over there, had received a severe shock in real estate investments. The third reason was, the great booms of Cripple Creek and British Bolumbia, which drew the attention of our and the investing public of the Western States to these places. How anybody can compare the efforts and success of the press, promoters and speculators in these two regions, with ours, can only purposely exaggerate. But they never would have reached the state of rawhiding ore, if they had not boomed so intensely, the countries, and if, especially in the case of British Columbia, the western smelters had not seen an opportunity to get flux and work from there. Besides we should know that "distance has always lent enchantment" and especially in the search for the precious metals.

There is a fourth reason why the Western mining camps are much more quickly developed, that is, that the western mining laws are much stricter in regard to developing claims, while ours are too lenient. Further, the prospectors are grubstaked by the merchants of the neighboring places, and are therefore better enabled to do work on the claims which they have located. Here, this is not so much the custom, and our prospectors are too poor to do this out of their own pockets. I might mention here another cause, that is, that gold claims are held at good figures. Our prospectors hoped for the building of the Ontario & Rainy River R.R. and kept their claims out of the market, or at such high prices as they thought would be realized after the road was built. Who can blame them? Only the one who does not know what prospecting means in this country.

These are the principal reasons why the development of the Rainy River district is so much retarded and that other regions got ahead of us, but surely not through over-booming or false representations. We here can certainly not speak of a boom, because we have seen nothing of it; the only town that has experienced and has created a little more interest among the mining world, was Rat Portage, and I am sure it does not regret it. I for my part did not wish to see a boom here, and therefore never encouraged steps to one. On the other hand was Mr. Winchell quite free from doing so? I remind only of the townsite of Koochi hing across the river from Fort Frances. I can see also very little difference between his report* on the Rainy River, and those of the Ontario Bureau of Mines. We can only wonder at such statements about booms from the pen of Mr. H. V. Winchell.

It is true there are a few mills built in the district which could have found much better use several years later, that is, at a time when they could have been continuously operated. But this is an old and oft repeated story. Why renew it again and again. The same is the case in regard to the Sawbill mills. What he says about them would have been correct not at a time when Mr. Winchell saw—*nota bene*, only the one on the Hammond Reef mine—last summer, but late this fall when the ground commenced to freeze and the little creeks nearly stopped flowing. The managers of the mines were not so much to blame for building the mills where they stand now, because there was enough water in these brooks during the hottest season, although I have to say it was against my advice. The Hammond's Reef mill is only a testing plant, and would have for that purpose a very good situation, had it not been for the later occurring water question, but this is settled by both the mills, and everything runs smoothly and they turn out regularly their bricks now.

The principal objections against Mr. Winchell's remarks in his two articles in the REVIEW and *Engineering and Mining Journal* is the tone which he uses in speaking about the gold occurrence in the Rainy River district. He acts as if he knew the whole district from one end to the other, although he does not. He knows only a part of the Rainy Lake, was only once up the Seine on the lower part of the Sawbill Lake, and if I am not mistaken he saw also a few places around the Lake of the Woods, in other words, he has seen only a very small part of the district. How many veins has he examined from all the thousands and thousands occurring in that country? Perhaps a baker's dozen. Now what does he know then about it? Is he justified in his sneering questions and belittling tone about the existence of those reported rich or not rich veins? Has he an idea of the manifold different rock formations, and how the veins occur in them, either as true fissure veins, contact or bedded veins, and how they are mineralized? No, he has not, otherwise he would not have made such peculiar statements as he did in his article in the *Engineering and Mining Journal*, October 23rd.

What he says in regard to mismanagement had been correct a year or two ago, but is not true any more to-day; most of the mines in operation are well conducted, so far as circumstances allow it. The remarks he made about the Bureau of Mines and its staff is rather not very flattering, but I am sure they know how to console themselves with the facts that "inadvertent hasty writing" is not always on our side, but only too often found, and combined with ignorance of the true facts, on the part of Mr. Winchell. If this were not so, he would have said nothing about the Bonheur wagon road which he claims to have been built by the government for the benefit of one or

*Twenty-third Annual Report Nat. History of Minn.

two mines. If he were cognizant of the facts he would have lauded the government's action, which favored not only one or two mines, but more than half a dozen, and opened thereby one of the best and most promising mineral areas of the Rainy River district.

His recommendations to the Bureau of Mines "at this critical juncture" is simply bosh, not less so what he says about building "refractory plants (that is mills) for free milling ores."

In conclusion, I ask anyone who has read his articles, and knows the Rainy River district for whose advantage and benefit have they been? Is he telling us something new? No, but old things which are partly not true anymore, and partly never have been so. Did he write them only *pour parler quelque chose?* No, but for something more.

F. HILLE,
Mining Engineer.

Port Arthur, Dec. 20th, 1897.

I have been considerably amused at the comments of some of the Rat Portage correspondents of Winnipeg and eastern Ontario newspapers regarding my mild criticism of the way in which mining properties in the Rainy Lake region are and have been mismanaged. It is not always pleasant to be told the plain truth about our past career nor to have our numerous failures and fiascos held up to the public gaze. And in thus calling attention to a few of the facts regarding the much-boomed Rainy Lake region I knew very well that those whose toes were stepped on would expose their identity by some loud squealing.

It was not, however, for the purpose of entering into any controversy with this class of newspaper miners that my comments and observations were committed to writing; but for the sake of the mining industry in which I am deeply interested as my life profession, and for the welfare of those whose money is being invested in the region on the advice of supposedly competent and disinterested judges.

And lest I be accused of condemning indiscriminately good and bad alike, let me call attention to the fact that the first official report on the region as a gold producing district was a report of the Minnesota Geological Survey by Dr. N. D. Grant and myself, issued in January, 1895; and that this report, while distinctly and emphatically warning those interested in the district against the very methods of mismanagement which I am now, and even then predicting the results and failures that have actually transpired, at the same time described veins that were said to be true fissure veins, sufficiently mineralized to pay for treatment, and came to a decidedly favorable conclusion as to the prospects of certain portions of the district where the geological conditions were seen to be the most suited for the development of mineralized lodes, and which have actually proven since that time to be the richest. Let me say also that I was the first to make a favorable report on a single property (the Foley) in the district, and that the mine was purchased largely as a result of my report which has been amply verified by later developments. And I may add that I am perhaps more largely interested in the development of the country than any of the verbose correspondents who gobble like a turkey at a red rag at the first word of caution or honest criticism.

Of course those who are posted and familiar with the district know very well that the veracious correspondent who reports in large headlines all the way from ten to thirty millions in sight at various properties really means only as many thousands. But what is the outsider, the man who is not informed, but whose financial aid is so much desired, to think as to the veracity and reliability of these reports when the property closes down leaving all these millions right there *in sight*, or when he reads in the report of the Ontario Bureau of Mines that the total output of these bonanzas for all of Ontario for 1896 was less than $150,000; and when he compares this output with that of Cripple Creek of $8,000,000 and $12,000,000 in 1896 and 1897 respectively, or of British Columbia of $2,500,000 and $8,000,000 for the same years and considers their relative advantages as compared with Ontario, will he not come to the conclusion that there is a "screw loose somewhere?"

For the good of the district, therefore, I take it upon myself to call attention to the fact that while there are a few good properties well managed and capably directed, that these are so rare as to be but bright oases in the desert of mismanagement and ignorance which pervades and overwhelms the entire region. Where there is one good mine, there should be a dozen or more by this time—and there would be if better judgment and experience had been employed. The energetic, competent mining man who is developing his mine for *operation and not for sale*, knows my criticisms are not for him. The howls of the balance of the community disturb me not, as they but show that my object is being accomplished and a few of the sore spots and cancers on the mining industry are being vigorously probed. Truth is mighty aud will prevail.

HORACE V. WINCHELL.

Minneapolis, Minn., 2nd Jan., 1898.

Odd Notes on Mining, &c.

By MR. A. H. HOLDICH, Nelson, B.C.

(Read before January meeting B. C. Association of Mining Engineers. Discussion March meeting Federated Canadian Mining Institute.)

The object of these notes is rather to suggest a few subjects for discussion than to offer anything very startling or novel, hence it is hoped that want of continuity in the chain of expression will be pardoned.

It has been suggested by more than one person that the present size of claims, 1,500 feet square, is too large, and that a return to the old conditions of 1,500 by 600 feet is desirable. If it were possible or usual for any claim-owner to thoroughly prospect his 52 acres and use it for its legitimate purpose, *i.e.*, mining, there need be no objection to his holding such a large tract of land; but we are all well aware that in the majority of cases one or two small prospect holes constitute the owner's idea of work, and the ground is simply held for speculation in the hope that some adjoining claim may prove valuable and so increase the value of his own unused property. It is not easy to suggest a remedy for this state of things, as even if an inspector of mines was appointed he could do very little, and even in one district only he might be quite unable to inspect every claim and see if the sworn assessment was really done, but nothing less than that would seem to be sufficient.

And, notwithstanding the small amount of work done, the value asked for the property is usually enormously out of proportion. Why a claim owner who has done little or nothing to open up his prospects should imagine that capitalists will cheerfully plank down their money on the off chance of getting some return eventually, it is difficult to say, but it is undoubtedly the prevailing idea. If the owner would agree to take chances together with the capitalist, that is, to take his money largely in shares, things would be much better for the country in general, as many more mineral claims would be opened up and in all probability valuable mines discovered.

But few seem to take into consideration the situation of their claims in asking a price for them. Transportation, access, timber and water are all most important points, and a really good vein may easily be rendered of very little value by the want of one or more of these necessities.

None of us are infallible, neither can anyone see an inch into the ground further than his neighbor, but it certainly does seem as if some of the mining experts would be improved by a study of elementary mineralogy and mining, and an addition of ordinary common sense. We should then hear less of the "millions of dollars in sight"—at the end of a tunnel generally—when actually no ore is blocked out at all, nor even its presence certain in other directions. Misleading and extravagant estimates do far more harm than good, and we in British Columbia cannot afford to lose the confidence of the English investor, a result that will surely happen if more attention is not paid to facts and less to a brilliant imagination.

The writer would like to ask what has been the general experience of mining men with copper and gold propositions [not necessarily together]. Do these mines usually improve with depth or not, or is there any rule to guide one in guessing at the probable future of the vein? Experience alone can teach one to estimate probabilities, and it will be interesting to know what the experience of our members has been. This is the more important now that smelters are becoming almost common, and it is so indispensable for the right working of a furnace that the ore supply shall be abundant and continuous. For many varieties of copper ore the only possible treatment is by fusion, and a small smelting plant might be in some cases erected near the ore deposit and the mineral "matted" on the spot. Of course other considerations must be borne in mind; *i.e.*, the presence of an ample water supply, also cost of fuel, and the conformation of the ground itself so as to handle materials as far as possible by gravity. Convenience of transport again must not be forgotten, as high freight rates will speedily reduce the profits to a vanishing point.

But, given all the necessary facilities, there is no need for any government, corporation or city to subsidize a smelter—if it is properly managed it is a highly profitable undertaking and has no need for any outside assistance. The reason why certain smelting plants that have been started in British Columbia are idle, is because they were not properly managed; some of the vital necessities of a smelter may have been absent, or the metallurgist in charge did not understand his business, or at least failed to modify his previous experience to suit the needs of that particular plant.

Another very important matter in connection with smelting is the assaying department. Analyses, as well as assays, must be made continually on the ore that is being raised, in order that any sudden variation in the character of the rock may be known and utilized, or guarded against beforehand; hence the prudent manager will always have his "mixtures" bedded, and the composition known before smelting, instead of afterwards when trouble happened at the furnace. [It is within the writer's personal knowledge that this somewhat extraordinary system of smelting has been practised in British Columbia.]

But the assayer himself must be trained as well as the manager, and it is a matter of congratulation that a step in the right direction has been taken by having public examinations for those wishing to act as assayers, although so far, I believe, it is not absolutely compulsory for candidates to submit themselves. It might be better if it were so.

In conclusion are appended analyses of a few samples of milk sold by a dealer to the inhabitants of this city, and any remarks from analysts accustomed to that kind of work will be most welcome to the writer. The dealer was fined $25.00.

No.	Sp. Gr.	Total Solids. Per cent	Fat. Per cent	Solids not Fat. Per cent.	Ash. Per cent.
1	0.9562	13.63	6.56	7.07	0.394
2	1.009	11.85	4.83	7.02	0.376
3	0.993	13.20	5.93	7.27	0.491
4	0.943	10.45	3.01	7.44	.....

Mining Law and Its Bearing on the Development of Mines and Mining Districts.

By Mr. Frank C. Loring, M.E., Rossland, B.C.

(Paper to be read at the January meeting of the B.C. Association of M.E. To be discussed at Federated meeting.)

From the earliest historical period to the present day, there has been, and is, universally recognized a distinction between ownership of ordinary realty and that of mining property, especially property in mines of precious metals, copper, tin, lead, etc.

In ancient times the ownership and right to dispose of mines of these metals was vested in the Crown, or was the personal property of the ruler. During the fourth century the laws of the Emperor Gratian especially set forth the right to the Crown in mines of gold and silver and provided that all right to work these mines emanated from him, and that the proper royalties should be paid him in consideration of obtaining these rights.

The ancient laws of Spain recognized the deposits of gold, silver and precious stones as belonging exclusively to the Crown and as the private property of the King. Even though these deposits were discovered on the property of a subject, if the owner of the land upon which they were discovered worked the mine, he paid a royalty of one-tenth to the Crown: if they were worked by another, one-tenth was paid to the Crown and one-tenth to the owner of the land.

In France, from earliest time, all mines were at the disposal of the nation. From the moment a mine was discovered the right to work the mine was distinguished from that of the surface.

When Mexico became a republic in 1821, the Spanish law then in force was adopted by the republic. This provided that the discoverer of a new vein or district was entitled to three pertenencias or claims on the principal vein, a pertenencia being 200 yards along the course of the vein. A discoverer of a new vein in the same district was allowed two pertenencias. A discoverer was required to send a written statement to a tribunal of miners describing the position of the vein or mountain discovered, and to post notices on the doors of churches, government buildings and other public places setting forth his claim. He was obliged to make an opening on the vein one and one-half yards wide and ten yards deep, that the proper officer might report upon, and from which he might ascertain the true course and dip of the vein or ore body discovered. If the vein departed from the vertical (as in all cases it did), a provision was made whereby it could be followed on its dip for an extreme horizontal distance of 200 varas, or yards, from the outcrop of the vein. This horizontal distance depended upon the dip of the vein and it was determined by the proper official to what extent the vein departed from the vertical, and the horizontal distance allowed, but it in no case exceeded 200 varas. If, after exploring to this distance, development showed that additional lateral rights were desired, if the ground had not been previously located, another claim 200 yards wide could be located by the owner. The owner was compelled to work at least four paid men for not less than eight months of the year. If this amount of work were not maintained, or if the mine became abandoned, it could be denounced and another could obtain the right to operate it under proper conditions.

The South American republics give concessions to mine, under conditions which provide that a property shall revert to the government after a certain time elapses, wherein work has not been prosecuted.

According to the common law of England, mines of gold and silver were the exclusive property of the Crown, and did not pass in a grant of the King under the general designation of lands or mines. In the case of the Queen vs. the Earl of Northumberland, which was tried in the year 1568 before the Barons of the Exchequer and all the Justices of England, it was held by their unanimous judgment: "That, by the law, all mines of gold and silver within the realm, whether they be in the land of the Queen or of subjects, belong to the Queen by preroga-

tive, with liberty to dig and carry away all ores therein, and with other such incidents thereto as are necessary to be used for the getting of the ore." Some of the reasons advanced by the Queen's counsel seem to-day peculiar. The first was in respect to the excellence of the thing; "for of all things which the soil within this realm produces or yields, gold and silver is the most excellent; and of all persons in the realm, the King is in the eyes of the law most excellent; and because gold and silver are the most excellent thing which the soil contains, the law has appointed them (as in reason it ought) to the person who is most excellent, and that is the King."

The second reason was in respect of the necessity of the thing. "If the King is the head of the Weal-Public, and his subjects are his members, and the office of the King, to which the law has appointed him, is to preserve his subjects, and their preservation consists in two things, viz.: In an army to defend them against hostilities, and in good laws, and an army cannot be maintained without treasure, for which reason some authors call treasure the 'sinews of war;' and inasmuch as God has created mines within this realm as a natural provision of treasure for the defence of the realm, it is reasonable that he who has the government and care of the people, whom he cannot defend without treasure, should have the treasure wherewith to defend them."

The third reason is "that inasmuch as coining is a prerogative of the King, if a subject should have the ore of gold and silver which is found in his land, he could not coin it, for if he makes coin it is high treason."

By the common law in those days, persons were burned for forging or counterfeiting money, because it was high treason to the King, he having the sole power to make money.

In the mining of other than the royal metals, ownership of surface was best *prima facie* title to ownership of mines under the surface. The rights of ownership to the tin mines of Cornwall and Derbyshire were obtained by making application to the proper officer, by depositing with him a prescribed amount of the ore dug from the mine, by proper staking, and were distinct from the ownership of the land upon which the mines were discovered. A royalty was paid to the Crown.

The United States, with the vast extent and rapid development of its mineral bearing territory, the great variety and complexity of its ore deposits, and immense aggregate production of gold, silver, copper, lead, zinc, and other allied metals; the aggregate value of which amounts to an annual production of over two hundred million dollars, offers us the most varied and easily obtainable illustration of the complications arising in lode mining. There, as elsewhere, a distinction has been made between mineral bearing and other lands, and special statutes have been enacted regulating the ownership and operation of mineral lands.

The law of 1866 limited the amount locatable by an individual on any one lode to 200 feet along the course of the vein, and by an association of persons to 3,000 feet, and provided that a U. S. Patent for mineral land gave title to only one vein. For the purpose of working this vein, surface ground not exceeding 25 feet on either side of the vein was granted. For many years there were no very serious objections to the operation of this law; but as ore deposits of more complex form were discovered its conditions were found to be inadequate. In order to meet new conditions the Mineral Act of 1872 was passed, which provided that a mineral location should not exceed 1,500 feet in length by 300 feet on either side of the vein discovered, and that no local law should restrict the width of a mineral claim to less than 25 feet on either side of the vein. In some parts of Colorado surface ground is still restricted to a width of 75 feet on either side of the lead.

The Act of 1872, which is still in force, provides: "That the locators of all mining locations . . . shall have the exclusive right of possession and enjoyment of all surface included within the lines of their location, and of all veins, lodes and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes or ledges may so far depart from the perpendicular in their course downward as to extend outside the vertical side lines of such surface location; but their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between the vertical planes drawn downward, as above described, through the end lines of their locations so continuing in their own direction that such planes will intersect such exterior parts of such veins or ledges. . . . On each claim located after the 10th day of May, 1872, and until a patent has been issued therefor, not less than $100 worth of labor shall be performed or improvements made during each year."

The idea in so granting all veins apexing within the surface boundaries of all claims to their extreme depth, was just in theory, and when the simple, well defined, easily traceable fissures then being worked were under consideration, was eminently fair and not leading to many serious complications.

The lodes of California, Nevada, and of the old counties of Colorado, were of such a nature that this law in its operation created no great amonnt of litigation; but the subsequent discovery and development of more complex ore deposits, and the complicated system of locations crossing each other, and of many forms, have led to such a vast array of litigation that the law, apparently so simple in theory and so just in operation, has been so discussed, distorted and adjudicated, that the mining decisions of the United States fill many volumes; and the practice of mining law has become a distinct and exceedingly lucrative branch of the profession. Men of experience and acknowledged ability have written voluminous treatises on Mining Law. No two courts exactly agree as to the rights of the mine owner, and some of the most important points arising have never been absolutely decided by the courts of last resort.

The theory of the law of 1872 is: The locator discovers a well-defined lode or vein in place, which is so easily distinguished from the country rock that there will be no difficulty in recognizing the distinction. That this vein is so easily traced, and that it continues in a comparatively straight line for such a distance that the end centre posts of the location can be placed directly over its apex, and that the vein in its downward course can be followed without fault or other displacement to the depths.

Were this always the case no difficulty would arise in the development of a mine or between the owners of adjoining property. This is unfortunately not so. The result is that one editor alone has fifteen volumes of mining reports, containing only the most important cases, and tending to complicate rather than to simplify the serious questions arising between conflicting interests.

Dr. Raymond in his "Law of the Apex" has discussed the questions of apex and extralateral rights most exhaustively; and many other authors have written learned and extensive works upon this subject. The result of all this labor is simply to emphasize the necessity for a radical change in the mining laws. At a mining convention held at Denver during the last year, a committee was appointed for this special purpose, which has reported. Still there seems to be a question whether its report will tend to better matters to any great extent. The theory of the present law is: The lode is the property desired and that surface ground is purely an attachment for the convenience of working. Under this theory the mine owner should be allowed to follow his vein indefinitely, whether it depart from the vertical boundaries of the location or not. It does seem as though, after having developed a mine, and inasmuch as this is the property sought after and the source from which values are obtained, the mine owner should be allowed to continue in his development and extraction indefinitely. It is often the case that a

mine has been developed at no great profit, and that were development restricted in depth and the owner compelled to stop upon encountering his side lines, the source of all profit to the mine owner would be at once destroyed, and in many cases it would be practically impossible to continue development from some adjoining claim. This in many cases would tend to shut down the mine permanently, and would have a tendency to lessen the amount of mineral wealth extracted, and in this way would be the cause of loss to the community. In many cases the depth necessary to sink before this ore body could be picked up from an adjoining claim would be so great that it would be a positive prohibition to a further development of the property, and further production would be permanently stopped. On the other hand, if the miner is allowed without restriction to follow what he claims to be his vein between the planes of his end lines, to an indefinite extent, what is to prevent his taking the ore belonging to another? The crossings of veins, faults, the union in depth of veins of different apexes, the difference in the courses of end lines, the departure in geological conditions from theoretically well defined fissures between walls, the occurrence of blanket deposits which necessarily materially modify the rule as to extra lateral rights, the occurrence of ore bodies not in veins at all, but in masses without well defined limits, the difference between the course of the outcrop of a lode and its horizontal strike and many other conditions —so complicate the question as to the right of ownership that the never-ending litigation referred to has been the natural result of the practical operation of the originally simple and apparently just law.

In order that some of the complications arising may be more easily understood, I will give you a few illustrations of possible and often occurring complications.

The prerequisite of a mining location in the United States is a discovery. A discovery has been ruled to be that which a miner would follow with a reasonable hope of finding pay ore. This construction is so broad in its operation that it often leads to much controversy; and in mining suits, depending on the validity of discovery, much conflicting testimony is given. No right can be acquired by location before the discovery of a vein or lode within the limits of the claim located. Should a mining location be made, and should another make a valid discovery before the original locator has done so, the first location becomes invalid, inasmuch as it was not a mining location under the provisions of the law. In many cases the original locator of a piece of ground has lost his location because of his failure in this regard. This often is a matter of evidence, and he who swears the hardest is often the most successful. If, however, a location otherwise valid should be made on a vein afterward discovered, no other rights intervening, the location would be valid to the limits of the claim.

The law provides that the end lines of all lode mining locations shall be parallel. It is seldom the case that the apex of a vein is of uniform course. In ascending and descending the sides of mountains should the vein depart in the slightest degree from the vertical, the course of the apex necessarily changes, and in all cases where the dip of the vein is other than vertical, the true or horizontal strike of the vein and the course of the apex are different, the angle of departure varying with the grade of the mountain along the outcrop of the vein and the angle of dip. It is seldom that any locator on a vein places his end lines at right angles with the true course of the vein. The result of this is that as the various claims on any lode develop the courses of the various end lines cross each other, and much conflict of interest is thereby created. Some of the hardest fought mining litigation in America has depended on this question of the intersecting and crossing of end lines. In order to illustrate this and many other questions arising, I submit herewith a map, showing the mining locations on what is generally known as the "Bunker Hill and Sullivan vein," in Wardner, Idaho. Nearly every possible complication exists in the mining locations and operation of the mines on this vein. Much hard fought litigation has already occurred, and unless all of the mines on this vein become the property of one owner more expensive litigation is bound to follow.

Following the outcrop of this vein westerly from the east end line of the Sullivan, we find that it extends nearly along the centre line of the Sullivan, down the mountain to Milo Gulch, thence crossing Milo Gulch; and owing to the fact that it dips to the south at an angle of 45 degrees in climbing the mountain and passing through the boundaries of the Bunker Hill, Stemwinder, Emma, Last Chance, and part of the Tyler, its outcrop tends much to the north, although the horizontal strike of the vein remains the same. In passing over the mountain on the Tyler ground and descending its western slope, the apex bends sharply to the south, passing through the San Carlos, Skookum and Oakland claims, until it crosses Deadwood Gulch. After crossing Deadwood Gulch on its westerly course it again ascends the mountain, and again bends sharply to the north. The courses of the end lines of the various claims on this vein give a remarkable illustration of the conflicting rights of the various properties. Were the Stemwinder, the Last Chance or the Tyler allowed to follow its vein without restriction between the parallel planes of its end lines, it would completely cut off in the depths either of the other two properties in its development.

Among the bitterly fought litigation which has already occurred, is that between the Last Chance and the Tyler, and there has not yet been an absolute and final adjudication of the vein rights of these two properties. The Supreme Court of the United States has apparently avoided this most important question, and whatever decision has been made has been done on other matters. No litigation has yet occurred between the Stemwinder and the Last Chance directly, but a preliminary suit has been tried, involving the right to the surface ground west of the Stemwinder and south of the Last Chance, and unless these properties are consolidated the issue is bound to arise sooner or later.

All of these mining locations were made by experienced prospectors, who were supposed to understand their business: and yet, had they so endeavored, they could not have created greater complications than exist on this vein. It has been suggested that the law be so amended, that the course of the end lines of the first location on a vein absolutely establishes the course of the end line of all mineral locations on the same vein. Were proper exploration and development made before the course of the end lines of the original location were finally established, this amendment might operate well, and its passage would undoubtedly prevent many complications. If, however, the first location were made as it was in this instance on the Bunker Hill and Sullivan, it would work a hardship on all subsequent locators, and would be exceedingly unjust in its effect. The Bunker Hill, Stemwinder, Emma and Last Chance were located directly across instead of on the course of the vein. The result is that it is a question in what direction the Bunker Hill will be allowed to go in its deep workings. The Stemwinder has already anticipitated the inevitable, and long ago amended its location, making its former side lines its present end lines. The rights of the Emma have never been adjudicated; and in the case of the Last Chance, the side lines have become the end lines, and instead of following the vein in its deep workings on the line of its dip, it is compelled to develop more nearly along the course than the dip of the vein, and into the territory west of its west end line.

The all-absorbing question of extralateral rights is ever present when properties on this vein are considered. The location on the Sullivan was reasonably correct: in the case of the Bunker Hill it may be difficult to say what its rights are. The course of the horizontal strike of the vein, as is shown by an arrow on the accompanying map, and the course of the outcrop are quite different. Will the Bunker Hill be allowed to follow its vein between the side lines in a westerly

direction to the depths, or will it be compelled to follow between the planes of the end lines drawn in to a point where the vein crosses the side lines to the depths, or will it be confined to its vertical boundaries?

In the case of the Last Chance and the Tyler, in spite of the immense amount of litigation already had, were the merits of the case decided entirely on the question of extralateral rights, it would still be difficult to determine the respective rights of these properties. If the location of the Last Chance were prior to that of the Tyler, it would be allowed to follow its vein indefinitely to the west between the planes of its side lines. In this case the Tyler would be entitled to all of the vein, the apex of which is contained within its boundaries, up to the plane of the north side line of the Last Chance; and, leaving the ore between the north side line and the south side line to the Last Chance, it would be entitled to pick up its vein again south of the Last Chance's south side line and continue indefinitely in depth until it conflict with some better title. If the Tyler were prior to the Last Chance in date of location it would probably be entitled to follow its vein between the planes of its northwesterly end line and of its southeasterly end line, under and through the Last Chance, and so on indefinitely until it conflicted with some better title. This does not take into consideration the rights of the Republican Fraction or of any other adjoining claims, on other questions which have arisen and which complicate the issue. The ore bodies lying south of the Last Chance and west of the Stemwinder, perhaps 1,000 feet beneath the surface, to whom do they belong? In anticipation of possible controversy surface locations have been made on this ground, both by virtue of surface discovery and of discovery based on ore found in the depths of the vein.

I do not pretend to express an opinion as to whom the ore in this region belongs, but unless these two mines become one property there is ground for controversy before a final decision is arrived at. In short, along the entire course of this vein, from the Sullivan to the Sierra Nevada, there is a mass of conflicting interests and possible trouble.

This same state of affairs exists in every mining camp in the United States In districts like Leadville, Cripple Creek and Aspen, many geological questions arise which create additional difficulties. Owing to faults, slides or other displacements, the pinching or the crossing of veins, the fact that in some cases the true apex of the vein may not be the highest point at which ore has been discovered, and for numerous other reasons, many additional conditions seriously complicate matters. Where the boundaries of one claim are allowed to cross those of others, as in Gilpin County, Colo., Leadville, Butte and elsewhere, still other complications arise.

At the mining convention held in Denver, Colo., during last summer, the subject of the revision of mining laws was discussed, and a committee was appointed to draw up new laws to be submitted to Congress. This proposed bill provides, amongst other things:

"That all the precious and useful metals, minerals, and ores thereof, also the following: Petroleum, asphaltum, brea and all other forms of hydrocarbons, monazite, bauxite, magnesite, soda, saltpeter slates, Mexican onyx, marble and building stone, phosphates, guano, clays, kaolin, gypsum, asbestos, sulphur, infusorial earths, natural pigments, peat, talc, mica, pyrite, corundum, emery, manganese, graphite and chrome, in public lands of the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration, and surface and subterranean prospecting.....That any mining claim located after the 31st day of December, 1898, shall be bounded as to surface by straight lines, and all right to mineral contained therein shall be confined within vertical planes, passing downward through said boundary lines.....A mining claim may equal, but shall not exceed, a square of 1,320 feet on the side, and the same may be in any shape, so that its width shall not be less in any place than 330 feet, nor the aggregate area exceed that of the square hereinbefore described. All future occupation, location, or purchase of public minerals lands, shall be governed by laws of Congress, to the exclusion of all local customs and regulations, and State or Territorial laws."

Any qualified person may acquire title to a mining claim by marking the position of his claim by monuments on the ground, and by posting notices thereon. Said monuments shall consist either of firmly set wooden stakes, not less than six inches square, and not less than three feet above ground; or of well-set piles of stones, not less than four feet high, posted at each exterior angle of the claim. Within ninety days after location, a lode, placer or other valuable mineral deposit must be discovered within the claim. Within ninety days a locator shall file the proper maps with the U.S Surveyor-General for his district, and shall deposit $50 in a United States depository, as an addition to the appropriation for the survey of the public land, together with proper affidavits of the locator and of two disinterested persons, as proof of the discovery of mineral. Within five years thereafter, the locator shall make application for a United States patent, and shall give proof that $500 worth of labor has been expended on each location; and upon payment of $5 00 per acre for a lode claim, and $2.50 per acre for placer or any other form of deposit, he shall be entitled to a patent.

It is proposed also that provisions be made for the establishment of proper mineral monuments, and for trigonometrical surveys, for the purpose of showing the relative positions of the various mining districts, and all the claims in each district. The locator is required to make an annual expenditure of $100 worth of work on each claim until patent is issued; this work to be credited to him upon the total amount of $500 required to be expended upon each claim prior to issue of patent, with a credit for the first year of the $50 which was paid to the Surveyor-General."

The most important change in these proposed amendments is the abolition of extra lateral rights. This would undoubtedly work a great hardship in many cases, but would put a final stop to a large proportion of the litigation now existing.

Dr. Rossiter W. Raymond is of the opinion that the requirement of a discovery is practically a farce. "That all that is really exacted is a declaration without proof that a discovery has been made, and if this declaration were a mistake or a lie, there is no way of correcting it after the issue of a patent, except the cumbersome proceeding of a direct attack on the patent by suit to offset it. The patent cannot be collaterally attacked in any other proceeding. It would be much simpler and better to let any location of mineral land be made without discovery. Possessory ownership of it would have to be maintained by annual work or payments, as the law might provide; permanent ownership would have to be got by purchase. In either case, the United States would not be damaged if there were no discovery made before the title was granted. The private owner of a supposed piece of mineral land would scarcely be such a fool as to say to a proposing purchaser, 'If this land is valuable I will sell it to you for so much an acre. If it is worthless, or if you have not found out whether it is valuable or not, I will not sell it to you at all.' Yet that is what the requirement of a discovery amounts to."

With reference to the annual assessment work of $100, Dr. Raymond says. "The assessment work now done is admitted in most cases a mockery. The money, if really expended, is practically squandered unless much more is spent than the law requires, and it might as well be paid into the treasury of the government as wasted on the surface of the ground."

It seems to me that if no discovery were required, even if in many cases it be a farce, the result would be that the locations could be made covering extensive territory with much more ease than at present, and

that the development of a mining district would be materially retarded, operating seriously against the public interest if this provision were abandoned. If it were possible that each location could be examined by a properly qualified officer as to the merits of his discovery, and also as to the amount of assessment work done, much of the objections to these provisions would disappear. I am strongly opposed to making the appropriation of the public mineral lands more easy than it is at present, and it is certainly not to the public interest and tends to create a monopoly in these lands. Although I freely admit that there is much fraud practiced in both of these matters at present, still there is a tendency toward somewhat of a showing which would be entirely annulled if all restrictions were raised. The proposed revision would allow a locator to have a length of 5,280 feet on the vein if he chose to have a width of only 330 feet. This, it seems to me, would be unjust. I believe that a total length of 1,320 feet is sufficient and for the general good, and I would be in favor of restricting the width to less than 1,000 feet. By this means there would be more locations made in a district and the opportunities for prospecting would be greatly increased, and blanketing the country with 40-acre tracts would be more difficult.

. I have gone into the conditions existing in the United States somewhat extensively, because conditions there are the best object lesson we can obtain of what difficulties are to be encountered in the location and development of mines in Canada. My special object in writing this is for the purpose of considering the state of affairs in British Columbia.

It has been said of the British Columbia legislature, that no session is deemed complete until some additional provision or amendment is made in the mining laws of the Province. The first Mineral Act was passed in 1884. This Act provides: That surface ground 1,500 feet long, by 600 feet wide, may be located in the form a rectangular parallelogram by any Free Miner. The Mineral Act of 1891 repeats this provision, and provides: That the end lines shall be parallel, but that the angles shall not necessarily be right angles. This Act sets forth: That three legal posts shall be placed as nearly as possible at equal distances from each other along the center line of the claim; that legible notices shall be placed on these posts, etc.; that during each year after location $100 worth of work shall be done; that proper affidavit shall be made recording this work in the office of the Recorder or Gold Commissioner, and that if work has not been done the claim shall be forfeited; that no Free Miner shall be entitled to hold either in his own name, or that of another, more than one claim on the same vein, except by purchase; that the owner shall have the exclusive right to all surface ground included within the boundaries of his location, and of all veins or lodes throughout their entire depth, the top or apex of which shall lie inside of such surface lines extending vertically downward, although such veins or lodes may so far depart from the perpendicular in their course downward as to extend outside the vertical side lines of such surface location; but his right of possession to such outside parts shall be confined to such portions as lie between vertical planes downward through the end lines of his location so continuing in their direction that such planes will intersect such exterior parts of such veins or lodes. If a location is so made that its center line crosses the vein instead of following on its course, the locator is entitled to as much of the vein as actually crosses the surface of the location, and the side lines become the end lines. A location shall be deemed to have been laid crosswise when the smallest angle made by the center line falling on the vein or lode is greater than 45 degrees. This Act continued in force until 1892.

This Act undoubtedly follows the United States laws with but slight changes. Instead of the locator being compelled to place posts at the corners of his location, he places three posts along the centre line. This, I think, does not give such complete notice to the public as the United States custom, especially where side center posts are required, as in Colorado.

I think this objection of indefiniteness in marking and staking is one of the great weaknesses of all of the British Columbia laws that have been enacted to the present time. It is very difficult at best for anyone to trace the boundaries of a mining claim, and this is especially the case when locations 1,500 feet square are made. The law cannot be too particular in this matter. This is one subject which the British Columbia legislature has not dwelt upon sufficiently and the requirements of which are not severe enough.

In the Rossland district the mines first located there, as the Le Roi, War Eagle, Center Star, Iron Mask, Josie, etc., have been located under the provisions of the Act of 1891. There is at present litigation between two of these properties as to their respective rights in following the vein beyond the vertical side lines of one of the claims into the other. In this case there are apparently two apexes and a meeting of two veins, which somewhat complicate matters. The provision for the rights of veins running across the location is in conformity with the decisions of the courts of the United States, providing for a 45 degree line.

In 1892, and in subsequent years, the legislature has provided: That locations 1,500 feet square can be made, rectangular in form and and having no extra-lateral rights. This law much simplifies matters, but it has a tendency to retard the development of a district. I am of the opinion that locations 1,500 feet square and containing over 50 acres of land are altogether too large, and therefore tending to retard the development of a mining district and not for the public good.

In the Rossland recording district there are nearly or quite 5,000 mining locations recorded. Undoubtedly most of these were made with the knowledge of the locator that they did not contain, so far as he knew, mineral of value, and were made solely for the purpose of securing ground for speculative purposes. There is no provision in any of the British Columbia Statutes for development work at the point of discovery. This is is a very important point to be considered. I am of the opinion that no one should be entitled to reserve for himself a 50-acre tract of land, or any other amount, without making a showing that the land so reserved is of sufficient value to warrant the Government allowing him exclusive right thereto. Experienced, honest and skilled officials should be appointed for the purpose of inspecting and passing upon the value of all mining locations. A locator should have ample time wherein to prove the value of his claim, say 60 or 90 days, but unless it be so proven he should not have the right to monopolize and and set aside this land from other prospectors more skilful or fortunate than himself. It certainly does not tend toward the expeditious and proper development of a country.

The provisions of the various laws passed by the British Columbia Legislature, from 1892 to the present time, require: "That two posts shall be marked; that a line shall be blazed between these posts; that proper notices shall be posted, etc." In other words, for the purpose of giving notice to the public that a tract of 50 acres of land has been set aside for his special benefit, the locator is compelled to more or less distinctly mark a line 1,500 feet long, to erect two posts thereon, to place a notice at the alleged point of discovery, and to record a notice of location; and this is the sole notice which the world has of the boundaries of the tract so appropriated. This line may be 1,500 feet from the extreme boundaries of his claim in one direction, and in no case does it in any marked degree so define his claim that any other prospector can, without extreme difficulty, and often great expense, ascertain its limits. This insufficiency and indefiniteness of marking has also a tendency to put a premium upon dishonesty. It is a comparatively easy matter to destroy posts or to shift lines so marked. Much trouble has already arisen from this cause. Proper monuments should be placed at each angle and along the boundary lines of each claim. These lines should be distinctly blazed, and as soon as possible

an official survey should be made. If land is of sufficient value that a locator appropriates it to himself, as against the rest of the world, it is of sufficient value to compel him to do all that is just and necessary, not only to maintain his own right, but to notify the world of that right.

No plea of hardship to the prospector changes the weight of this argument, because in order to create value on his property the owner has to undergo much expense in any case, and the public domain is too valuable to allow any person, from speculative or other motives, to reserve it to himself without showing good intent.

I think that in the two important questions of the mineral value of the land, proper location and definition of boundaries, the law cannot be too severe, especially when one considers that in British Columbia no price is set upon mineral land, and all that is done in the way of expense is for the sole benefit of the owner. Even were a price of so much per acre placed upon mineral land, the necessity for these restrictions for the general public good would still hold good.

Much sympathy prevails regarding the poor prospector, and there exists a tendency to aid him in every possible manner to perform his most important part as a pioneer in the development of the wilderness. No one can be more forward than I in rendering him the honor due. We owe to him more than to all others the credit of giving to the world the vast stores of mineral wealth produced in America. No hardship is too severe, no region too distant or inaccessible, no danger too great, to appal him. Were it not for the prospector there would be few permanent settlements in the west. The first incentive to the farmer and to the home builder is created by the discovery of gold or silver by some lone prospector, who, long before the agricultural, grazing or manufacturing resources of a country have been considered, has explored its extreme boundaries. The growth of the mining industry, resulting directly from his discoveries, has made possible the creation of cities, the establishment of factories, and the advent of the farmer, the mechanic and the capitalist. The hardships of the Arctic and African explorer are small compared with what the prospector often bears without murmur, and usually without reward, and while I believe that every facility should be given him to realize from his mineral discoveries, still, after having made these discoveries, it is not only to his interest, but to the interest of all, and public policy, that his rights and the rights of the community should be well defined, distinct and definitely prescribed.

Regarding annual assessment work, I go so far as to maintain that no one has a right to the exclusive possession of mining property without continuous and systematic development, and that no one should be enabled to set aside tracts of mineral land for speculative purposes, or for any other reason, and prevent their development, but that he should be compelled either to lose this special right, or so develop his property that its value will be proved within a reasonable time, or, if he is not able or competent so to do, that another should have the privilege.

The broad, liberal and wise policy adopted by the British Columbia and Dominion Governments in the facilities offered and the protection given to the miner in the pursuit of his business, cannot but result in great benefit to the country at large, and will cause a rapid development of the vast region yet unexplored, which is destined to be one of the very greatest producers of mineral wealth of the world.

NOTE.—Much of the information contained herein has been obtained from "Lindley on Mines," and from the reports of mining cases in the United States, from which sources liberal quotations have been made. F. C. L.

The experiment by Messrs. Donald Currie & Co. of a nickel-steel boiler in a large steamer will afford an excellent opportunity of comparing the behaviour of nickel-steel as a material of boilers with ordinary steel, and the result will be watched with much interest in shipping and engineering circles.

Mining Machinery in the Slocan.

By HOWARD WEST, A.R.S.M., New Denver, B.C.

Read before the January meeting of the British Columbia Association of Mining Engineers' Discussion March meeting Federated Canadian Mining Institute.)

The Slocan mining division of West Kootenay has been well and fittingly described as a poor man's country, which assertion does not necessarily indicate that a man without means can come in and develop his claim from the proceeds of ore obtained direct on the surface, for such instances are few and far between even here; but because in comparison with other camps, the minimum amount of working capital is required as a rule before commensurate returns are shown. The Slocan of yesterday is not, however, identical with that of to-day, such rapid progress is the district making, and the designation which was applicable when the country was first opened up by no means holds good literally at the present time. Originally the surmised extent of the mineral belt was limited to the galena bearing argillites stretching from Kaslo on the east to Silverton on the west, but later discoveries have proven that this supposition was far too restricted in its character. Flanking the slates to the south is a mass of more recent granite, which penetrates the older strata, and protrudes in places through the argillites, forming knobs, and occasionally basins of granite, where denudation has done its work effectively.

This granite, at first boycotted, so to speak, by prospectors and others, for no apparent reason beyond insane prejudice, includes within its borders many now well known mines and prospects. The ore-character, however, is not the same, although in places galenas predominate as in the slates; consequently mining in the dry ore belt, as it is termed, assumes new and somewhat different phases from that which obtains in the Sandon district. The major portion of the granite area has been recently severed from the Slocan proper, and included in what is now known as the Slocan City Mining Division. As, however, the two regions are largely operated by the same men, and moreover present at least some points of similarity, it may be as well for general purposes to summarize the whole as the Slocan, more especially in view of the fact that by reason of past association they are indissolubly connected in the public and professional mind.

I commenced by saying that the Slocan has been known as eminently a poor man's country from its earliest discovery, and one of the determining factors to this distinction, omitting for the present the question of the proximity of high grade ores to the surface, has been the extreme ease and facility (I am referring now to the area covered by the sedimentaries) with which the ground could be mined by indigent prospectors themselves, with the aid frequently of merely a pick and shovel, in marked contrast to the Rossland camp, where the country rock is abnormally hard. Such a condition of affairs naturally, and in one sense fortunately, militates against the introduction of heavy and expensive machinery. This results not alone from the fact of machinery being deemed superfluous, but the conditions tend to keep the locators from seeking the assistance of outside capital, without which it is impossible to go to any great expense in the matter. The favorable nature of the country, however, is only one of a number of advantages which this section of Kootenay possesses in common with others. The general topography and natural contour of the ground admits of the most economical exploitation and development by a system of horizontal tunnelling, consequently each opening serves not only to remove the ore, but acts also in the capacity of an adit, so that the necessity for introducing elaborate hoisting and pumping machinery is obviated at the start.

In these important respects Kootenay is to be warmly congratulated, and it would be well for intending investors to bear this in mind when considering the relative merits of other localities.

Coming to the consideration of the original subject, namely, the machinery now in use, we will divide it roughly, for convenience, into four classes: 1. That used in breaking ground. 2. For hoisting, pumping and ventilation purposes. 3. In transportation. 4. In preparation of the ore for the market.

1. As previously observed, the slate wherein most of the shipping mines are found is extremely soft and easy of working, and therefore it is not surprising to find that rock drills are in little demand; in addition, the veins usually contain small but rich chutes of ore, and the object is to extract these with as little breakage as possible. In the granite area, where drills would be an unquestionable advantage, more especially in driving long cross-cuts, few mines are as yet sufficiently advanced to warrant their introduction, but doubtless in the future we shall hear of many properties, in the working and development of which they are destined to play an important part. The only instances of the contemplated use of rock-drills in the Slocan which have come under my notice are at the Galena Farm and the Slocan Star. Each of these mines is equipped with a four-drill compressor, but in the former instance no drills have so far been connected, although the ground is fairly hard, while at the Star they have, I understand, only been employed intermittently, more as an experiment than anything else.

2. *Hoisting and pumping.*—These two are considered together, because conditions which effect the one almost invariably effect the other also. On account of the sloping nature of the ground which exists at practically all the mines, neither hoisting nor pumping is necessary. In some few instances where winzes are sunk, having no connection with the surface except at the upper end, a bucket attached to an ordinary hand windlass is sufficient to cope with the water, and also to raise the ore and waste. True shafts are, generally speaking, conspicuous by their absence, but may be observed at the Arlington, Galena Farm and the Dardenelles. A boiler has been recently conveyed to the former, which it is proposed to use for hoisting and pumping purposes, but as yet the plant has not been fully installed. The work at the Galena Farm, however, presents many features of interest, which are certainly deserving of more than passing mention.

Whatever may be said or thought about the merits of the mine, or the action of the promoters in floating the property with such an enormous capital, there can be no doubt that, given opportunities, the company is prepared to operate on a liberal scale. They intend evidently to mine in the true acceptance of the word, therefore do not hestitate as so many do about necessary preliminary expenses. Their splendidly timbered double compartment shaft, now down to a depth of 230 feet, would be hard to beat in any district, and a visit to the shaft house, which is unique in the Slocan as regards equipment, well repays the trouble involved in making the trip. Until quite recently buckets only were used in raising the stuff to the surface, but the limit having been reached where these could be economically employed, a single deck cage of the usual platform type for vertical shafts has been installed, on which the car is raised, being held in position during the operation by two hooks, one of which is caught in a loop hole on each side of the car. The cage is supported by a round wire rope of medium size, which passes over a five-foot groove pulley at an elevation of 42 feet above the shaft head to a drum four feet in diameter. This latter, on which the rope is wound, is of the flat type, having a flange at each end. Power is imparted by means of two water wheels, a Pelton and a Risdon, which correspond in measurement, being each six feet across, and are both connected on the same shaft with the drum. The power house also contains a boiler and a four-drill compressor, for use when occasion demands. Water is brought from the creek underground in an eighteen inch pipe, which tapers to sixteen where it enters the bulkhead, two hundred feet distant from the shaft. From here it is conducted in nine inch pipes to where it impinges on the wheel through inch and a half nozzles. With a head of 320 feet, 150 H.P. can be readily generated, which is ample, not only for hoisting and pumping, but will suffice to run the concentrator when erected.

I regret that I have had no opportunity of personally visiting the Dardenelles, but I am informed that a Knowles pump is also in operation there. The shaft exceeds two hundred feet in depth.

I inadvertently omitted to mention before this, that water raising appliances at the Farm consist of two small force pumps, one a Cameron and the other a Knowles, which furnish a continuous discharge through a two inch pipe. It is probable, however, that machinery of greater capacity will be required as work progresses.

2. *Ventilation.*—Natural ventilation is relied on almost exclusively, and in the present stage of development where the levels mostly reach daylight is all that can be desired. In one instance which came under my notice at the Enterprise mine, a small fan stationed at the foot of an upraise is propelled by power obtained from water which is conducted direct from the surface. This furnishes quite a current of air, and being inexpensive and extremely simple of construction, might, I should imagine, be copied with advantage at other mines.

3. *Transportation.*—The ore is hand sorted as a rule at the mouth of each tunnel, and there being no necessity to concentrate it all at one point on the surface, shoots are generally employed to conduct the material from the stopes to the level below, and very rarely is local hoisting gear of any description required. For clearing out the tunnels wheelbarrows are mostly used in the initial stages, but as the workings become more advanced, and the necessity arises, rails are put down Sometimes these consist merely of strap iron laid flat on the runner, but more frequently perhaps of rectangular steel rails standing on edge. The common guage is twenty inches, to suit the waggons, which are made of steel, and hold something less than a ton, depending on the specific gravity of the material trammed. Some slope to the front, and are so arranged that they can be tipped at both end and sides; others again are almost square in longitudinal section, the front being designed to open on hinges, while when closed it is kept in position by a vertical bolt. Human power only is used for underground transport, and can hardly be improved upon under present conditions. To convey the ore down the mountain side to the railway, packing on mules' backs was the primitive method originally employed, and is still used to some extent. An exception was made in the winter, when raw-hiding was permissable if the trail was in sufficiently good condition. With the construction of waggon roads to the mines this was improved upon to hauling in waggons in the summer and in sleighs in the winter. As the mines developed and became capable of larger and more regular production, a new and enlightened era began to dawn on the industry, which gradually burst from its cloud of obscurity, and invoked the aid of machinery in lessening the expenses incident to these old-fashioned methods. It is but natural that any developments should take place along the line of the utillzation of gravity, and the arrangement which has found most general acceptance so far is the three-rail gravity tramway, which in the eyes of mine owners would appear to present marked advantages over others, judging by the frequency of its adoption. Those already constructed may be seen at the following mines: The Slocan Star, Payne, Washington, Alamo and Alpha. The arrangement differs in no particular from that ordinarily employed elsewhere. A wire rope, to which the cars are attached, passes over a drum at the upper end, being supported on the ground by wooden rollers. Switches are made at suitable intervals for the cars to pass, and the weight of the descending car filled with ore

suffices to pull up the empty on the other end, which may be loaded up to a certain limit with materials for the mine. A brake is of course attached to the drum above, and the speed can be regulated at will by the operator. It is sometimes found inconvenient to have the rope too long, and for that reason the line at the Alamo is divided into two portions, each about 3,500 feet in length, the ore being dumped down a shoot into the car below, at the junction of the sections.

Another method of transportation which is gaining favor, owing to its adoption and successful operation by the Noble Five Co. at Cody, is the bucket system or aerial ropeway. There are, as everybody is aware, many types of wire tramways, but the time at my disposal will permit of no more than a hurried reference to the one here mentioned. It is built on what is known as the Finlayson plan, and consists of two stationary ropes, on which the bucket carriers run, and an endless rope below directing the motion, attached to which are the buckets themselves. The total length of the tramway is, roughly, 6,000 feet, the supporting towers being erected at suitable intervals, varying of course with the nature of the ground passed over, amounting, in one exceptional case, to as much as 900 feet. The usual height of the towers is from 50 to 75 feet. The buckets carry from four to six hundred pounds weight, and are suspended at intervals of two hundred and fifty feet. The whole action is automatic, from the loading to the unloading of the ore, the rate of speed being controlled by powerful brakes on the drums. When run to its full capacity, over four hundred tons can be handled in a day of twenty-four hours, at an approximate expense, exclusive of wear and tear, of considerably less than twenty-five cents per ton, which contrasted with the old style is an enormous reduction

4. *Preparation of the ore for the market.*—Rough sorting is carried on underground to the extent usually of sacking the likely looking material, and keeping it distinct from what is undeniably waste. At the entrance to the tunnels as beforesaid ore sorters are stationed, who effect a more complete separation by means of an operation known in Cornwall as cobbing, which consists merely of breaking the ore on a rock bed with a small hammer, which is held in the right hand, and picking out the valuable material, which in this case is immediately sacked ready for shipment. While this arrangement has its advantages in a small mine, where sufficient ore is not available to warrant the erection of a concentrating plant, and serves to prevent what might otherwise be absolute loss on a shipment, the tedious and wasteful nature of the performance is at once apparent, and it is therefore natural to find that the richer mines and those having large reserves of low grade ore which it is impossible to convert into a shipping product by these means, have either already adopted, or intend to do so at no distant date, some form of mechanical concentrator. Four such plants are now in operation in the Slocan, namely, at the Slocan Star, Noble Five, Alamo and Washington mines, and if half those who have already announced their intention of so doing really erect concentrators, at least six more will have to be added to the number before the end of this year. Those above mentioned have all been designed and built by the same man, Mr. Thomas L. Mitchell, and consequently we shall not be surprised to find in each a degree of similarity in details of construction. Power is supplied in each case, from a Pelton water-wheel, although the water supply is occasionally found insufficient, and at rare intervals freezes, necessitating a temporary closure. At the Star a 40 H.P. engine and boiler provides against any such contingency. The heads of water obtainable at the different works are as follows. Alamo, 224 feet, Star, 471 feet, Noble Five, 562 feet; the Washington measurement I have been unable to obtain.

The ore is delivered to the mill by means of a wire ropeway at the Noble Five, while at each of the others a three-rail gravity tramway is employed.

Bins from 150 tons capacity at the Star and Noble Five, to 1,500 at the Alamo, receive the ore, which then passes over a grizzly direct to the crusher. This consists of a nine by fifteen Blake (Reliance pattern) at the Star and Noble Five, of a four by ten Blake at the Washington, and a small Comet at the Alamo.

As it would be tedious to describe each mill in detail, I will give a general description of that at the Star, which I recently had the honor of inspecting thoroughly, and explain wherein the others differ. After passing through the crusher into a receiving bin below, the ore is supplied to two sets of coarse rolls by means of an automatic cam feeder; from here it is raised through an endless elevator to a revolving screen, which separates it into four products. That passing through the smallest mesh of three *m.m.* is conveyed at once to hydraulic classifiers, which effect a separation into three parts.

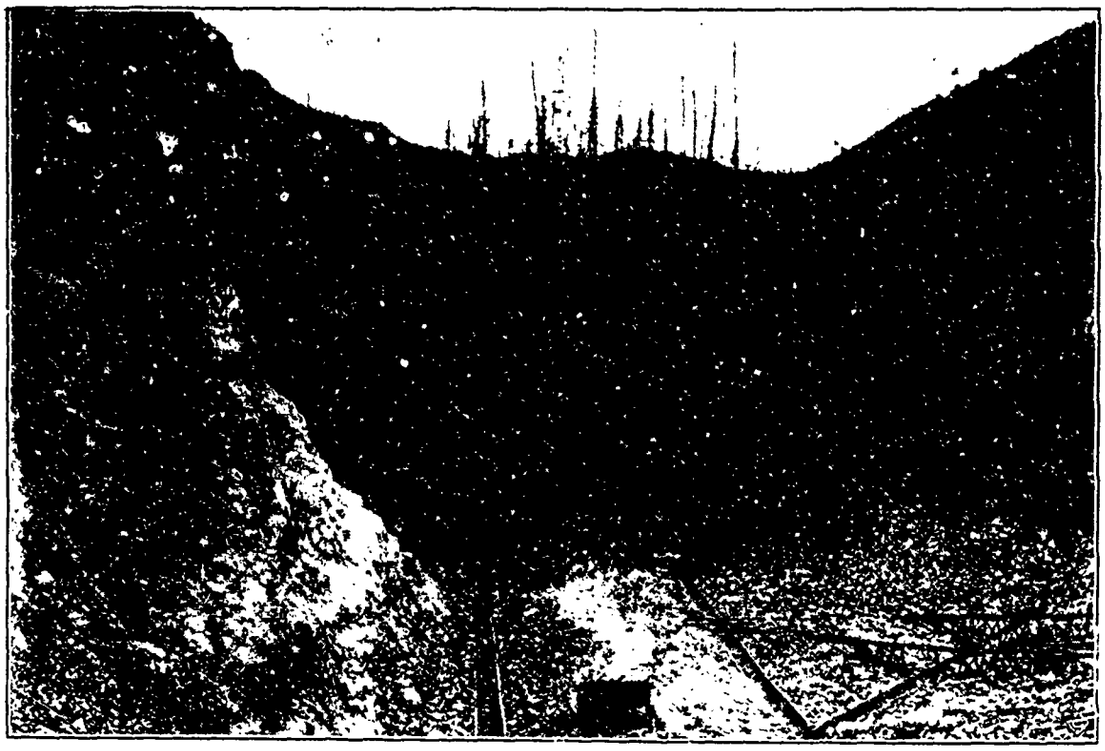
The material from here is sent direct to six Collum jigs, the overflow being carried to V shaped settling vats, which supply two double-decked slime tables of the circular type, being each eighteen feet in diameter. The other three sizes from the trommals pass respectively to two Hartz jigs. The middlings from the four coarser jigs are then put through middling rolls, and pass again to the elevator, while those from the other two go to fine rolls, and thence to elevator No. 2, from which it is delivered to the classifiers. The middlings from the Collum jigs are passed through the finest rolls, and thence to elevator No. 2 on their way to the classifiers again. The finished material is taken to bins, where it is allowed to drain thoroughly before being sacked, preparatory to shipment.

The Noble Five mill differs little in general principles from that at the Star. The one at the Washington, which gained distinction from being the first built in the Slocan, is also of somewhat the same pattern. At the Alamo a Comet crusher is employed in lieu of the Blake at the others. Another difference consists in the fact that the middlings from the jigs pass to a Huntington mill for further comminution instead of rolls. Lake Superior classifers are used and there are four double decked slime tables as against two in the newer mills. The introduction of Collum jigs as auxiliaries to the Hartz, is only to be observed in the later patterns. The Star and Noble Five mills have a daily capacity of 150 tons of crude ore for the twenty four hours, but the other two being smaller, are only designed to put through one-third of this amount.

One feature worthy of mention in view of recent controversy on the subject, is that all are situated on side hills and are carefully arranged so as to obtain the maximum assistance from gravity in transporting the ore from one operation to another.

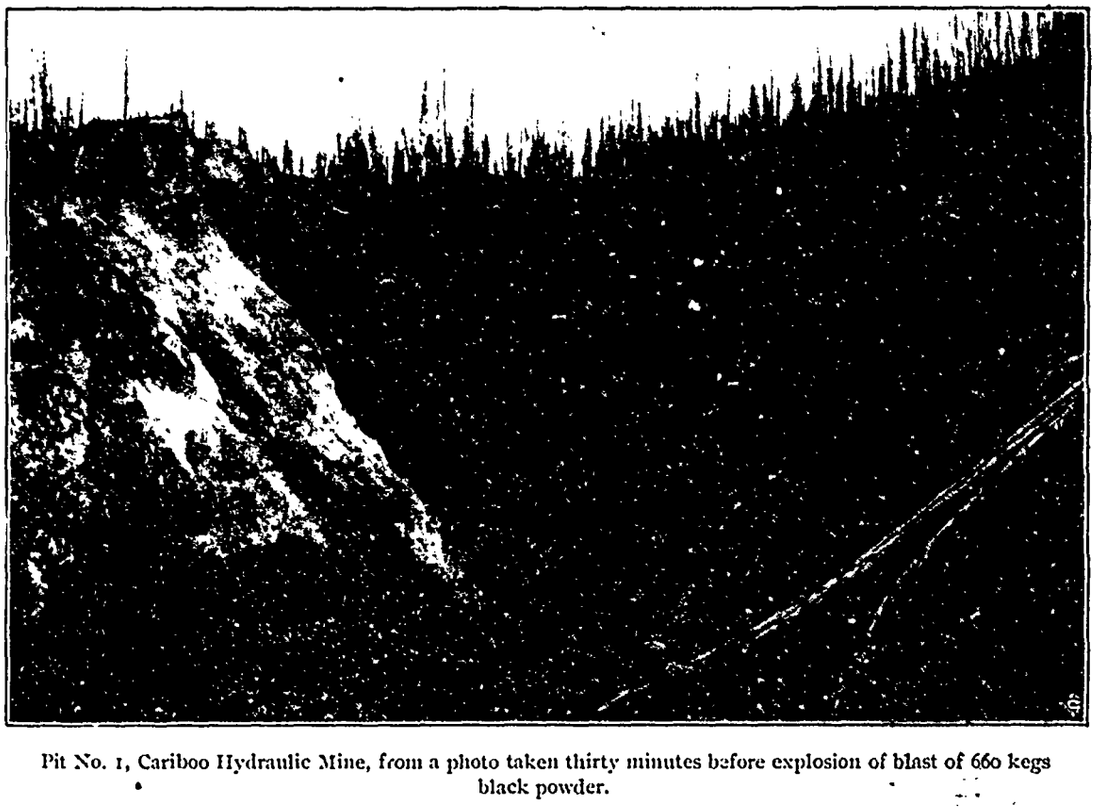
All of the concentrators work satisfactorily on the class of ore for which they are intended. There is unfortunately sometimes a lamentable though unavoidable loss of silver in the tailings, due to the fine state of subdivision and the friable nature of the associated minerals particularly certain varieties of copper and antimony. At one time the tailings from the Star were reported in the local papers to assay up to twenty-two ounces in silver, but this was doubtless exaggerated, as much of the original ore is of lower grade than this. The loss of lead is trifling and the separation from zinc-blende leaves little to be desired. The degree of perfection obtained necessarily depends largely on economic considerations, and there seems little prospect in the near future of effecting a more thorough saving in values than is done at present. The zinc in most cases would not pay for shipment even if it were in sufficient quantity, and the mills could be adapted to retain it. The flouring of the grey copper and antimonial combinations can hardly be avoided and there is a consequent loss, to recover which is next to impossible.

In order to omit nothing of interest I wish to refer incidentally in closing to the sluicing operations at the Wonderful and also to the use made of small gasoline engine at one of the mines.



Pit No. 1, Cariboo Hydraulic Mine, B.C., from a photo taken ten minutes before explosion of Bank Blast of 660 kegs of black powder, August 26th, 1897.

Photo taken five seconds after explosion of Blast, Cariboo Hydraulic Mine.



Pit No. 1, Cariboo Hydraulic Mine, from a photo taken thirty minutes before explosion of blast of 660 kegs black powder.

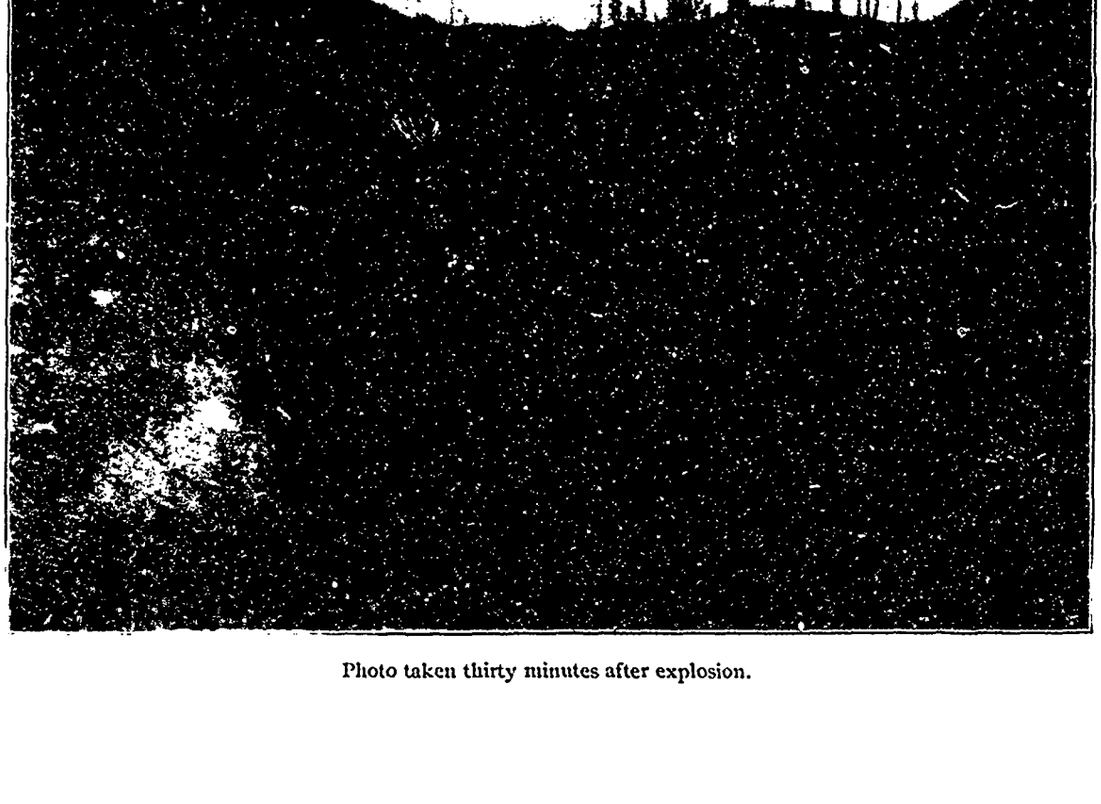
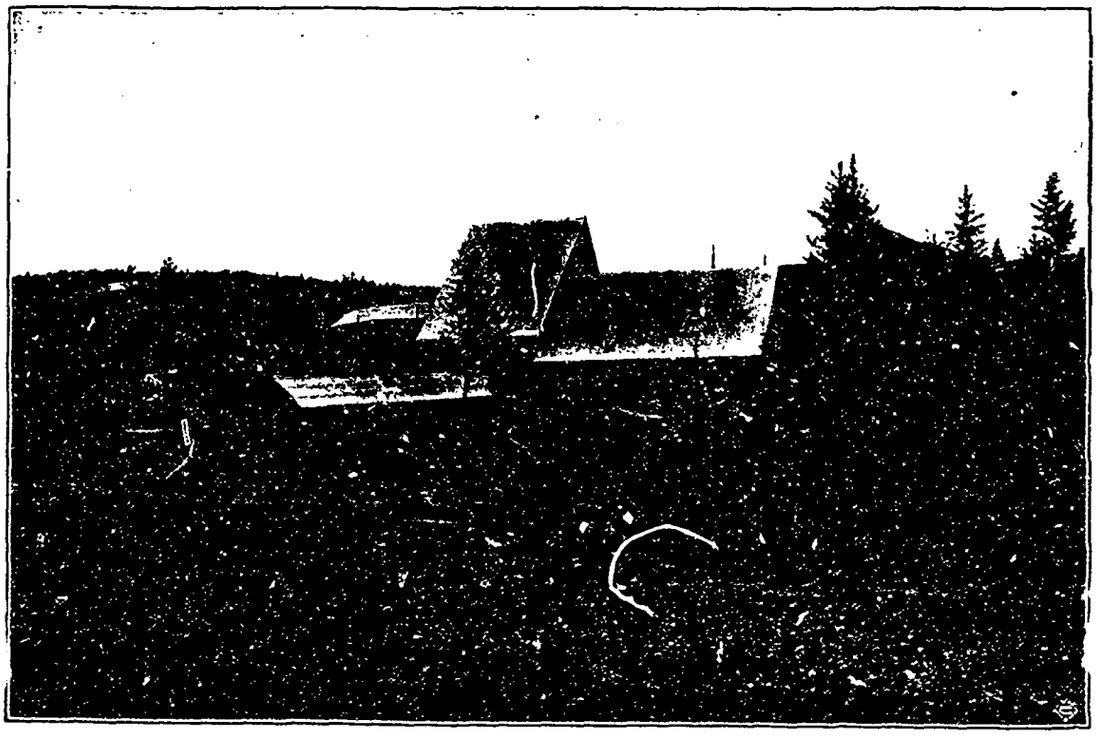
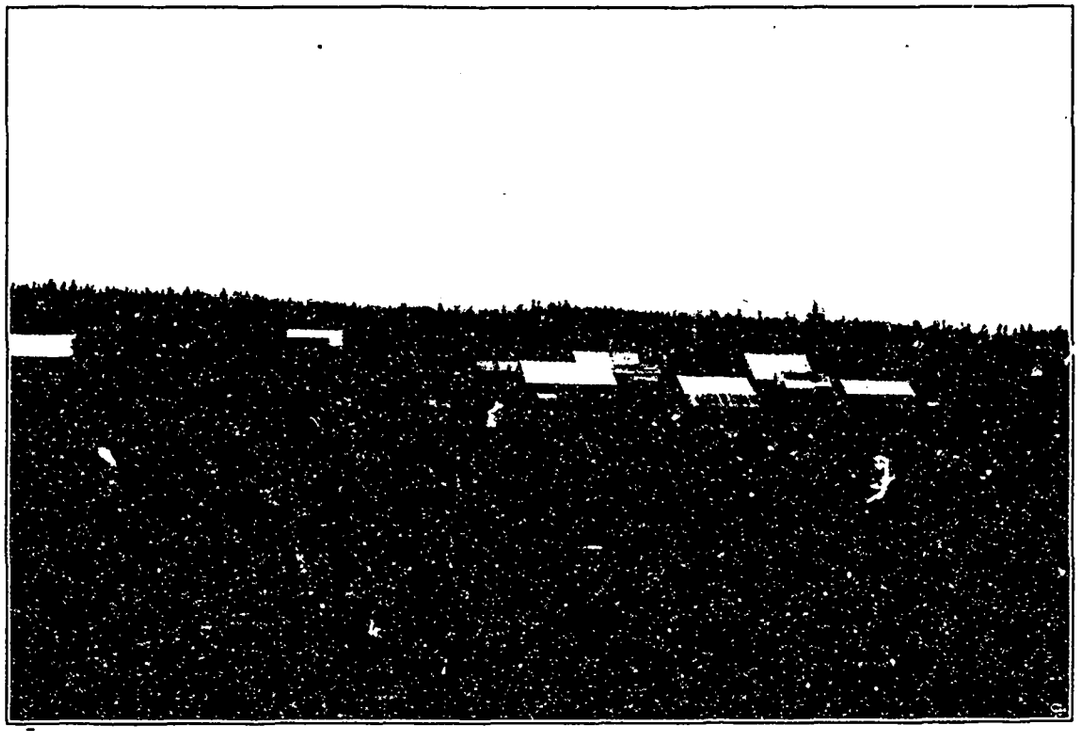


Photo taken thirty minutes after explosion.

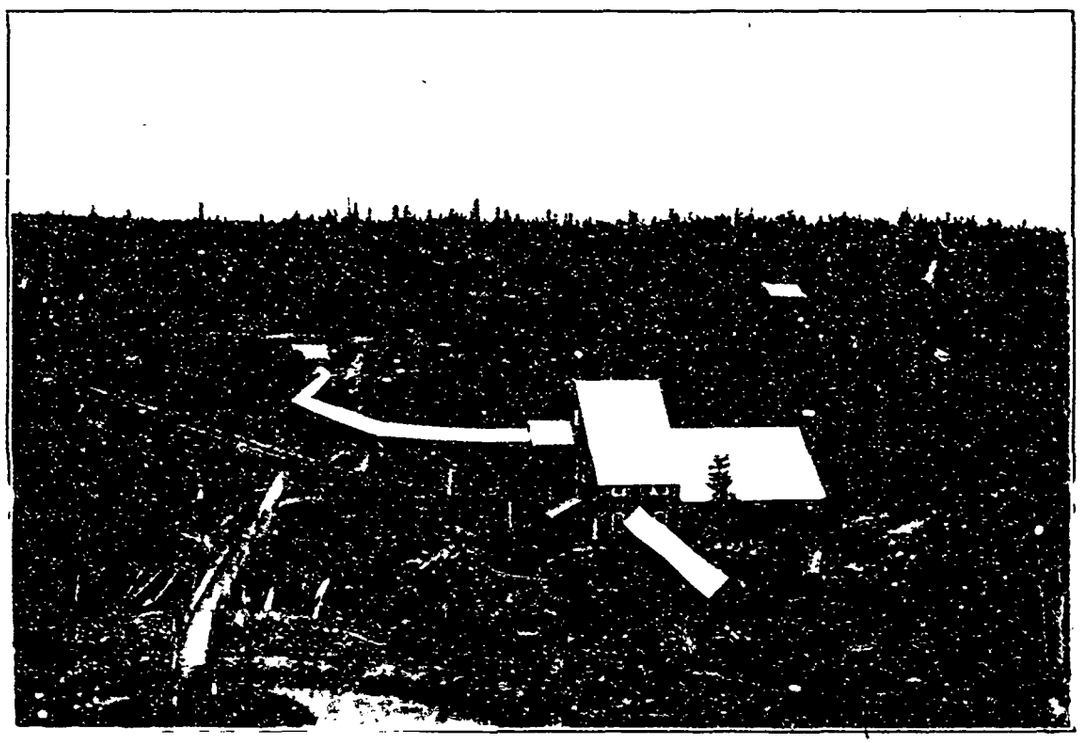
Horsefly Hydraulic Mine No. 5 Pit.



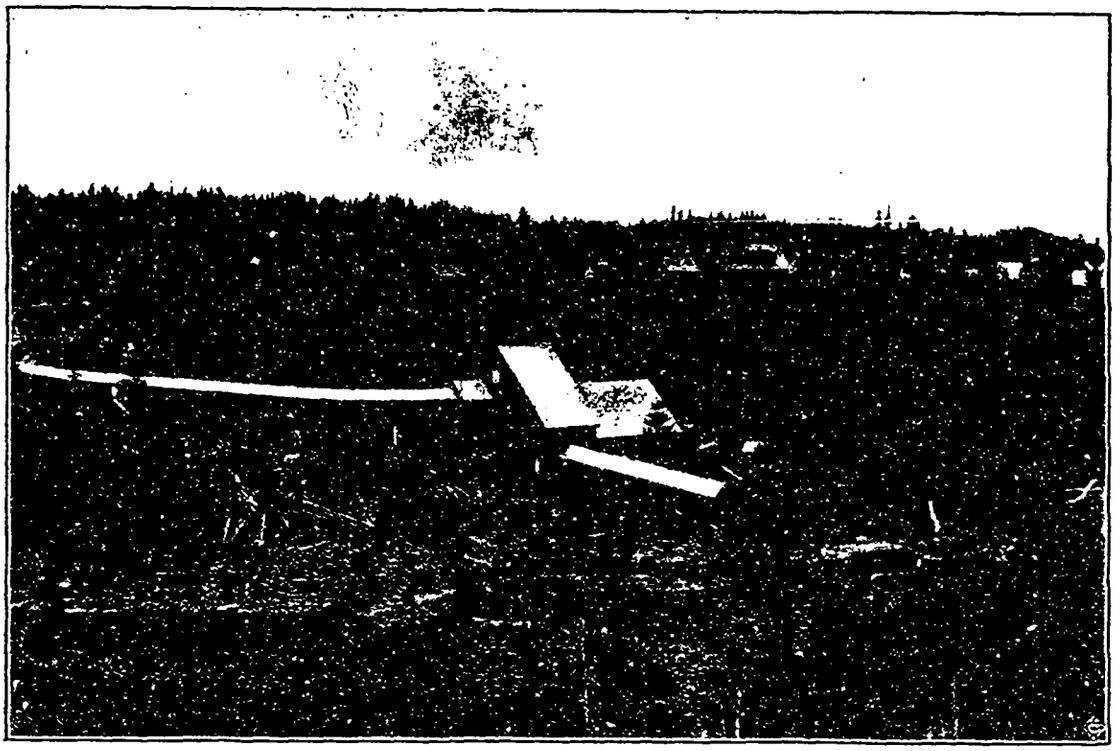
New Stamp Mill for treatment Cemented Gravels, Horsefly Mine, British Columbia.



Camp Buildings at Horsefly Hydraulic Mine, Horsefly, British Columbia.

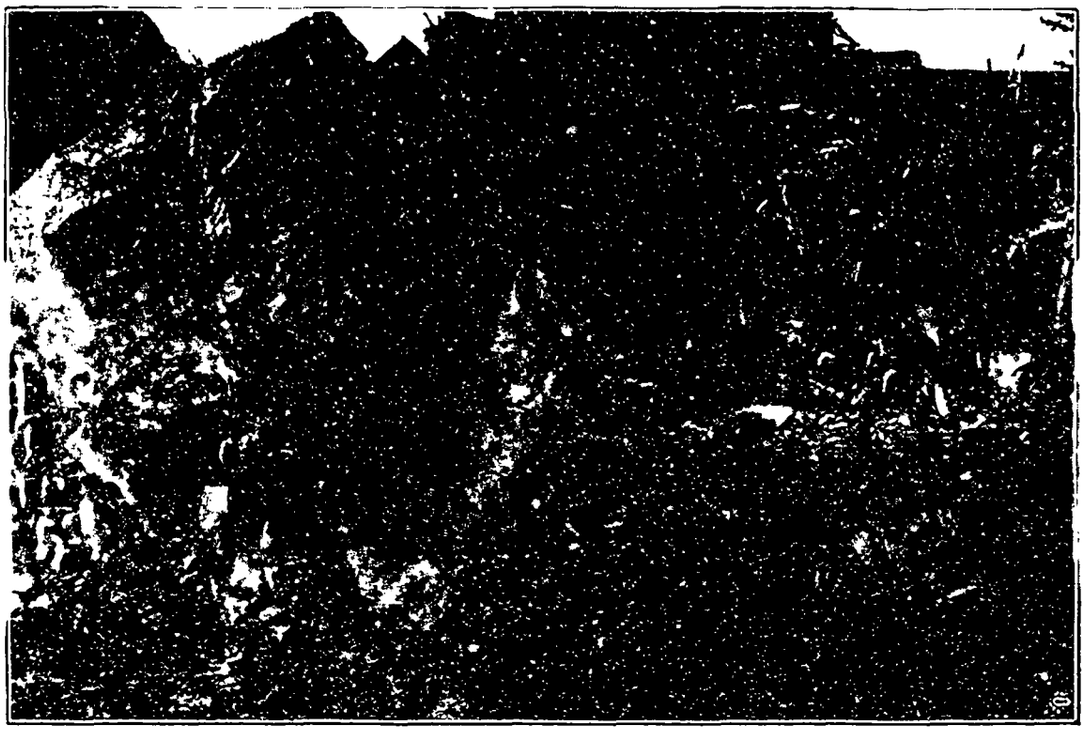


Ten-stamp Water Power Cement Mill, Sluices and Cut Pit No. 1, Horsefly Hydraulic Mine.

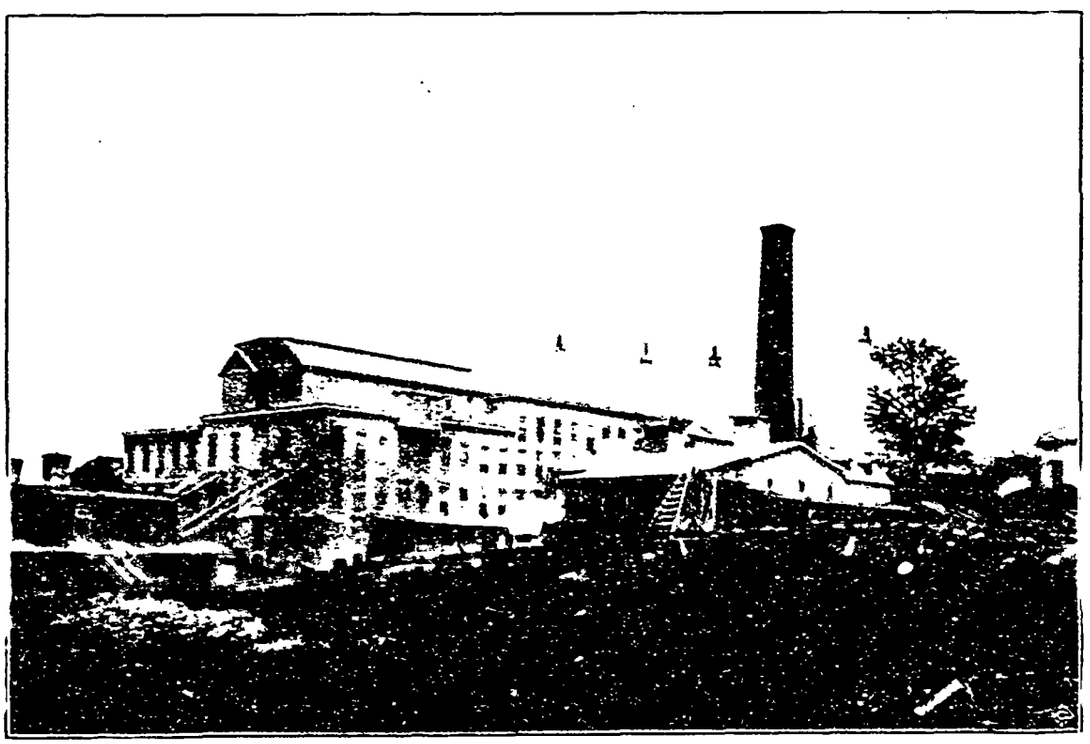


Ten-stamp, water-driven, Battery for treatment Cemented Gravels, Horsefly Mine, B.C.

Photo showing Horsefly River (B.C.) above the Mill, Horsefly Mine.

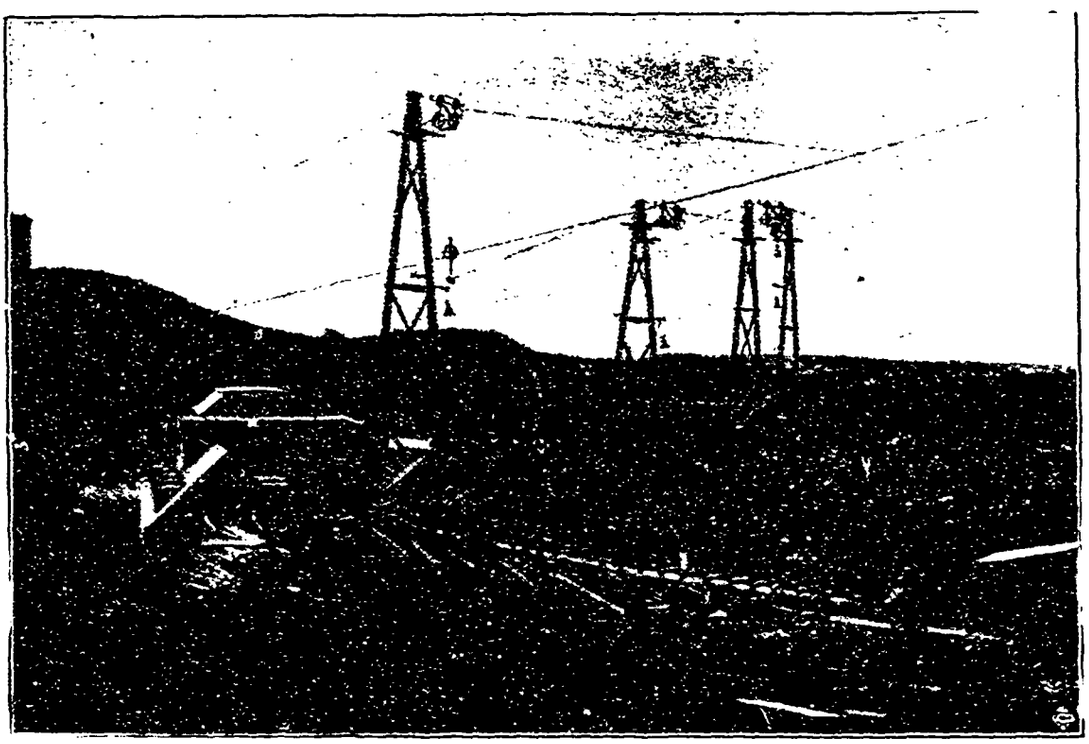


Interior of Main Pit at Danville, Que., operated by the Asbestos and Asbestic Co. Limited.

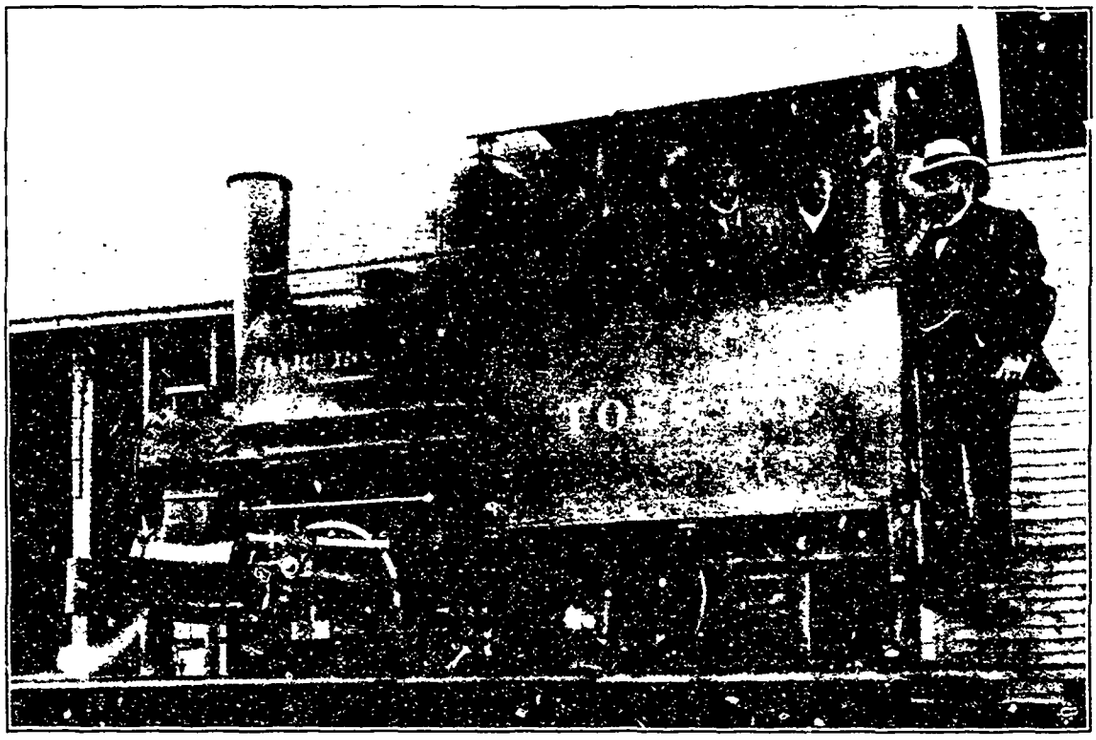


Factory at Danville, Que., for treatment of Asbestos and Asbestic.

Surface Works at Danville, Que., operated by the Asbestos and Asbestic Co. Limited.



Another view of Surface Works at Danville, Que., operated by the Asbestos and Asbestic Co. Limited.



Mine Locomotive "Tos & Tic" at Danville Asbestos Mine.

Mr. Gilbert Bartholemew, Chairman.
Mr. Henry Hayman, Director.
Mr. K. H. Martin, Director.
Mr. Feodor Boas, Man. Director.

In the former instance as many are aware, regular sluicing operations have been carried on, with the result that a large amount of galena in the shape of rocks and small boulders has been recovered from the loose overlying deposit and shipped to the smelter.

At the Payne which is now by far the largest producer in the Slocan, a gasolene engine is regularly employed to work a small crusher which renders rough ore sampling comparatively easy. That engines of this type will receive more general attention from mine owners when the large number of uses to which they can be put are thoroughly understood, goes I think, without saying.

I should not be doing my duty if I allowed this opportunity to pass without some reference to the demands of the Slocan Lake section of the country. Here is found a large variety of ores the majority of which are palpably adapted to local treatment in preference to smelting. The introduction of properly designed mills, the suitability of which for the purpose having been fully established beforehand, would give a tremendous impetus to the mining industry and largely increase the present output. Here is an opportunity for eastern manufacturers to come to the front, and demonstrate beyond a doubt that these ores can be economically handled right at the mines; great caution is necessary more especially, in the details of design and construction to insure success, but I am confident that no difficulties are of an insurmountable nature, and I therefore respectfully submit this for the consideration of all interested in the future welfare of the country, whether financially or professionally.

In concluding, I hardly feel it incumbent upon me to apologise for the manifold shortcomings and possible errors which may have crept into my paper unobserved. I have tried to avoid doubtful statements as much as possible, but our worthy Secretary will bear me out when I say that I have contributed this under difficulties and was only persuaded to make the effort on the assurance that any minor slips would be pardoned

That the Slocan is destined to become a marvellous producer of the precious metals under more favorable conditions, greater even than present returns appear to warrant, no one who has thoroughly examined the district will venture to deny. The responsibility which devolves upon the engineer in the matter, is manifestly proportional to the greatness of the industry and it therefore behooves investors to use the greatest care in the selection of the men who are to help build up and control the staple industry of our western province.

Some West Kootenay Ore Bodies.

By J. C. GWILLIM, Slocan City, B.C.

(Read before the January meeting of the B C Association of M.E. Discussion March meeting Federated Canadian Mining Institute.)

The object of writing this paper is to offer some observations upon West Kootenay ore bodies in general and some in particular. Some of the chief types of ore bodies as so far explored have been already dealt with by officers of the Dominion and Provincial governments in their annual reports. So that there is little more to be said about them at present, and they will not be referred to at length.

Neither will any new and particular theories of ore genesis be offered. Always bearing in mind that passage in Kemp on "Ore Deposits" which reads:

"It is, however, true that among the subjects on which, human "imagination, often superstitious, has run to wild extremes, and on "which cranky dreamers have exercised their wits, the origin of ore "deposits stands out in particularly strong relief."

The productive nature of this district is shown by these rough values for the last five years, including 1897: $300,000; $800,000; $2,200,000; $4,500,000; $8,300,000.

The ores which produced these values are of three main classes. The argentiferous galenas of Slocan—Kaslo and Ainsworth primarily; The pyrrhotite copper gold ores of Trail Creek secondly; and the silicious dry ores of gold and silver which are more especially found in southern Slocan and Nelson divisions, but which also occur as subsidiary ore bodies in every mining division of the district. Another large contributor is the Silver King with its copper-silver ore; this, however, is a somewhat unique deposit as far as productiveness is concerned.

These principal ores are not confined entirely to certain areas, but each has its own chief centre and its particular characteristics in form and value.

In considering the galena ores one may begin with those of the Ainsworth division as these, in 1883, were the first to cause attention. They occur chiefly in a narrow strip of schistose rocks and slates which run along the west shore of Kootenay Lake and extend backwards into the mountains from one to four miles, where they form a contact with the great granite mass which lies between Kootenay and Slocan lakes.

Along this narrow strip there are many rich ore bodies, both galena and dry ores of silver. The galena itself is not of as high grade as that of the Slocan, whilst the dry ores of pyrite, argentite and native silver in the same vicinity are often exceptionally rich. These ore bodies appear to have formed usually in fissures and shatter zones which strike most often in the same direction as the country rock, which here runs north and south. The country rock is composed of wide bands of green and grey schists, products of volcanic action, and argillites and limestones. Across the lake in an older series of banded rocks very large exposures of low grade galena have been found Excepting that of the Blue Bell, none of these are much developed. Going north from Ainsworth, the productive galena bearing zone recedes to the westward and is chiefly concentrated about the upper waters of Kaslo Creek and Carpenter Creek, near the summits of the range.

There appears to be little doubt of the true fissure origin of those Slocan veins. They have fairly direct courses with a general tendency to striking north-easterly. The veins cross the slates and limestones and also certain sets of dykes. The walls are free, with a small amount of gangue as a rule, and the dips are at high angles. No faulting of much account has occurred since the filling of these veins. Occasional dykes interfere. These, at times, appear to have some effect in causing local mineralization; they cause very little displacement.

The gangue matter is a true secondary deposit, derived in part from the broken walls, and chiefly from limey and siliceous solutions, together with a considerable amount of spathic iron and some barite.

The spathic iron and galena are at times banded, but more usually there is a patchy mixture of all the constituents of the vein, at the same time the galena is chiefly concentrated along one or other of the walls. This is especially true of the variety "steel galena" which may often be seen bearing the slicken-side marks of movement on the vein walls. Such may be seen in the White Water, Idaho and Enterprise. The best illustration of a clay seam seen in this section is at the White Water. Here, on a well worn foot-wall of 45° dip may be seen a thin parting of clay, then upon this a regular band or slab of dark dull steel galena of about one foot thickness. This clean and smooth, over this comes a foot of stiff blue clay containing fragments of wall rock and galena. Above this again is a second vein of mixed quartz, spathic iron, and patches of a bright crystallized galena. This brighter galena is said to be the richest. It contains a little grey copper and some dense fine grained zinc blende.

The country rock is composed here of soft finely laminated slates containing very little lime.

An analysis of such found in the Wellington, which lies near by, gives:

Si O_2=49.57; Mg O=3.22; Fe 2 O_3=8.74; Al 2 O_3=24.64; Ca O=0.47.

This mass of slate which abuts a serpentine mass immediately to the north shows signs of a slow movement, at the present time, and is full of minor faulting planes with cousiderable selvage clay.

Whilst mentioning this White Water section something may be said of the numerous quartz bodies here met with. These ramify the slates as small segregated stringers and sometimes crop out in wide bodies of a character somewhat like those gold bearing quartz veins of southern Slocan. These, however, have so far been found to be very barren. So far as explored none of the galena veins have been followed into the granite which bounds this area of slates, nor has any change of country rock or ore which amounts to much been observed in the deepest levels yet gained, none of which exceed 750 feet.

Although the galena ore bodies are, as a rule, regular, there is a distinct localization of the valuable ore. This forms shutes which follow pretty much on the dip. They vary greatly in width. That of the Payne being the widest so far found; intermediate portions of the vein are but poorly mineralized.

Beyond the limits of the Slocan area of slates very few veins of wet ore are found. Those which occur, such as some on Ten Mile Creek, as the Enterprise, and on Kokanee Lake, as the Molly Gibson group, show exceptional richness and promise. These veins are of true fissure origin. They dip at high angles, and have a gangue matter chiefly of quartz and calcite, with the ore well collected along the walls. In these veins there usually appears to be some richer constituent than the galena. At times this is carried in the associated zinc blende, and also in the cleavage planes of the galena, as argentite or other sulphide of silver.

The much criticized Two Friends mine on Springer Creek carries a very high grade of galena, more especially localized in the neighborhood of an interfering mica trap dyke. Some experiments made with this galena gave the following results, assays being all from one hand specimen piece:—

1. Picked small cubes with a greenish stain or crust upon them..... Ag.=335. oz.
2. 80 mesh siftings from coarsely crushed ore of pea size..... Ag.=298. oz.
3. Picked granular or wavy galena.. Ag =231. oz.
4. Picked cubes brushed and clean.. Ag.=181. oz.
5. Coarse remainder of above, which would not go through a 40 mesh sieve..... Ag.=176. oz.

These results seem to point to some rich interstitial matter, and are borne out by the visible occurrence of a dark dull matter which is adherent to some of the cube faces of the galena.

It may here be said that the chief producer of value in West Kootenay is the silver-lead galena ore of Slocan—Kaslo and Ainsworth. It is greater than that of all the other ores combined.

While speaking of the galena ores it becomes necessary to take into account those large deposits of the Lardeau country which has, so far, produced very little owing to want of roads.

This district was visited by Mr. Carlyle during the past summer. His report will probably be out before this paper is read, and will anticipate the remarks made here to some extent.

This district has been in the waiting stage of mining for several years. A good deal of development has been done but very little shipping.

The ore bodies, both galena and dry ores, show a considerable conformity to the strike of the country rocks. In many cases they follow contact lines. Certain bands of rock appear to influence the mineralization. The strike and dip of these rocks are wonderfully regular. The former is north-west and the latter in crossing from the Silver Cup to the head of Gainer Creek, some ten miles north-east changes from 20° N.E. to 15° S.W., the valley of the south fork of Lardeau being between these points.

Very large bodies of clean and concentrating galena occur on the upper branches of the Lardeau River, and also smaller ore bodies of mixed galena, zinc blende and grey copper, these last being usually of high grade, whilst much of the heavier galenas are not as high grade as in Slocan; they are more varied in value and depend a great deal upon the amount of grey copper present. There is also a higher gold value than in Slocan galenas. Mr. Jamieson, late engineer of the L. & F. R. Gold Fields Co., writes of the Alpha as being a true vein some 45 feet wide, of quartz containing galena, having a slate foot wall and serpentine hanging wall. There is, however, a contact of much greater magnitude in the matter of ore production. This is the great band of limestone, locally known as the "Lime Dyke," which cuts across the country between the upper waters of the Lardeau and Duncan rivers.

This consists of a massive limestone which rises at times 500 feet above the more broken down schists and pitches under them at a dip of 15° from the vertical to the south-west, the strike being N 65° W. Along this "lime dyke" are located many of the principal groups of claims, such as the Abbot, Black Prince, Bad Shot and Glengarry, some of which are massive galena bodies and some high grade grey copper and zinc ores with a well crystallized calcite gangue.

Some of these ore bodies are on one side and some on the other of the limestone, which is a few hundred feet thick, also some follow the contact and some dip into and across the limestone, then forming lenticular masses of high grade ore connected by stringers. In these there do not appear to be free walls, the ore being cemented more or less to the country rock. Ore bodies of like character in schists and limestones somewhat similar occur east of Kootenay Lake.

So much has been said of the copper gold ores of this district that little need be said here, the most accepted theory of their nature is that of replacement of the country rock along the course of fissures. Sometimes the mineralization appears to be concentrated about apparently interfering dykes, as is the case with some galenas in this district

Here as elsewhere certain characteristic ores are much confined to certain rocks. An analysis made upon a prevalent fine grained grey rock found in the tunnels gives:—

Si O_2=49.16; Ca O 13.60; Mg O 9.15; Fe2 O_3=10.13; Al2 O_3=16.27.

Going westwards, there are many changes in the rock, but upon Big Sheep Creek, at the Velvet, ore bodies of the same apparent origin occur. That is to say there is a main seam, or fissure, along which massive ore is concentrated together with a zone of partially replaced country rock, there being no vein filling as ordinarily understood This ore is chiefly copper pyrites, the pyrrhotite being less evident in this section. The soft green grey country rock containing this ore gives on analysis:—

Si O_2 62.62; Al2 O_3 20.26; Fe2 O_3 5.75; Mg O 3.60.

A second series of quartz veins occurs in this section, they appear to cut some of the more basic deposits.

Concerning the third class of silicious dry ores these have been studied in more detail than the foregoing, especially those which occur in the main granite mass which lies between Kootenay and Slocan lakes. The silicious dry ores of West Kootenay are represented very

widely. So far, they have not been mined to any great extent, and many expensive experiments have somewhat discouraged investment; when they are properly understood they will become an important factor as producers. Amongst such ore bodies are the O. K., Fern, and Poorman, the dry ores of Slocan granites, and some of the Ymir section.

In these the values are gold and silver, some as the native metal, and some freed by oxidation, also in auriferous copper and iron pyrites, grey copper and argentite. These veins usually vary much in width, seldom exceeding six feet. The strike has no general tendency and the dip appears to be more or less inclined, according to the district. There are many dipping at angles of under 45°; this low inclination is often attributed to a process known as "breaking over," a somewhat complicated arrangement, considering the nature of the rocks in which they occur.

In these ore bodies the valuable portions are concentrated into shutes and pockets; considerable care and experience is necessary in order to sort out ore which will pay to ship—or $75 to $100 rock. When the whole quartz body can be treated by some milling process yet to be devised, a large field of operations will be opened up, for the veins are very numerous in some sections.

In the section of country drained by Twelve Mile, Springer and Lemon Creeks, there is a very peculiar and characteristic ore body. This is composed of a coarsely crystallized quartz from a few inches, and sometimes a seam only, to five feet wide. At the surface these veins usually dip less than 40° from the horizon. No depth as yet gained—about 100 ft.—has proved them to become more nearly vertical.

Many small displacements have taken place along cross faulting planes. As far as seen the ore body always leaves a continuity either along a fault plane, or along a seam where only a thin streak of selvage exists. It has been said that these are segregation veins pinching out into solid wall rock. This also lacks confirmation.

The values are contained in pyrites, argentite, oxides of iron, and free gold and silver. The gold value which is as 1 to 5 of silver north of Springer Creek changes to equal values along the north slopes of Lemon Creek, and further south still, as at the Alpine, Black Prince and Maple Leaf, the gold is chief and the silver unimportant. Along the walls of these veins the dark grey granites have been altered serietic and kaolinized matter. At times there is a free wall and selvage matter, and at times the quartz is apparently cemented to the granite. As both these conditions occur on the same wall within a few feet of one another, it becomes rather puzzling to explain the matter, however, on gaining depth to the undecomposed portions of the vein the walls are much more free and definite, the "frozen" walls being due in a great extent to a cementing of the wall rock owing to decomposition; there is not much evidence of movement upon the walls. The whole granite mass shows signs, under the microscope, of great strain and crushing. At times there is a well defined comb structure in central portions of the vein, this cavity is usually filled with a frangible, somewhat granular pyrites, in some cases marcasite. The iron is rarely well crystallized, it occupies interstices and is penetrated by large and well formed quartz crystals. Argentite occurs in little wedge-like bunches fixed in the spaces between quartz crystals, more especially within the zone of decomposition, which extends to some 25 feet in. Below this point the gold and argentite occur in a very finely divided state associated and intermixed with the iron.

There is a concentration of value in the oxidized portions. It is not often greater than that which may be expected to result on the decomposition of pyrites into oxide of iron. The ore, both pyritous and oxidized, varies very greatly in value without any visible change in appearance. Pyrites within five feet of one another may go $5 and $150 respectively.

On the oxidation of the pyrites there is a collection of the freed gold; it appears as visible pin points and scales which do not pass through the sieves. Something of the same kind appears to take place with the argentite, causing the malleable crystals to form. However, as the mineralization of these veins varies so much it may be only a coincidence which makes this appear so. Concerning the many minor ore bodies now being developed, very little has been done. There are some very interesting associations of the richer silver ores with silicious flint-like gangue matter; and some in connection with a system of dykes which traverse this granite area. These will speak for themselves bye and bye.

For the analysis of the country rocks I am indebted to Mr. W. S. Johnson, who is now making some further experiments upon the dry ores of this district.

Notes on the Albertite of New Brunswick.

By JOHN RUTHERFORD, M.E., Windsor, N.S.

(Paper to be discussed at the next meetings of the Federated Canadian Mining Institute.)

Over forty years ago, much interest was aroused over a dispute as to the character of a mineral found in the carboniferous formation in New Brunswick. There was also some doubt as to its relationship to the series of rocks forming the lower division of the coal measures.

One peculiarity was its position in a considerable deposit of calcareo bituminous shales, which shales contained much bituminous matter; but a still greater peculiarity was the mineral itself. So much did it differ in its characteristics from ordinary bituminous or anthracite coal, that the point in dispute, arising from a question of ownership, was whether it was a true coal or asphaltum.

It is needless to dwell on the strong opinions expressed by able experts on each side, in support of their respective views; the trial is a *cause celebre* in the mining world, and to this day there is probably a remnant of difference of opinion. Perhaps the latest decision is that given by Professor Bailey and Dr. Ells, of the Geological Survey of Canada, who, in 1886-7, reported fully on the mineral and the geological structure of the locality in which it was found and expressed their opinion in the following words: The albertite "is in no sense a true coal, but rather an oxidized hydro-carbon, related to, though not identical with asphalt, and at one time existing like petroleum, in a condition of partial or complete fluidity."

The position of the albertite in the shales is another peculiarity, which has given rise to diversity of opinion with respect to its origin. By some it was maintained that the enclosing rocks constitute a true bed and roof, although tilted into a nearly vertical position, and indicated an original horizontal deposition, as of ordinary coal seams. By others the space occupied by the mineral was considered to be a fissure, caused by the elevation and general disturbance of the strata, and subsequently filled with the albertite when in a fluid condition. It is specially in connection with this last named supposition that the following description of the result of the mining operations at the Albert mine is given. The writer visited the mine and went through the workings when it was in fairly active operation. Later, in 1881, he was requested to make a thorough examination of the then condition of the mine, and to report on the expediency, or otherwise, of a further continuance of the explorations then being made. The facts of position were so clearly brought out by the examination, that an adverse report was handed to the board of directors, and shortly after all operations were brought to an end. The writer is thus in posses-

sion of information that may be of interest to those who still hold undecided views on the manner of deposit.

Mention has been made of the bituminous shales in which the albertite is embedded. Apart from their strong impregnation with bituminous matter, and an abundance of fossil fishes in the shales, the evidence of great disturbance is very striking, not only in the anticlinal form of the strata, but also in the folded structure of the beds, and the polished slickensided appearance of the rock in many places.

Another feature to be noticed is the somewhat limited extent superficially of the Albert shales; for, although shales of the same character are found in other localities, some distant from the Albert mine from five to eight miles in an easterly direction, the exposed extent of the shales at the mine is only about 250 acres.

The sketch map No. 1, enlarged from the map of Bailey and Ells, shows the superficial extent of the Albert shales, and the diversity of dips they exhibit. The area of the shales is bounded on the north-east and south by the underlying conglomerate rocks, but at the west end they abut against a superficial termination of an extensive high range of pre-silurian rocks. Having thus as briefly as possible outlined the geological position of the mineral, some details will now be given relative to its form as developed in the course of mining. The general course of the vein from end to end is N.E; its direction is crosswise with respect to the strike of the shales, their dip at the west end of the mine being to the S.W., and at the east end a little south of east. It is almost vertical in some parts of the mine; the general inclination of the dip is, however, to the south. The thickness of the vein varied considerably throughout the entire range of the workings, from a few inches to eighteen feet; and these changes were of frequent occurrence. The extent of the workings in an east and west direction is about 1,000 yards; the lowest level is at a depth of 1382 feet from the surface. From this level, in consequence of the thinning out of the vein and the passing through a considerable space of barren rock and impure coal, several exploring holes were sunk to the dip the results of which will be given.

Plan No. 2 shows the actual position and shape of some of the interruptions met with in the course of mining. It does not, of course, show every interruption of this kind, but at the west end of the mine two characteristic shapes will be observed, the massive form in one case, and the peculiar isolated shape of the other, these last being apparently detached fissures. The irregularities in the thickness of the vein, and the occasional barren spaces were notable at an early period of the mining operations, and became more frequent as the openings were driven at greater depths. In the 980 foot level, *i.e.*, 980 feet from the surface, the opening to the west of the west shaft passed through a series of nips, as they were termed, meaning thereby spaces occupied by the shales, which in a horizontal respect would represent a succession of somewhat parallel gashes, varying in width and length, and in some cases running to a point at each end. Even from the surface nips have been traced to their termination at a considerable depth. Another feature in the lower levels was the increased extent of impurity of the vein, caused by an admixture of shale, and the position of the albertite in a pure state, only in what are termed pockets.

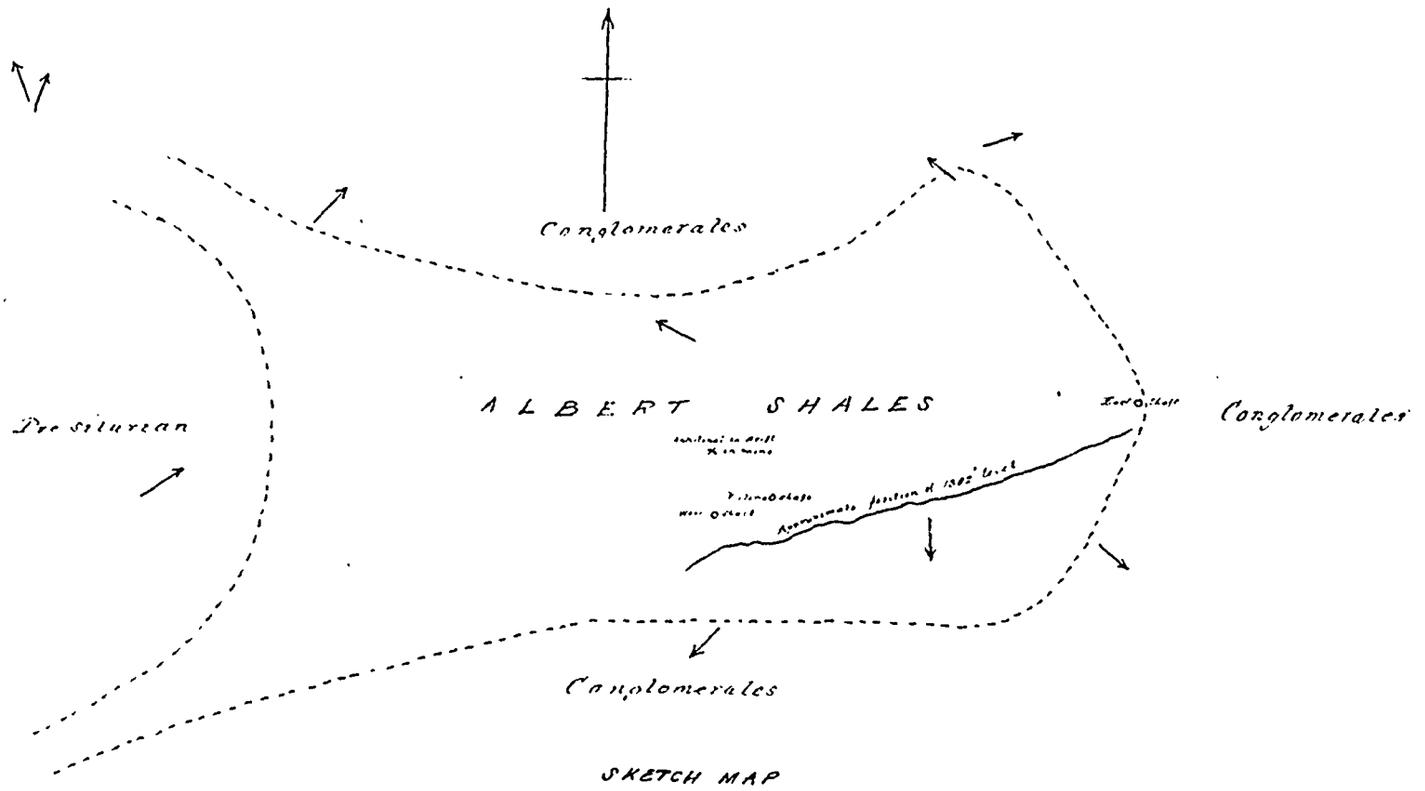
An increase in all these circumstances seemed to be so indicative of an approaching termination of the deposit in a descending direction that the explorations now to be described were undertaken in order to arrive at a decision in this respect. Down to a depth of 675 feet the yield of coal was pretty uniform; at that depth the length of the level worked was 2,085 feet, and on that distance there were nips of barren ground aggregating 102 feet in length, thus reducing the productive ground to 1,983 feet. Each foot in height, in this distance, yielded 289½ tons of coal. A steady reduction in yield was found as the depth worked increased, until, in the lowest level, 1,382 feet from the surface, in a distance of 2,954 feet, two-thirds of that length was occupied by nips and the yield of coal fell to 58½ tons per foot in height. It seemed evident, therefore, that the coal was being exhausted, and in order to test this apprehension several openings were made below the 1,382 feet level at the east end of the mine. These explorations were openings large enough to allow a man to work in, and were sunk to various depths over a distance of 1,200 feet in a westerly direction from the east shaft; the result was as follows: In these holes the coal was either cut off entirely or so reduced in size as to be unworkable. The depth sunk varied from 5 to 210 feet. In one hole the thickness of the vein was reduced to 9 inches, in another to 6 inches, in another to 4 inches, and in the deepest—210 feet—a thickness of coal of 2 feet in the level fell, with variable thickness, to 12 inches and then to a mere leader, which terminated in totally barren rock. This variation in the thickness of the vein, which was so general, is exemplified in the 210 feet hole. The thickness in the level, as stated, was 24 inches; at 36 feet down it was 42 inches, at 53 feet it averaged only 9 inches, at a depth of 97 feet it increased to 24 inches, and at 113 feet it was reduced and terminated as stated. These explorations were therefore considered confirmatory of the exhaustion of the vein.

The indications at each extremity of the workings still further strengthened this opinion. At the west shaft a drift was driven to the north, from the vein in the 1,162 feet level, 700 feet. This was entirely in hard shale and no coal was found. Westward from the end of workable coal, in the same level, a drift was driven 400 feet, terminating in soft shale and sandstone. At the east end an exploratory drift was driven eastward 600 feet from the shaft, and cross drifts to the north and south out of it, covering a space between the extremities of over 700 feet. These also were in shale and sandstone, and equally unsuccessful in finding any coal. The accompanying plans will, it is hoped, aid in realizing not only the position of the vein in the shales superficially, but also the peculiar interruptions of which mention has been made. Attention may be drawn in the first instance to the sketch map No. 1, which shows the oblique course of the vein in relation to the strike of the shales and the axis of their anticlinal position.

In plan No. 2 the section is given from the surface in order to show at what an early stage in the operations the nips were met with; one of about 50 feet in thickness was found to extend to a vertical depth of 800 feet. In connection with these nips attention may also be drawn to the parallelism of direction that prevails. Whether their course has its starting point from the lower end of the deposit, as regarded in a vertical position, or if it be assumed that some had their origination at the upper end, it is evident their bent has been imparted by some operating force on the west side, derived in all probability from the mass of metamorphic rocks at the west end of the shales and against which they abut. A brief description of the mode of working this peculiar mineral, in all respects, will be of interest. The method pursued in opening at an additional depth was to sink a hole from the working level—say 100 feet; out of this hole, midway between the upper and lower levels, drifts were turned away and driven a short distance east and west, the hole and the drifts being well timbered. A chain was then suspended in the hole from top to bottom, and the hole was then filled with coal. This part of the work was generally done before the shaft was sunk to the depth at which the level was to be driven. When the shaft level reached the hole, the chain was worked up and down by a lever to loosen the coal, which, when taken out, left the hole free for an air-way and for working the mid drifts.

It may be noteworthy to add to this record of so interesting a mineral, that 54 cubic feet produced a ton of 2,240 lbs.; that it yielded 15,000 cubic feet of 64-candle gas to the ton, and that the price ob-

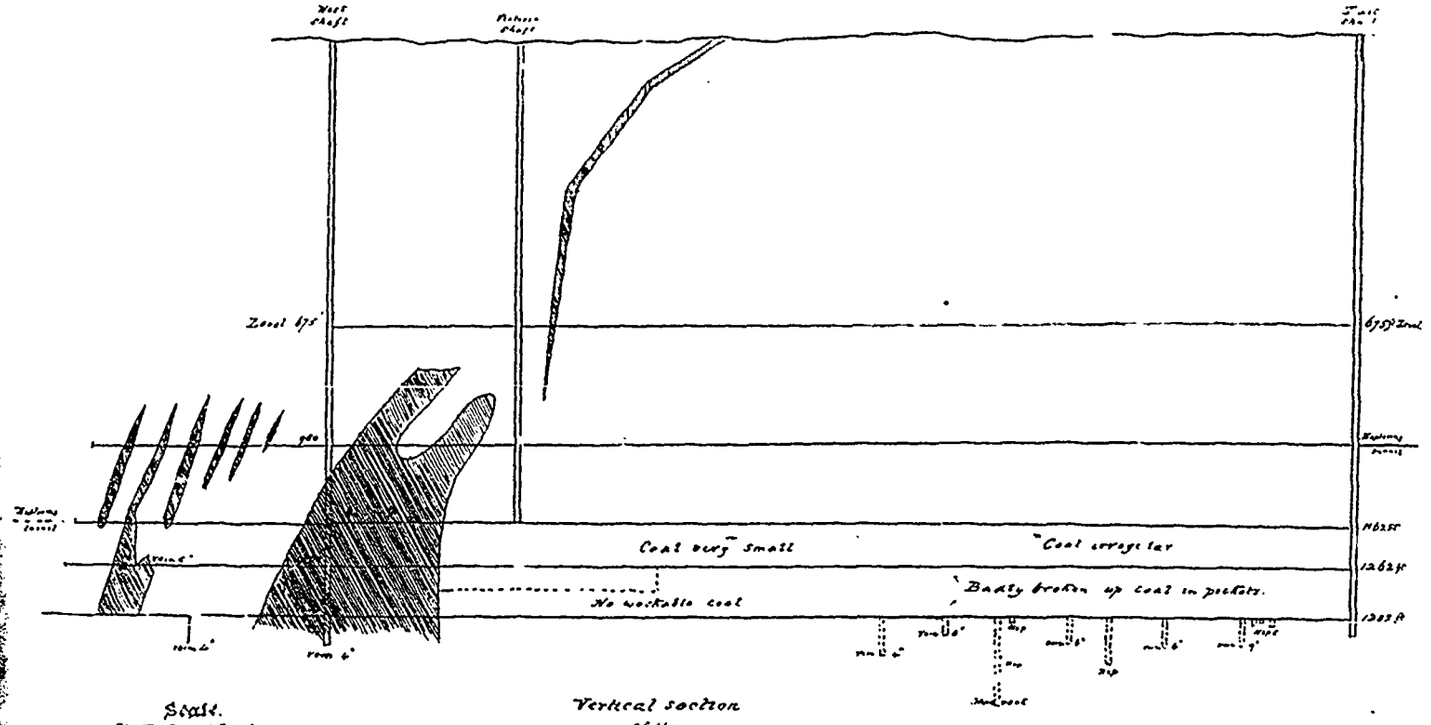
PLAN No. 1.



SKETCH MAP
showing position of the
ALBERT SHALES
and course of ALBERTITE
in the
ALBERT MINE, N.B.

Scale
10 Chains = 1 Inch.

PLAN No 2.



Scale.
300 Feet = 1 Inch

Vertical section
of the
ALBERTITE WORKINGS
in the
ALBERT MINE, N.B

tained during the course of years the mine was in operation, ran from $10 to $15 and $21 per ton—$18 being steadily maintained for some time.

Before closing this memoir it will not, it is hoped, be considered irrelevant to refer again to the very unique character of the albertite deposit. So far as the writer has information no similar deposit is known; if there be any such it would be intensely interesting to know all the circumstances of geological position for comparison with those of the albertite. These in that locality may be summarized as consisting of the position of the mineral in a considerable deposit of shales highly impregnated with bitumen, with overlying micaceous and bituminous oil-bearing sandstones, an anticlinal form of the strata of local intensity, with corresponding but still greater general disturbance indicative of violent upward as well as lateral pressure; of the further peculiarity of the shales, that of their finely laminated and perfect stratification, and the abundance of fossil fishes they contain. The fineness of deposition exhibited in the shales would certainly imply a somewhat quiescent state during its accumulation, and it may be further inferred that such a condition was adapted to the mode of life of the fishes found in such abundance, and that by an elevation of the strata they were suddenly shut off from exit to the main body of water, and thus entombed as the successive depositions gathered over them.

That there must have been some local difference that tended to the production of the peculiar deposit, albertite, in that detached portion of the Albert shales may be fairly inferred in view of the striking similarity and geological condition of the shales which are found at Belliveau and Memramcook, the localities before referred to, and the absence therein of any deposit of albertite of a workable size.

It remains to refer to the question of origin of the albertite, and the diversity of opinion that was, and perhaps is still, held regarding it As intimated in the beginning of this paper, the particulars of position in the mine and other circumstances, it was hoped, might be of service in this respect. Plan No. 2 is a vertical section of the vein from the surface to the lowest level and the exploration openings. Looked at in a horizontal point of view, the question may be asked, has it any resemblance to a similar representation of an ordinary seam of coal? Then, in a geological point of view, as shown on plan No. 1, are the usual characteristics of conformity of deposition with the enclosing strata present, and the general underclay of a coal floor?

To these questions the writer thinks a negative answer must be given. The interruptions in the regularity of the vein, their peculiar shape both in the massive and the fissure form, and the variable thickness of the vein, apart from a still greater diversity in the relationship with an ordinary coal seam, seems to indicate too great a dissimilarity to permit of the deposit being classified with it. The other diversity referred to may be given in the words of the able manager of the mine, Mr. Byers, who in a letter to the writer says: "From my observations during twenty-five years' experience at the Albert mines, I think there is no doubt about the albertite having been injected into an open fissure in a very fluid state. Every crack and opening in the shales for some distance from the main fissure has been filled with the fluid. I have worked the albertite from eighteen (18) feet in thickness to a few inches, and in all cases found it pure albertite, without any strings of impure matter like other coal, except where a piece of loose rock had fallen into the fluid mass, and in these cases the rock was covered with albertite, like a piece of rock thrown into boiling pitch." This is surely a strong corroboration by a thoroughly practical man of the geological deduction arrived at by Professor Bailey and Dr. Ells.

On the Strange Singularity of Colour in Some Forms of Asbestos.

By Robert H. Jones, F.S.A., London, Eng.

(Paper to be discussed at the next meetings of the Federated Canadian Mining Institute

When we consider the many forms of asbestos which are known to exist in various parts of the world, we cannot fail to be struck with the very small proportion of these which, up to the present time, are found to be available for use, not only in the arts and manufactures, but for innumerable purposes connected with industrial and every-day life. Such as we have been able to utilize are found to be of the greatest value; others, for which no special use could at first be discovered have, in the course of time, proved to be valuable for certain specific purposes, but still by far the greater number remain, for which no definite use can yet be found. These at present are regarded chiefly as mineralogical curiosities only by those scientifically acquainted with them, while, so far as the trade is concerned, they are left severely alone and treated as waste.

These forms of asbestos are by no means the only things which, because they are deemed to be profitless to us, are generally treated as waste; though, on reflection one cannot fail to see that the term is an absolute misnomer, for the longer we live and the more knowledge we acquire, the more certain we become that there is absolutely no single thing in the inorganic, any more than in the organic, world, which can rightfully be regarded as waste. The frequent use of this word only shows the feebleness of our poor imaginings, which result from our imperfect understanding. There is no form of matter on, in, or under the earth, which has not been specially designed for some definite or specific use; and if we could only once understand the purpose for which it was created, we should see that every created thing has some certain use, and that there is nothing in the world which can rightfully be termed waste.

To take only an ordinary instance; when travelling over the world, how often does it happen that we meet with some district of so uninviting a character, so boulderstrewn, or encumbered with large rock masses, so wanting in verdure, so ruggedly mountainous, so wildly precipitous as to be generally inaccessible, so much so that even the most unreflecting of human beings will at once see that the Almighty could never have intended it to form an agricultural or pastoral land. Supposing any such person to be especially looking for this last, in his bitter disappointment, he may well be disposed to cry out that it is all barren, hideously barren, hopeless and altogether waste, while in the blindness of his ignorance, he altogether fails to realize that it is to entirely different qualifications he must look in such a land as this, than to pastoral beauty and agricultural capabilities. Beneath such lands often lie the great storehouses of Nature's mineral wealth, which she dispenses, with no niggard hand, according to the requirements of the world, though only too often as the fruit of untiring and unremitting toil. As perhaps an altogether too familiar instance of this, we have only for a moment to look to that uninviting region towards which the hearts of men seem now to turn almost with one accord, as to a land of hope, according as they may be more or less afflicted with that eternal and incurable disease, *auri sacra fames*, Alaska and the Klondike.

And it may be here parenthetically mentioned, that far richer goldfields than these await us, it may be in the near future, in Central Siberia; in the neighborhood of Tomsk, Irkutsk and Krasnovitsk. But, unhappily, these lie in that heart-breaking region to which the pitiless laws of Russia condemn so many thousands of political prisoners to wear out their lives in hopeless misery. This particular part of the country is, in fact, so rich, far beyond that of the Klondike, that

no man cares to waste his time in collecting the alluvial gold or washing for dust, when he can easily gather a fortune by picking up the nuggets which lie ready to his hand. In many respects, the land resembles the Klondike. In winter many parts of it are altogether inaccessible, and are even in summer terribly hopeless; while it is, at all times, cursed with the awe-inspiring and terrible complications of the Russian mining laws, one hideous example of which came under my personal cognizance while engaged in some extensive iron works there, and this I may perhaps be excused for recounting, notwithstanding its irrelevance, on account of its national interest.

Our manager was a fine, commanding, athletic, John Bull Englishman, as the Russians themselves make the worst of managers. He was much liked by the English employés, and much in favor with the authorities; but it happened that, one spring, about the time of the melting of the snows, such torrents of water came pouring down from the hills, and with such violence, that they carried away part of a reservoir embankment, swept away several houses and caused the loss of several lives in one of the company's villages. The manager personally was in no way to blame, but did everything in his power to relieve and compensate the sufferers and the survivors; yet then only he became cognizant of the fact, that under one of those diabolical laws, which drive so many people in pure self-defense into nihilism, every manager of an industrial works is held to be personally responsible for every accident which may occur in them, and in the case of loss of life is visited with condign punishment. And his informant, one of the Secret Police to whom he had been of assistance, also informed him that this matter had already been considered at St. Petersburg, and he himself, as the responsible manager, had been sentenced to five years in Siberia. Hardly crediting this, he was able by the connivance of many friends to reach the frontier before the arrival of the warrant for his arrest. He managed to pass the barriers and get out of the country, leaving of course, every thing behind him. It would avail nothing to tell how, penniless and in rags, and in hopeless misery, he contrived in time to cross Europe. Suffice it to say, that when at last he reached his home, the sufferings and privations he had undergone were found to have hopelessly affected his brain and soon afterwards he died by his own act.

Leaving this digression we will now continue. It is by no means gold alone that has so often to be looked for in such desolate and uninviting regions as those mentioned. Asbestos especially is not seldom to be looked for in the most dismal and frequently untrodden parts of the country, and asbestos prospectors are only too familiar with such places, a sample of which anyone can see for himself as he approaches the hungry-looking and inhospitable mountains of Coleraine and Black Lake.

It has been particularly requested that in this paper I should give some information as to the colored varieties of asbestos and especially the blue variety which comes from the Cape of Good Hope, and is known as the Cape blue. What may be said to be the normal color of asbestos, which at any rate is that with which we are the most familiar, is a snowy white when fibreized, such as is found more especially in Thetford and Danville. Even a more beautiful fibre than this, is that found in the Laurentian formation, such as was formerly worked by Mr. Circkel at Templeton, and notwithstanding the fact that it is remarkably pure, on account of its entire freedom from any taint of metallic oxide, which only too frequently so deleteriously affects, by discoloring, the fibre, it is a very remarkable fact that in the course of the operations at Templeton, Mr. Circkel uncovered a curious vein of a blue-black color, nearly two inches in width in the thickest portion of it. This extraordinary vein was found at a depth of sixty feet below the surface in serpentinous limestone of a dark bottle-green color, but how it came about that the metallic oxide should have become concentrated in this one particular spot and developed in the fibre such an unusual color, no one can tell.

Then if we turn to some of the more pronounced colors exhibited by the foreign fibres, we shall note that some shade of blue is by far the most predominant, consequently we will commence with the dark-blue fibres of Africa. The most important of these, which is technically called Crocidolite, a name derived from a Greek word signifying a woof, in allusion to its fibrous structure, is found, with slight differences of texture or color, in several parts of the world and in the text books is generally described by authors following Dana, as being of a "lavender-blue or leek-green color" and a silky lustre. With this description I entirely disagree. If you will look at the sample I have sent to your secretary and which I brought from the company's office, I think you will agree with me that the color might be better described as a Prussian blue; and the description silky I also take to be erroneous, the fibre having no approach to the silkiness of Thetford or Danville but being much more like wool, that stocking wool, in fact, which mountain women seem to be always engaged in knitting. This peculiar fibre seems to occur in practically inexhaustible deposits in a desolate mountain region bordering on the Great Orange River, in Grigualand West, South Africa.

And this crocidolite fibre, when in the crude rocky state shewn in the photo, has one remarkable peculiarity which I have never observed in any other form of asbestos. If the ragged fibres be taken off, which can be easily done, and the lump of crude then taken into the palm of the hand, so that the thumb can be rubbed up and down, the hard lump will take a fine polish, the polished surface, at the same time, acquiring a much deeper tint than heretofore. This looks as if the fibrous lump is more compact than usual, though the fibres are just as easily separable when required for carding or spinning, which is a peculiarity found in this Cape blue fibre alone. In places also a a brownish tint is observable, shewing much like that brown fibrous quartz which in the States is called on account of its tawny brilliancy, by the name of Tiger Eye. This is found also in in the same place in large quantity. It is a beautiful ornamental stone, capable of taking a very high polish and can be cut or engraved as clearly and finely as a precious stone, and when polished the fibres of the asbestos are distinctly observable.

I perfectly well remember when this blue fibre was first brought from the Cape to England by a gentleman named Harris, who at once came to consult me about it and to ask my assistance in the working or disposal of it. I was then struck with its enormous comparative tensile strength, quite as much as by its singularity of color and its peculiar texture; but, knowing that, at that time, little could be done in England with any asbestiform fibre but the purest white, and knowing also that its color, which was so evidently derived from the protoxide of iron, would cause it to be totally disregarded by English manufacturers, whatever intrinsic value it might be otherwise found to possess, I was ultimately obliged to decline to deal with it. Mr. Harris having tried elsewhere, found, as I had predicted, that English manufacturers were too conservative to touch it, consequently, he returned to the Cape and laid the matter before some of the members of the De Beers Company, who quickly took it in hand and furnished him with all the capital he required for working it. He then once more returned to England, registered his company and set to work to commence operations, which are still carried on with, as I am assured, a very fair amount of success. Three of the directors of the De Beers Company joined his board, the others being also well known men. Most of the shares also were taken up by ship owners and others, who were able to influence business, so that practically they

were perfectly independent of the English market, and the company were soon able to announce that they had succeeded in obtaining very important contracts for boiler and steam pipe coverings in the dock-yards of the French and Italian navies and for the protection of a large number of the steamers owned by the *Navigazione Generale Italiana.*

Let us now consider the peculiar nature of the fibre as shewn by its chemical analysis, which is given as

Silica	51.1
Protoxide of iron	35.8
Soda	6.9
Magnesia	2.3
Water	3.9

from which it is perfectly evident that very little reliance can be placed on it as a fire resistant. It is claimed, however, to be a remarkable non conductor, and much stress is laid upon the fact that this famous blue fibre can be so well opened and carded as to produce "wool of half the specific gravity of the finest (so called) wool obtainable from other asbestos."

One specialty of the company consists in the manufacture of a kind of asbestos cushion, or, as they term it, a mattress, which is used as a boiler covering, and this they claim to be superior to the cement system, for the following special reasons:—That it can be fitted to boilers before leaving the works, so that a perfect fit can be assured; that it can be so fitted around the boiler as to prevent breakage; that it proves also to be a valuable protection to the tank tops in double bottomed vessels which, owing to the heat from the bottom of the boiler, invariably give trouble by so quickly rusting away; and moreover, that it can be fitted to a cold surface, and thus avoid the necessity of getting up steam, as well as the mess, dirt and consequent inconvenience incidental to the application of ordinary cement.

In the preparation of these jackets or mattresses, the company claims that their pure, well-carded asbestos fibre is packed dry in asbestos cloth, which is sown around it and stitched through it at frequent intervals, in order to keep the material from shifting; whereby it forms a mattress or jacket which can be made to any size or shape to fit the object to be covered, and to which it is secured by bands of hoop iron, or some similar means, in such a way that it can be removed and replaced with the greatest ease. The outside, when painted or tarred, has a surface which will resist any amount of friction. It can be walked upon without injury and requires no protective casing. They also weave a hollow rope, which, when filled with their pure carded asbestos fibre, is said to be the best heat insulator extant, as also the simplest, lightest, cheapest and most durable boiler or pipe covering made.

Nor must we omit to mention their "Blue Cape asbestos bedding." This they declare to be fire-proof, as well as insect and germ-proof, rot-proof and hygeinic. It is formed of three separate layers of material, two of these being formed of the blue fibre, with the third of the finest hair sandwiched between the other two; in which state this bedding is formed into exquisitely soft, springy mattresses, pillows, etc. Numerous other articles of a useful and ornamental character are made out of this fibre, but it is to be feared that its first cost will in some measure militate against its extensive use. The works of the company are at Turin, where they have a large plant and machinery.

Besides the Cape, there are several other blue fibres, one of which, if asbestos as asserted, is of a most wonderful character. This was some time ago sent on from the South American Republic of Bolivia. Its special peculiarity lay in the fact that instead of having anything like a woolly or silky appearance, it has considerable resemblance to hair, and therefore is more like halotrichite* than any form of asbestos. The fibre is of a long, clear and very beautiful texture, is of considerable textile strength and of a deliciously blue, translucent color. It is also capable of being easily carded, spun and woven; but unfortunately from the time of its first introduction to this day, nothing more has been heard about it. It can only be surmised that the whole thing has been lost sight of in some of those political troubles which are so frequent in these South American Republics.

Then, quite recently, another of these hair-like, translucent blue fibres was discovered and brought over to England. This was not of quite so fine a texture as that last mentioned, but was very beautiful. It was brought from a place called Alilonci, in the sub-district of Sankimert, in the Austrian province of Bosnia, at a distance of about twenty miles from the Novi station The mine lay, as usual, in a wild, mountainous part of the country, somewhat difficult of access. Its product is in every way remarkable and the reports of its origin not only surprising, but in many respects startling, if not incredible. It was reported on and the fibre described by one of the professors of the Imperial and Royal School of Mines at Vienna. The report was altogether of a marvellous character and the analysis, made by the director of the same institute, at the chief office there for experiments, was even more surprising still. This analysis reads as follows:—

Scilicic acid	54.10
Argillaceous earth	...
Oxide of iron	15.76
Protoxide of iron	7.33
Magnesia	12.60
Lime	1.44
Natron	5.40
Kali	0.45
Carbonic acid	0.09
Water	.....
Loss by burning after deducting carbonic acid	2.81
	99.98

From the chemical constituents here given, it would almost appear as if this so-called asbestos was no form of asbestos at all. On more careful and fuller investigation it will, in all probability, prove to be some other asbestiform mineral like glaucophane.* At any rate, it would seem that nothing at all like it has ever been shewn before.

At present, it has only been found in indurated muddy clay, which is described as being a secondary deposit, washed up as the German geologists tell us out of the primary deposits by aqueous agency; no indication of what the nature of this primary source is has ever yet been discovered. There is nowhere any indication of pyroxene, tremolite, hornblende, or serpentine, such as one might naturally look for, although the owner tells us that on one occasion, in the course of the excavation, he came across a big stone (some kind of conglomerate, I should imagine, from his description), to which, he says, some wonderfully long fibres, worth any money, were attached. But inasmuch as he did not preserve this wonderful stone, nor show it to any one, I think we can safely regard the story as altogether apochryphal. The soil all around is composed, say the local geologists, of strata of the trias formation, consisting, in the first place, of Werfen strata (the oldest strata combination of the triassic system in which sandstone forms the principal part, but in addition to which there are also found alternate beds of slate and lime), in the second place of black limes, the so-called Geehenstein limes, which form the next oldest component part, and in the third place of dolomites which follow in immediate succession to the Geehenstein limes. Over the whole ground there is spread out a mighty mass of diluvial mud, and it is of this that the fibre is said to be a product; in which case it would appear that the mud or clay itself was the primary source. This clay, as it hardens in drying, when

* An iron alum.

* A blue soda hornblende, usually found with black mica.

thrown up, forms great indurated masses, and if one of these be taken from the heap, it has the precise appearance of dry plastic clay, and when broken in the hands there is revealed in its interior a glorified bunch of blush, translucent fibre, which (if we ignore the color) can be likened to nothing but a tress of some lovely woman's hair. The texture of this is good, the tensile strength considerable, and its spinning and weaving qualities admirable. Then, also, a London dealer tells us he can sell any quantity of it, and an experienced manufacturer assures us that it would sell for £13 sterling per ton in the London market.

There are many other forms, both of chrysotile and crocidolite, of a blue and blueish color found in Norway, Moldavia and other parts of the world, but none of them are as yet of any importance. There are also many green fibres, notably one of the curious eucalyptus green found in Australia, so characteristic of the verdure of that country. The only sample of this I am acquainted with is of a hard, fibrous texture like the Cape blue, but the fibres are, like that, easily separable and I should think as readily capable of being spun and woven. Australia is a fine asbestos country, several good white varieties being found there and used in the different manufactories. Great quantities of the Laurentian fibre also occur there, some of the veins being much larger than any to be found in the Ottawa district of Canada, and some portions of these are slightly stained with oxide in such a way as almost to make the nacreous veins look as though bruised. Some other of the Australian fibres are of a pure white and applicable to all kinds of merchantable purposes, but a sample of brown fibre was recently sent me from the gold district of Coolgardie, which could only be used for grinding purposes, and this has the precise look of a stick of cinnamon, such as we may see in any grocer's shop window.

Many of the foreign brown and rusty-colored fibres are very objectionable. One of these, of which a large quantity was recently sent from Servia and Hungary, is stiff and harsh and irritating to the skin on handling. Directly a piece is taken in hand for the purpose of examination, its filaments penetrate the skin and irritate the flesh like the stinging of a nettle. They are also very troublesome to eradicate, as every movement of the hand will work them further and further in. Something similar to this occurs in Wyoming, and many coarse, ropy looking fibres occur in the States, and these are also very generally of rusty-looking color.

Many of the Russian fibres are of a similar color and texture to the Servian, but none of them are of the same troublesome nature to handle. Recently we have had some much better fibres from that country than formerly, and now we have specimens of a remarkably good quality, one that will probably meet with a ready sale in England, provided it can be sent over at a reasonable price.

Calculating and Recording the Value of Ore Reserves.

By John Clince Little.*

The vertical projection of a mine-workings, in any metalliferous deposit of a tabular nature, may be made to show a good deal more than the bare facts of the amount of work done and ore excavated. We can plot contour lines from level to level exhibiting the number of units of value of ore existing within any given portion of the lode's superficies, provided we have a sufficient detail of lode widths and assay (or mill-test) values, obtained in the course of driving, sinking and rising. Since underground cost is also, primarily, expressed in units of cost per square or lineal unit of ground "spent," value and costs can be quickly compared, and profit or loss at any point can be equally plotted. Surface cost and general charges are however expressed per unit of weight of ore milled, but by a simple expedient these costs can be distributed over the area exploited and the *total* cost per square unit can be recorded in situ. Thus, to take an example, a lode of gold-quartz may be stated to be worth £14 per square fathom, and its total cost of working £10 per square fathom, showing a profit of £4 per square fathom at that point. All these three items are "plottable" on the section, and the section may be made a permanent record of these facts.

This most obvious manner of *reporting*, as formerly practised in Cornwall and elsewhere, appears to have fallen into disuse for gold-quartz mining in recent times; and the present methods while often supplying full material for calculation of lode values, do not always present the requisite detail in such a form as to afford a concise idea of the actual value. It seems that in the case of gold-mines accuracy of conception of statement is very essential. When, however, one comes to try to work out the actual money value of a gold-quartz lode from the data supplied it is found to be a very long business, and this has prompted the writer to suggest the use of a slide-scale, which will facilitate all calculations of value, cost, profit, or loss. A simple example will best show the method of working, and the utility of the system advocated can then be judged.

Will a two-foot lode of quartz assaying twelve pennyweights per ton pay, if it cost £5 per square fathom to mine and 4/6 per ton to mill, the general charges amounting to another 2/- per ton?

The scale answers as follows :—

The lode is worth (as per scale)		£12 17 6 per sq. f'm.
The lode costs :		
(As per information) to mine	£5 0 0	
(As per scale) to mill and general expenses	1 12 6*	—£6 12 6 per sq. f'm.
	Profit	£6 5 0 per sq. f'm.

We can thus plot the boundaries of average grades of ore ground, and the areas of profitable and unprofitable ground can be distinctively colored

A mine section thus becomes of additional use, for from it we can gather not only :—

(1) How much work has been done for money expended,

(2) In what directions the excavations are extending relative to the boundaries and to the main lines of communication above and below ground; but also—

(3) Where the ore is.
(4) What its value is.
(5) How far each class of ground extends.
  (*a*) The quantity available.
  (*b*) The relative proportions in which it should be milled to strike a fair average.
(6) What it costs per unit of lode area.
  (*a*) What burden of development cost the lode will bear as it stands unbroken, *i.e.*, how far apart the levels and winzes should be placed
  (*b*) The proportionate mining, milling and general charges cost in situ.
  (*c*) The profit or loss at any point.
(7) What are the future prospects as to profits.
  (*a*) Where is the ore trending
  (*b*) Which points should be pushed ahead.
  (*c*) The proportion of barren to pay ground.
(8) What should be the programme of work and scale of operations.

The modus operandi is as follows :—

A. THE SCALE.—CONSTRUCTION.†

The scale can be made in boxwood for about 5/- by any good instrument maker. Suitable dimensions are 1·15″ x 0·25″ x 13″. The graduation can be done by hand with an ordinary ruling pen and Indian ink. A small metal **T** square, to be bought at any tool shop, is required for parallel ruling. Or anyone with a sharp knife can make a slide-scale in stout card-board for a few pence, but of course this will not last so long.

The formula for construction is as follows :—

Sterling value per square fathom = inches (Quartz width x pennyweights (per ton x 0·00448.

This formula requires that 4·73 inches thickness of quartz be accepted as representing 1 ton per square fathom and also that 1 ounce of fine gold £4.246.

For a convenient unit for the construction of scales of tabular logarithms of inches, pennyweights, and pounds sterling, let :—

Log 10 = 1 *3 inches.*

This gives a range between Log 0.05 and Log 300 of about 11½ inches and the scale can be made to read from 1 inch to 6 feet, from 1 pennyweight to 5 ozs., and from 1/- to £300. The assay scale is made to slide. The adjustment for the Log constant 0.0448 is easily done by trial, before commencing to graduate the sterling scale relative to the inch and assay scales. It is best to prepare a table to 50ths of an inch representing the value of each division before commencing to graduate.

It will be seen that the scale is only constructed to read up to a thickness of 6 feet. Probably few samplers would care to certify to an assay being reliable over a greater width. In case of bigger lodes they would "section-sample" the hanging and footwall parts, and, even in the case of small lodes, where there are markedly distinct lines of mineralization such a plan would be safest. Further it will be noticed that the scale divisions, being logarithmic, are smaller for the higher numbers, but the frequent combinations being either big lode and low assay or small lode and high assay, there is a certain amount of compensation: at any rate the Value scale is more accurate for the poorer lode values, and it is of course in the case of the poorer lodes that a close margin of profit must be most frequently expected. The exact amount of profit on very rich lodes on the other hand is always more or less uncertain on account of the violent fluctuations in assay value which is the especial characteristic of such lodes.

One of the chief uses of the scale is that it assists in calculating cost for a given size of lode. This has already been exemplified It is perhaps a new feature to combine surface *cost* per *ton* with underground cost per *fathom*. The writer believes it can be demonstrated that the fathom unit is more reliable than the ton unit for purposes of calculation, as it possesses the first requisite of a working unit, viz.:—stability.

*Paper British Society of Mining Students.

*Arrived at as follows :—
Set 1 dwt. against 4½ inches (= 1 ton per fathom) The 6/6 divis on then stands opposite 1½ dwt. The 1½ is then taken as "milling indicator-per-fathom" for any size of lode at 6/6 per ton. In this case (a 2-foot lode) the 1½ dwt will be found opposite £1 12s. 6d.

†The writer hopes to be able to supplement this with another paper describing a similar scale for general use in lodes of any base metal.

Cost per ton at surface is certainly a fairly constant figure for any given scale of turn over. But cost per ton underground is subject to wide fluctuations, independent of the scale of output, the chief factor being the varying size of lode. Given equal conditions a lode carrying 1 ton per fathom requires about as much work as a lode carrying 2 tons per fathom, because the same bulk of ground has to be broken to give access to the miner. Obviously therefore the cost per *ton* of quartz in the first case is double that in the second case, whereas cost per *square fathom* will in both cases be about the same.

Further you require to know, not only how many tons are available, but also over how great an extent of ground they are scattered. You then know the amount of work involved and, approximately, how long it will take.

The writer therefore thinks that the frequent plan of segregating expenses under all heads in terms of average-cost-per-ton is somewhat misleading at any rate as regards underground operations. We must always remember that it is the underground work which absorbs the greater proportion of the working capital put into an undertaking, and the practical miner does not talk of tons *whilst he is underground*, because he measures his work instead of weighing it. These, therefore, are the reasons for expressing value in £ per fathom and for converting cost to the same rating. It helps us to grasp at once whether a given size and value of lode will cover all expense. Whether the square fathom unit is used in preference to the square foot or square metre is of course immaterial. It simply means a suitable alteration of the log constant It need scarcely be noted in passing that many mines which measure their work in lineal feet still retain the square fathom for stoping. The formula may also be altered so that the scale can make any constant deduction ; such as 15% loss on milling, or a 5% royalty charge on milling results.

B. THE SECTION.—PLOTTING.

As will already have been gathered, the section can be converted into a chart of either value, or cost, or both combined under the head of profit and loss. The frequency with which samples are taken in the course of a drive does not matter, except that greater frequency should indicate greater accuracy. The points at which samples are taken are laid down on the section. This is done for all rises and winzes as well as for levels. It then becomes a simple matter to join up all points reading the same sterling value on the scale, and what may be called contour-lines of average value are thus traced, which will indicate the probable extent of any class of ore ground between levels and the pitch of the ore shoots. Each mine must be catered for on its own merits. The writer finds it usually convenient to distinguish 5 classes of ore ground in a mine ; more than that are too confusing and the chief use of a graphic method is to simplify things. These five classes of ground, viz.: barren, poor, payable, profitable, and rich, are distinctively colored on the section when their boundaries have been drawn in the manner above described. The character of a mine can then be seen at a glance—where the ore is and its extent, whether it occurs in patches, ore courses, pipes, or well defined shoots. The chief precaution to be taken in tracing areas is to give "right of way" to the poorer value in any case of doubt.

Frequently the inability to continue a contour line on the dip of a well defined shoot will indicate that the level beneath has lost the true leader, and a crosscut at that point will recover the main vein. On the other hand a value-chart indicates in a very forcible manner any gradual impoverishment of a vein in depth and the extent of a poor zone. While frequently through this poor zone there will be a limited pipe of good ground, persisting downwards, and indicating possibilities of improvement again in depth in a certain direction.

The areas of different classes of ore-ground in reserve between levels can be found with a planimeter, or can be traced through on to oil paper and cut out and weighed in a balance. We can thus speedily find: (1) The actual number of fathoms of ore-ground of any class in reserve and (2) the relative quantities of other classes, so that we can determine (3) the proper proportions in which each class should be milled in order to strike a fair average throughout the mine for the duration of any given financial period. In relation to the advantages gained by this systematic way of locating stopes, the stopes themselves are always varying in value, but, by the system of contour lines here advocated, such changes can not unfrequently be anticipated. In a large paying mine with say 25 development points there will be probably from 50 to 75 stoping points, and it is practically impossible for any supervising engineer to keep track of all these points unless he has some graphic system to fall back on. A mass of tabulated figures produces no lasting impression, whereas a chart gives a birdseye view and can be carried in the memory with ease.

In conclusion, the object of this paper is purposely limited to the speedy manipulation of those figures which may result srom careful measuring and sampling. The *methods* of sampling lodes do not come within its scope. The writer hopes that other members will contribute their experience as to the best methods of performing those essentials on which the whole fabric of any valuation is based.

The Estimation of Gold in Ore, and Data on Dry Crushing Experiments.*

By MR. FRANKLIN WHITE.

The following tables will show the possibility of assaying ore before crushing with sufficient accuracy to afford very useful information. One set of calculations refers to wet milling, one to a dry crushing test. I cannot give the name of the mine from which I obtained the first set, but the figures supplied to me, and which I am at liberty to use, are sufficient for my purpose. If we follow the usual system of taking the fine gold won together with the gold in residues (ascertained by assay) as equalling the total gold contents of the ore milled, we have the following :—

*Paper read before the Chemical and Metallurgical Society of South Africa.

No. 1.

Extraction.

Mill yield	13,095·14 ozs fine gold	67·61	per cent.
Cyanide yield	2,655·27 " "	13·71	"
Concentrates yield	1,138·74 " "	5·88	"
Clean-up and slags yield	122·81 " "	·63	"
Gold left on eight plates	200·00 " "	1.03	"
Total	17,211·96 " "	88·86	"

Residues, etc.

Tailings residues	735·858 ozs fine gold	3·80	per cent.
Concentrates residues	399·000 " "	2·06	"
In slimes dam	1 020·188 " "	5·27	"
Total	2,155·046 " "	11·13	"
Accounted for	17,211·96 ozs fine gold	88·66	per cent.
Residues, etc.	2,155·046 " "	11·13	"
	19,367·006 " "	99·99	

Making mineral worth 9·66 dwts. per ton. The mineral was assayed before being crushed, and the average value worked out at 10·3 dwts. per ton. When calculations are made on this basis we have the following :—

Extraction.

Mill yield	equals 63·514	per cent.	of the assay value.	
Tailings yield	" 12·868	"	"	"
Concentrates yield	" 5·518	"	"	"
Clean-up, etc.	" ·595	"	"	"
Gold on plates	" ·969	"	"	"
			83·464	per cent.

Residues, etc.

Concentrates at 9·52 dwts	1·933	per cent.	
Tailings " 0·515 "	3·567	"	
Slimes " 1·84 "	4·944	"	
		10·444	per cent.
Unaccounted for		6·092	"
		100·000	"

Here we have a lower extraction to the extent of nearly 5½ per cent., and an unaccounted for of 6 per cent.. the latter figure clearly indicating that something is wrong. A glance at the assays of residue tailings and slimes will, I think, show that they are too low. If the former were put at 1·1 dwt. and the latter at 2·5 dwts.—figures which would not discredit either the cyanide battery manager—we should have an increase in the residue contents of over 1,100 ozs., and the "unaccounted for" would be reduced to a very small figure. Here, then, in the second set of figures, although the results given us do not absolutely check, we have a very clear indication of what was wrong. When once this was realised a remedy could be applied. In the former case, however, the manager would sleep comfortably in the persuasion that his extraction of 88·87 per cent. was excellent.

No. 2.

Test crushing (dry) of 917 tons oxidised ore from Botha's Reef.

Charges.

Tons crushed	917.	
Average assay	9·625 dwts.	
Total gold contents	441·356 ozs.	

Residues.

Tons crushed	917.	
Average assay	2·708 dwts.	
Total gold contents	124·245 ozs.	
Theoretical extraction	317·111 ozs.,	or 71·84 per cent.

Gold Won.

Bullion	374·3 ozs., equal to 290·3 ozs. fine,	or 65·77 per cent.
In slags and sumps	13·6 ozs. fine.	
Total accounted for	303·9 ozs. fine,	or 68·91 per cent.

Fine gold recovered worth £1,203 8s. 6d., or 26s. 3d. per ton.

The plant used was as follows: One No. 1 Gates crusher, three old vats holding 45 tons each, two 30-ton solution vats, and two zinc boxes—all second-hand. The vats leaked at first.

TREATMENT.

First 500 tons : solution ·25 to ·3 per cent. for 17 hours, then a weak wash of ·13 per cent. in all 24 tons per vat ; final water washes 8 tons ; total time 38 hours. Remaining 417 tons (coarser stuff) : solutions ·27 per cent. to ·32 per cent., standing for 72 hours, circulating the solution for 24 hours ; weak washes and water washes as before ; total time 120 hours. Lime used, about three pounds (unslaked) per ton. Cyanide consumed (leakage included), 11·2 ozs. per ton treated. The first 500 tons gave a theoretical extraction of 66·4 per cent. ; the remaining 417 tons gave 73·13 per cent., although the ore was very coarse, owing to crusher head having worn. The ore was stoped and sent direct to the crusher, no drying being necessary.

ANALYSIS OF THE CRUSHED ORE.

Samples from eight charges before and after cyaniding were separated into different sizes by sieving, and the resulting quantities dried, weighed, and assayed, giving the following results :—

Remaining on	½-inch	mesh	19·7	per cent. ; extraction,	56·6	per cent.
"	⅜-inch	"	17·37	" "	65·17	"
"	⅛-inch	"	19·80	" "	66·00	"
Passing	⅛-inch	"	23·70	" "	77·60	"
"	1/16-inch	"	19·00	" "	81·00	"

Some of the larger pieces would be 1½ inches in length. It is clear that if the ore had been crushed to ½-inch, which would not have been a very difficult or costly proceeding, a theoretical extraction of 79 per cent., or say 76 per cent actual, would have been obtained in one operation. The experience gained in the first 500 tons gave an increased extraction of 6·7 per cent in the second lot, so it is reasonable to assume that a second 900 tons would have given, if crushed to ⅛-inch, 82 per cent. extraction, at less expenditure of cyanide without amalgamation or slimes treatment. It is probable that more cyanide was used than was absolutely necessary, as in an experiment it is better to have too much than too little. Can the advocates of wet milling show a better result with the same expenditure in plant, work and power? A sample of the same class of ore, but of better quality, so as to give more possibility for the presence of coarse gold if it existed was crushed to pass a 400-mesh sieve, and submitted to Mr. A. F. Crosse to be tested. His report was to the effect that the ore assayed 14 dwts. 10 grs fine gold per ton, the residues after five days' treatment 22 grs. per ton—equal to an extraction of 13 dwts. 12 grs., or 95·1 per cent. When calculated by the gold obtained from the cyanide solution, the extraction equalled 94·8 per cent. The free (undissolved) gold remaining was found to be 3 grs. per ton; therefore, no fear need be entertained that the coarseness of the gold would be detrimental to successful work. The decomposition of cyanide was equal to 11·2 ozs. per ton of ore treated. Our president remarked during the discussion on Treatment of Battery Slimes that in his works there was a difference between the theoretical and actual extraction, that the gold went in many different places, mostly lost round the works. No doubt there is loss in all methods requiring handling and mechanical treatment, but I think that the chief cause of discrepancy is want of precision in the weights taken, after that, errors in assaying. If once the gold reaches the vats, what is dissolved should be collected by the precipitation process or remain in the solutions, unless there is leakage, or loss in cleaning the slimes. Either of these cases represents an actual loss, the gold is neither in the residues nor in the bar. If our president is correct in stating that the notable difference between actual and theoretical extraction is due to loss, then the gold in the bar or slags plus the gold in the residues does not represent the whole of the gold originally in the tailings as received from the slimes separator, and Mr. Williams' contention that if you lose 100 ozs. fine gold in the residues, and have actually recovered 900 ozs. of fine gold in the works, it is fair to say that you have an actual extraction of 90 per cent. cannot be accurate. It is an extraction of 90 per cent. of only part of the gold that was in the ore at the commencement of the operation. I am sorry not to be able to give to Mr. Williams a definite answer as to the cost per ton of the test crushing (dry) made at the Village Main Reef. The cost of such crushing, made with make-shift machinery, would be no guide to what could be done with a large and well-designed plant. The first 600 tons crushed was also experimental work, different meshes from 200 to 700 were used, and different strengths of solution and duration of treatment. Nevertheless, Mr. Feldtman's assays, carefully made, gave a theoretical extraction of 80·2 per cent., of which 61·4 per cent. was accounted for, and I believe that had it not been for a leak in one of our ancient pumps that our actual extraction would have been fully 77 per cent. The remaining 400 tons, crushed to 500 mesh, which we found to be most suitable, was cyanided after I left the Village Main Reef, so I do not know what results were obtained, but charge No. 18, the first of the second series, gave a theoretical extraction of 89·25 per cent., the ore assaying 31 dwts. 20 grs. before, and 3 dwts. 10 grs. after cyaniding. In any case I do not consider that what we were able to do in any way exhausted the possibilities of the process we were testing for the first time on a reasonable scale. The perfection to which cyanide treatment has been brought here (members of this society have done a great deal towards this) the removal of financial obstacles, and the large quantities of ore of a remarkably even character with which we have to deal, are new elements which have to be taken into account in our endeavours to perfect a process for extracting the gold from the ore. We have to consider not only which may be the cheapest mechanical means of reducing the ore to a powder, but also and chiefly which is the method of crushing which will give us a product best suited to the subsequent processes of getting out the gold which are at our disposal at the present day. (Applause.)

Discussion.

Mr. Crosse, while thanking Mr. White for his paper, asked him if he would kindly put a postscript saying that the ore from the Village Main Reef is pyritic. He was sure the paper would be read with great interest all over the world, and he did not think he mentioned the fact that the ore was pyritic.

Mr. White—The ore was pyritic, and taken from a depth of about 700 feet. The reason we took pyritic ore was, although there is a large amount of oxidized free-milling ore on the Rand, it is nothing compared with the amount of pyritic ore which will have to be treated in the future, so we preferred to make a test with pyritic ore, which some authorities considered untreatable by dry crushing and cyanide.

Mr. Crosse was afraid dry crushing was a subject rather likely to bring out bitter feelings. He wanted particularly to ask the President and members to keep as much as possible to the subject under discussion. It was a comprehensive subject that branched off into different lines and after a short time they would probably find themselves discussing something totally different. He thought it ought to be divided into two distinct lines. In his idea, there were two divisions in dry crushing—the first was the mechanical portion which concerned engineers, and the second the treatment of crushed material. As a chemist, having once found that the gold is soluble, he had no doubt that a high extraction could be obtained. Regarding the mechanical part, chemists were not competent to give an opinion.

Mr. John R. Williams said: Mr. President and gentlemen,—I much regret that I am unable to-night to reply to Mr. White's very valuable and interesting paper, as through ill-health I was compelled to take a holiday and a change, so have not had the pleasure of reading Mr. White's paper until this afternoon: but there are one or two questions I would like to ask, and a few remarks to make. In the first place, how were the ore samples taken to arrive at the set of calculations in table No. 2? Was the ore weighed? If not, how was it estimated? But, even taking these corrected figures, I find Mr. White gives us credit for an extraction of 83·464 per cent., add the slimes at 11·13 per cent with an extraction of 80 per cent., this will give us a total extraction of over 92 per cent., and this at a cost of under 6s. per ton, which is accomplished at the Crown Reef G. M. Co. I quite fail to see that the experiment on oxidized ore from the Botha Reef compares in any possible way, as the difference between the 68·91 per cent. actually recovered is 23 per cent less than is recovered by the mill, tailings, and slimes plant, and this 23 per cent on an ore of 10 dwts. is equal to 9s. 2d. per ton, or 3s. less than the total cost by wet crushing; now, Mr. President and gentlemen, if this applies to an experiment where great care, I may say the greatest care, is exercised, what will be the result in ordinary practical working? Also, I think most of our members present will admit that the treatment of oxydized ore is quite a different proposition to the treatment of pyritic ores. I regret Mr. White gives no figures of cost. The fact that Mr Crosse got an extraction of 95 per cent. in his laboratory is really a very trivial argument in favor or against any method, as unfortunately we all know that laboratory and practice work do not *quite* agree. Another point is, that, whilst I have always admitted that some ores are amenable to the dry process, others are most emphatically not, and I am sure that when Mr. White comes to pyritic ore (even on the Bothas Reef) he will have to discard his dry crushing plant, which, like a boy's short pants, suited the childish days of metallurgy, but metallurgy is now a man and therefore requires man's dress. Whilst thanking Mr. White for the figures given re the Village Main Reef dry crushing experiment, in which I find a theoretical extraction of 80.2 per cent, with an actual of 64.4 per cent., Mr. White here very nicely adds that if the tanks had not been suffering from my national vegetables (I mean leaks) his extraction would have been fully 77 per cent., which compares badly with the 92 per cent above mentioned, as no assays of the ore are given, and no cost. I am sure that all our directors and shareholders are more than justified in still clinging to our present system of wet crushing, and I am sure that the results obtained at the "Village Main Reef," "Afrikander," &c., &c. &c., with all their many excuses for leaks, defective English, American and German, &c., machinery, has not convinced me that I should be a pupil to Mr. White's doctrine, and I cannot help expressing regret that Mr White has not long ere this been a convert (a better term, I think, would be backslider) to his old and trusty friend, *water*, which he will find better than any other fluid, or even dry crushing, for the recovery of gold.

Mr Schumacher asked whether there were any details published on the results of dry crushing in the Klerksdorp district.

The President—No details have been brought before the Society. This afternoon I happened to meet Mr. Wollaston, who has been engaged in dry crushing near Klerksdorp. They obtained, as far as I remember, 14s 6d worth of gold per ton of ore treated, and the total costs were 12s. 6d. per ton In the United States there is a great deal of dry crushing going on—for instance, at Mercur. I do not know of any combination of wet crushing and cyaniding except at Butte.

Mr. McNaughtan—Is pyritic ore treated in the States by cyaniding?

The President—The Mercur ore contains from 10 to 12 dwts. per ton, and their residues average from 2½ to 3½ dwts. The ore lies in horizontal layers, so that the mining is very simple. Their total costs in some cases are as low as 9s. per ton. Most of the rock is very porous and readily treated by cyanide The pyritic portion, however, contains about 1 per cent. of arsenic and a little iron pyrites, and is sent to the smelter. Where the value of the ore is low, it may be possible to make a profit by dry crushing, although impossible by wet crushing. Let us look at Mr. White's figures for a moment. That portion of his residues which remained on a ½-inch screen had yielded an extraction of only 56 per cent.; that remaining on a ⅛-inch mesh gave 65 per cent., and so on. That portion passing a ¼-inch mesh gave an extraction of 81 per cent., which is fairly satisfactory. Now, in Mr. Crosse's results I see he obtained a 95 per cent. extraction by crushing through a 400 mesh. Of course, when you crush sufficiently fine to pass through a 400-mesh screen, your costs begin to run up. Still, it can be done; for instance, at a chlorination works in Cripple Creek, Colorado, they treat about 240 tons, and the bulk of that is crushed through a 400-mesh screen. I do not want to stay in any mill where such work is done. I have been there, and I came away! I think the bulk of our best mills here obtain by wet crushing and subsequent cyaniding over 80 per cent. extraction without the slimes treatment, and towards 90 per cent. with the slimes treatment In Mercur it is absolutely impossible to crush wet. They have practically unlimited tonnage, but they have not sufficient water to crush wet. If they crushed wet, and made the ordinary losses that we make today, it would mean nearly 1½ tons of water lost per ton of ore crushed.

Mr. J. R. Williams—Two tons.

The President—On the Salisbury and Jubilee they estimate 1½ tons. In Mercur they cannot afford to loose more than 10 per cent. of moisture on the weight of the ore, and that would be only about 20 gallons per ton. That is not the only place in the world where the same conditions prevail. In the deserts of California, Colorado and New Mexico it would be impossible to use the ordinary wet crushing methods. We are now about to experiment on crushing with cyanide solution in a 3-stamp battery, and will treat the ore in a complete model plant. There will be four small vats for concentrates and twelve tailings vats, arranged for double treatment, and three slimes vats. 75 tons of ore a month, which this plant will treat, will undergo ordinary treatment, except that we will have cyanide solution in circulation instead of water. This solution will be constantly separated from the concentrates, sands and slimes, returned to the mill, and re-used after its gold contents have been precipitated by the Siemens process. If you wet crush with cyanide solution you would not throw away any more water than you would with dry-crushing

Mr. Schumacher—With regard to the mines that are dry-crushing in America, what is the value of the ore? Is it free milling? What I want to get at is whether you are laying down a sort of general rule that for very

poor ore it may be worth while to dry crush, whereas for rich ore you uphold the system of milling as we have it here.

The President—At present only non-pyritic ore has been treated in America by cyanide on a large scale. They cannot cyanide pyritic ore containing arsenic.

Mr. Schumacher—Has pyritic ore ever been treated by the dry crushing process?

The President—I think so—in parts of New Zealand. When I was in San Francisco, Professor Christy showed me several samples of gold ores containing from 2 to 3 per cent. of pyrites and galena which he said could be treated by cyaniding after dry crushing.

Mr. Schumacher—Not in actual working?

The President—I really do not know of any place where pyritic ore is treated on a large scale by dry crushing and cyaniding.

Mr. McNaughtan—Would you give us the percentage of extraction in Professor Christy's experiments?

The President—They are very high—over 90 per cent. in every case.

Mr. J. R. Williams said he saw more than one well-known engineer in the room, and he thought that their opinion of dry crushing would be valuable.

Mr. Drake said he saw the process worked in New Zealand, but, like the President, he would not like to work in a dry crushing mill. He thought that if people there knew as much as was known on the Rand about slimes treatment they would abandon dry crushing. In New Zealand they used water power, and yet they crushed dry.

Mr. J. R. Williams—Can Mr. Drake give us any figures with regard to the cost of crushing?

Mr. Drake—they are very high. They crush with stamps, dry.

Mr. J. R. Williams—The cost of wet crushing on the Rand is somewhere between 2s. and 2s. 6d. Can you give us any ratio between the cost in New Zealand and here?

Mr. Drake—It is a difficult place to get information. There is no place in the world where you could get so much information about the costs of working as on the Rand.

The President—It is doubtful whether they know in other countries in many instances. (Laughter.)

Mr. J. R. Williams mentioned that a short time ago he had two tons of slimes sent down from Lydenburg. They were crushed so as to pass through a mesh of four holes to an inch. The slimes carried about 82 per cent of gold. They had really started at the wrong end of the stick in having a tailings plant: what they wanted was a slimes plant. Their tailings did not average more than from 7 to 8 dwts., whereas their slimes averaged from 18 dwts. to an ounce.

Mr. Crosse—I would like to ask Mr. Williams, supposing he had a proposition put before him of some outside reef where they only had a 20-stamp battery or its equivalent, would he in that case first amalgamate the free gold on the plates and then separate the concentrates and have them treated separately, and have a special slimes plant. In cases of that kind it may be preferable to have a dry crushing plant. Even if he did not obtain as much as by the more complicated process, the commercial results would be better.

Mr. J. R. Williams said he was afraid there would be difficulties in the way of dry crushing. The cost of amalgamation was a mere nothing—it was merely a fraction of a penny per ton. In the case of the 20-stamp mill, he should certainly, as a metallurgist, expect one man to look after the mill, to drive his own engine, to act as his own foreman, and to "boss" his boys. In a 10-stamp proposition two men should work the whole installation, and he really failed to see where the question of costs came in. Of course, if they had a high-salaried management, it meant a very large difference whether they ran 20 or 200 stamps. There was more than one place in the Transvaal where the battery manager managed the battery, cyanide works, and was general surface manager.

Mr. W. Fischer Wilkinson—I may mention that in Carolina, some years ago, the dry process was tried on very pyritic gold ores, which were crushed by Krom rolls and chlorinated. The process may be at work now. The full account is given in the transactions of the American Institution of Mining Engineers.

Mr. W. H. Wood was called on to express his opinion, and promised to speak on a future occasion.

Mr. H. W. Miller was sorry to say he had no practical experience on the merits or demerits of the dry crushing process, but he thought it would be difficult to get anything cheaper than gravitation stamps. In every process there must be a considerable amount of wear and tear. Notwithstanding the great advances which had been made in metallurgy of iron and steel, it seemed very difficult to produce a metal to reduce ore by a cheaper and more economical method than by gravitation stamps.

Mr. McNaughtan said that some little time ago he made a few experiments to determine the total amount of pyrites in the Geldenhuis Estate ore. Roughly speaking, he thought they could put down the pyrites at about 3 per cent. He then gave the results of his experiments, which showed that the residues in the sand vats contained upwards of 1 per cent. of fine pyrites which had passed the spitzlutte, and which, after the ordinary cyanide treatment, still assayed about 10 dwts. Charges such as those of spitzlutte concentrates which leached freely gave a close correspondence between theoretical and actual extraction, whereas those which leached imperfectly showed a considerable discrepancy. He considered the chief advantage of dry crushing was for the treatment of friable ore.

Mr. W. A. Caldecott said that in each case crushing must be carried sufficiently far to render the gold accessible to the solution during subsequent lixiviation. In the case of many pyritic ores this would necessitate the use of at least a 900-mesh screen, and it would be very doubtful whether the product which passed this would be leachable in vats of a working depth. To instance the influence of fineness of crushing upon the percentage of extraction, he mentioned that in a company on the Rand where good extractions were obtained with a 600-mesh screen, a reduction of the mesh to 900

increased further the percentage extraction in the sand and concentrate vats by 5 per cent.

The President said that Mr. Caldecott also had some figures on the cyanide treatment or Sheba concentrates.

Mr. Caldecott said that in an experiment by the treatment in the ordinary way for three weeks the extraction was only 37 per cent., but when the concentrates were reduced to an impalpable powder the extraction went to upwards of 90 per cent.; it was only a case of the accessibility of the gold.

Mr. J. R. Williams—After a careful examination of the residue from the cyanide tank very often—I won't say always—there is more gold contained in the very fine pyrites than there is in the coarse. I had a case in point only last week. The mill in question had a 700-mesh, and, notwithstanding the extraction was a good one—the ore was good—I thought a residue of 2 dwts. was rather high. Very fine pyrites which had passed through a mesh having 10,000 holes, I was very much surprised to find carried nearly 18 dwts.

The discussion was then adjourned, as also the discussion on Mr. W. Fischer Wilkinson's paper on "The Economic Value of the Main Reef," to the next meeting.

The President, in concluding, said: I am very glad to see such a large and varied gathering of mining engineers, mine managers, battery managers, and some of our financial men. I am pleased to see many taking an interest in metallurgical questions. It is gradually beginning to be understood here what an important bearing the solving of metallurgical problems have on the profits obtainable. All mining men are trying to reduce costs, and we on our part are trying to increase the extraction, which is working at both sides of the question. It is a great pleasure to all of us metallurgists to have representatives of every section of the community, who are just as much interested in this subject as we are, coming here and discussing these questions with us. (Applause.) We have just received an advance copy of the transactions of this Society from May, 1894, to January, 1897, in book form. There will be about 400 copies for sale here in about a month's time, and anyone can obtain copies from the secretary. The price has not yet been decided upon, but will be about 10s. 6d.

The proceedings then concluded.

British Columbia Mines in 1897.*

By Wm. A. Carlyle, Provincial Mineralogist.

While the recent discovery of gold has attracted the attention of the world to the Klondike, in the Canadian Yukon, the great interest already aroused in the mines of British Columbia has not abated, and throughout the Province, in nearly every district, mining men and capitalists are now assiduously examining mining properties. More thorough development work is in progress, and the prospects for this new but growing industry are most promising. This year has not witnessed the continuance of that insane rush, seen last year, to float mining companies, nor has there been the same influx of, in many cases, inexperienced, buyers, keen to secure property to dispose of elsewhere by the aid of startling, and, to say the least, exaggerated prospectuses among an eager public, imbued with the true gambling spirit, and skilfully worked up to a pitch, when whatever may be offered is greedily absorbed. Nevertheless, there has been, and is now, a large number of influential men in the country representing ample capital, carefully studying over mineral resources and making important purchases, with the result that much more good work is in progress and much more will be soon begun. Last year the prices asked for "prospects," or undeveloped claims, rose to absurdly high figures, partly because such prices in some instances were paid, but this year holders of such claims have had to become reasonable, although in some parts far too high a valuation is placed on untried and unworked claims. This feature in our mining affairs will right itself.

Lode mining made a beginning ten years ago, but in reality only dates back five years, and the rapid progress during the past five years is most significantly indicated in the following table from official returns, the figures for 1897 being partly estimated:

1887.....$17,331	1891..... $29,607	1895.....$2,342,397
1888..... 75,000	1892..... 139,440	1896..... 4,257,179
1889..... 47,853	1893..... 297,400	1897..... 8,000,000
1890..... 79,753	1894..... 781,342	

For the year 1897 the official returns of mine output have not been yet secured, but from the customs returns of ore and matte sold and exported, nearly all of which has gone to the smelters or refineries in the United States, though a growing amount is going to Swansea, the above estimate of $8,000,000 is believed to be very nearly correct. To December 11th the customs returns of ore and matte exported from West Kootenay alone amount to $7,610,000. The total output of all the mines will rise in every probability to $10,000,000 for 1897, showing a gratifying increase, as follows:

1890.....$2,608,608	1893.....$3,588,413	1896.....$7,146,420
1891..... 3,546,702	1894..... 4,225,717	1897.....10,000,000
1892..... 3,017,971	1895..... 5,655,302	

The above figures command attention, so indicative are they of the steady yet rapid increase in the output of our mines, which have now produced over $110,000,000, and of the fact that British Columbia is preparing to take her place among the great mining countries of the world.

The above figures are not large when compared with some of the other mining regions, but it must be remembered that only six years ago the interior of this province was for the most part trackless; but following the discovery of gold and silver deposits in West Kootenay, the opening up of this country by railroads, water-ways, roads and trails has been marvellous, and the railroads now in progress of construction or contemplated will open up still greater areas of mineral land now lying fallow, with the certain result that the mining industry will receive still greater impetus and the figures of production rise much higher. During the past few years of depression all railroad companies have had to proceed very cautiously and to curtail the

*Engineering and Mining Journal.

building of new lines, but with the returning era of prosperity and a better money market these companies are preparing to extend their systems, as is exemplified in the action of the Canadian Pacific Railway Company, which has now begun the construction of very important lines and branch lines in the Province that will be of the greatest service, not only in making accessible new districts and in reducing transport charges, but also in the establishment of large smelting and refining enterprises within our own borders, the extent and importance of which we can only now surmise.

For a mining country this country offers nearly all that could be wished for, because the supply of water, timber, fuel, fluxes, etc., is everywhere abundant, while climatically we do not suffer from extremes in heat and cold, the long summer months being most favorable for prospecting, while the winter snows do not hinder, but in fact greatly facilitate mining operations, as, for one instance, the rich ores found high up on many of the mountains can then be easily and cheaply raw-hided down the snow trails. Centres of supply are being now established in many parts and supplies can be got at more reasonable figures. There are many experienced miners coming in from Montana, California, Colorado, etc., and good labor at fair wages is easily obtained.

A brief description of the principal mining districts is appended:

The great gold-producing centre is Rossland, where splendid bodies of profitable gold-copper smelting ores are being exposed as development advances. The condition of this camp is this year much ahead of that of last year. Underground development is beginning to assume very considerable extent and importance, and as this work proceeds the prospects greatly improve, leaving it simply as a matter of time, work and capital when the production will be much greater. Cheaper transport and treatment charges are being provided and awaiting these several properties with large reserves of good ore now blocked out are rapidly extending the opening up of these mines. In the rush of a year numberless companies with small capital attempted to develop other claims, but the money being insufficient these companies have been forced to suspend work, and many of these properties will yet be merged into stronger enterprises and then be more fully tested.

Although the Le Roi mine, which has paid to date $675,000 in dividends, of which $400,000 was during 1897, has been the chief shipper, the tonnage in 1896 of 38,000 tons, in 1897 up to December 11th, increased to 64,000, and this can be further greatly increased as soon as the other properties begin stoping their reserves. The average values of Rossland ores have not been determined for over a year, but prior to that the average lead values of 27,000 tons smelted gave 1.67 oz gold, 2.5 oz. silver, 2.3 per cent. copper; total value, $37.18 per ton; while 1,200 tons of the Le Roi first-class ore gave 2.6 oz gold, 1.83 oz. silver, 2.5 per cent. copper, or $53.05 per ton. The cost of freight and treatment varies from $9 to $14 per ton.

In quartz ores suitable for milling much work is now being done on quartz veins in different parts of the Province, and the results are being awaited with great interest. Near Nelson two mills are now in operation, and in this district several quartz ledges are being exploited. In the southern part of Yale district, as at Camp McKinney, where the Cariboo mine has paid $173,000, and at Fairview and other parts, large quartz leads are being opened up and tested, while Cayoosh Creek and Bridge River in Lillooet, East Kootenay, Alberni on Vancouver Island, the islands and coast line of the mainland and other parts are being busily explored. Here auriferous quartz veins have been staked off, and during the coming year definite results should be obtained. These districts are practically new, but much work is being done where two years ago not even prospectors were seen.

The discovery of rich placer diggings in the Canadian Yukon, of which Mr. Ogilvie has given such valuable information, will be of importance to this Province in that the vast region to the north of Cariboo, already famous for its gold production in the past, the mines and Creeks of the Omenica, Cassiar and other districts long reported to be gold-bearing, but little tested, as means of ingress and transport of supplies have been so difficult, now promise to be overrun by a wave of prospectors, who will search this northern country as never before. Many new trails and roads will be built by both the Dominion and Provincial governments, and many parts never penetrated before, except by fur hunters, will be examined, with results it is impossible now to foretell.

In Cariboo, the rich creeks so far discovered have been worked out, except where large capital is needed, and now several strong companies are at work on the gravels in the ancient river channels gradually being traced out, or in the deep buried channels of the present rives, a single instance being the Cariboo hydraulic mine, near Quesnelle Forks, where a very rich and extensive gravel deposit is being laid bare, about $375,000 having been taken out in this preparatory work. Farther north new enterprises are on foot to mine auriferous gravels there, and many creeks hitherto but slightly prospected will be reached by better trails and much more carefully explored.

The Slocan district in West Kootenay has during the past year shipped, in large and small amounts, from over fifty claims, and the production of $2,000,000 in 1896 will be much exceeded in 1897. In 1896, 18,215 tons of this rich silver-bearing lead ore from the Slocan yielded net 117.4 oz. silver per ton and 52.7 per cent lead, leaving a net profit of about $75 per ton. Customs returns show that this year 37,000 tons have been shipped of this class of ore. Much active work is in progress and many new properties are being developed.

At Nelson, the Silver King has been a large producer all the year of silver-copper ore, and in the region to the south other gold-silver mines will soon be on a paying basis, while in Ainsworth, the Trout Lake, Lardeau and Illecillewaet districts much new work has been done, with good results. In East Kootenay the two large deposits at the North Star and the St. Eugene mines are being developed, only awaiting the approach of the railroad now being built, while other claims are being exploited.

Copper is being produced from the mines at Rossland, the Silver King at Nelson and the Van Anda on Texada Island, and in the Boundary Creek district the large deposits of at present low-grade gold-bearing copper sulphides are being opened up, but not to that extent which will ensue if a railroad, now being surveyed, is begun and completed. Copper deposits on the St. Mary's in East Kootenay, in Kamloops and on Vancouver Island are also being exploited, but as yet not enough work has been done to demonstrate their value; but much interest has been attracted thither and many claims will be carefully tested, as companies have been formed for this purpose.

On Vancouver Island the collieries are engaged supplying a very fair demand for all coal, the high quality of which is already well known, and at Comox coal from the Union mines is being coked, and the excellent coke shipped to smelting centres inland. In the Rocky Mountains the vast deposits of coking coal in the Crow's Nest Pass are now being opened up on a large scale, as the railroad is being rapidly built, and in a short time cheap coal and coke will be shipped to the heart of the smelting centres of the Kootenays and also to the great smelting centres in Montana to the south.

HAULAGE IN MINES In mining, more perhaps than in any other industrial operations, compressed air as a motive power has been found exceptionally advantageous For haulage, it is rapidly supplanting the steam locomotive, and electricity can only be said to take a second place. Mr. E. P Lord, in his paper, read before the Anthracite Coal Operators' Association, New York, adduced many sound reasons for giving the preference to compressed air, even for long distance transmission. It is safer in fiery as well as non-fiery mines, and materially assists ventilation by the air given out by the exhaust, thereby greatly reducing the risk to life or property. In the butt entries and rooms where ventilation has been difficult, and where, on account of low roofs, light rails, etc., other classes of power have not been attempted, the compressed air locomotive has been at work with very manifest success. With electric haulage the danger of sparking of brushes on the motors, rupture of the cables conveying the current, and the contacts made in cables and switches, is very obvious. Even at a low voltage it is possible to obtain a very severe shock, while with a 600-volt circuit on a damp floor or in water the results might be very serious. Other practical advantages in the pneumatic system are the moderate cost of plant and installation, due to the absence of any overhead wires or obstructions, economy of operation secured by durability of construction, convenience and simplicity of management, exceptionally low cost of maintenance, and the practical impossibility of overcharging. There are also cleanliness and quietness in its working, and great flexibility, adapting it to almost any requirements. Steam power is, of course, the origin of compressed air and electricity alike. It is the cost of maintenance, depreciation, operating, repairs, etc., as a transmitter and distributor that should be considered. Air being a perfect gas, is not subject to the losses of condensation like steam, although, of course, subject to some loss during expansion, from contraction, due to fall in temperature. A leakage of air is less dangerous than electric leakage. In passing through pipes air is subject to friction in the same manner as water or any other fluid. Frictional resistances in pipes are proportional to the density of the fluid; consequently, at equal velocities, the frictional resistance of air is enormously less than that of water. Air may be transmitted in mains, without serious loss or fall of pressure, at ten to twenty times the velocity practicable with water. At 90 lb. air is 115 times lighter than water, and frictional resistance at equal velocities is less than 4 per cent. of that of water. In air mains, velocities of 25 to 50 feet per second are allowed without serious frictional loss. Without going further into the comparison of pneumatic with electric or steam haulage, it is undeniable that the writer of this paper has been able to make out a very good case for the superiority of compressed air.

IRON AND NICKEL ALLOYS.—Some recent experiments in alloying nickel with iron have resulted in the discovery of certain remarkable properties as regards expansion, and these have suggested the desirability of using certain alloys for the construction of measuring instruments. Mr. Guillaume has determined the densities and modulus of elasticity of a series of alloys of iron with from 4 to 45 per cent. of nickel. He gives in the "Comptes Rendus" one curious result in the case of alloys with 25 per cent. of nickel. A rule made of this alloy and annealed at a given temperature, continues to elongate when it is kept at a lower temperature. He also finds that an alloy containing 22 per cent. of nickel expands when it is heated much more than ordinary steel, but an alloy of iron with 37 per cent. of nickel hardly expands at all, so that the presence of an additional 15 per cent. of nickel in nickel-iron alloys is sufficient to entirely change the nature of the metal.

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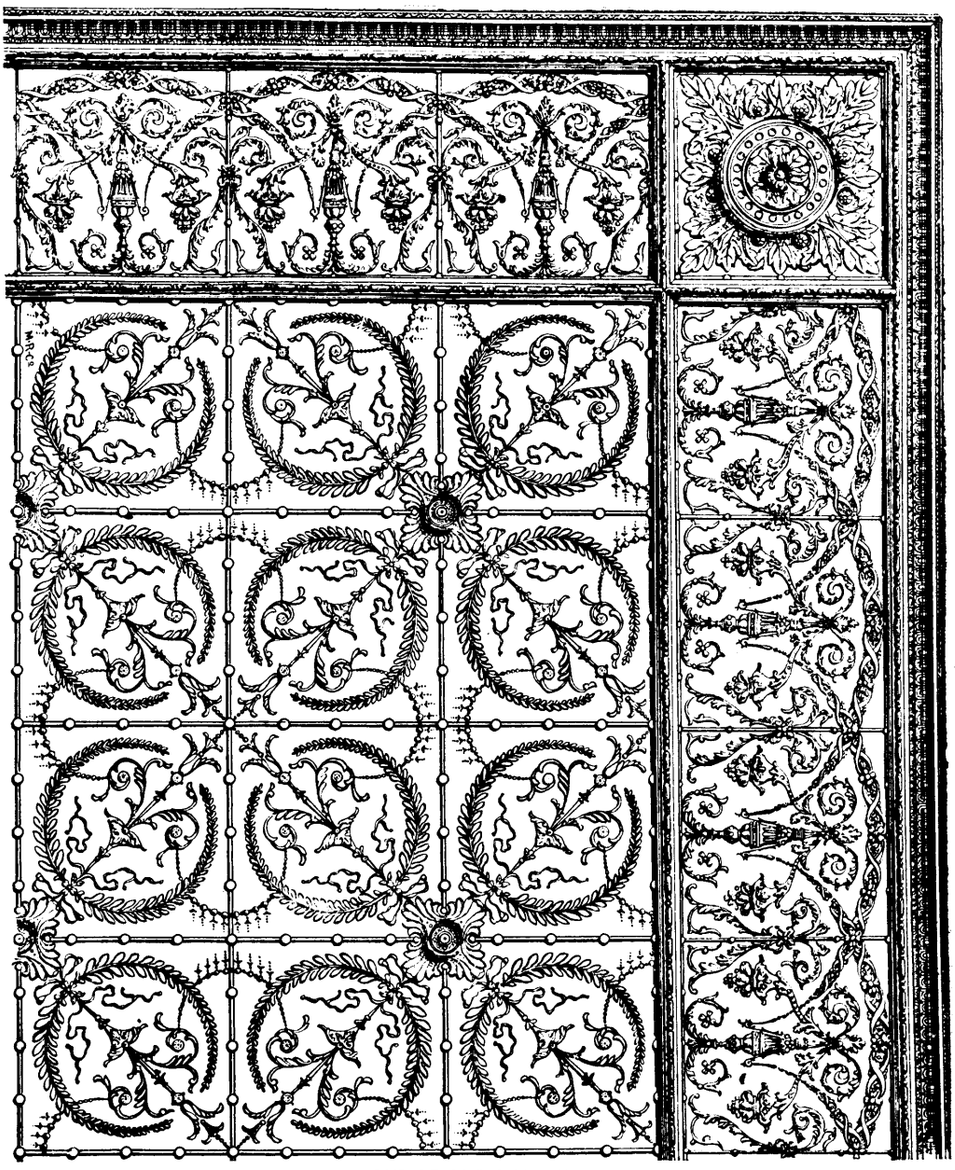

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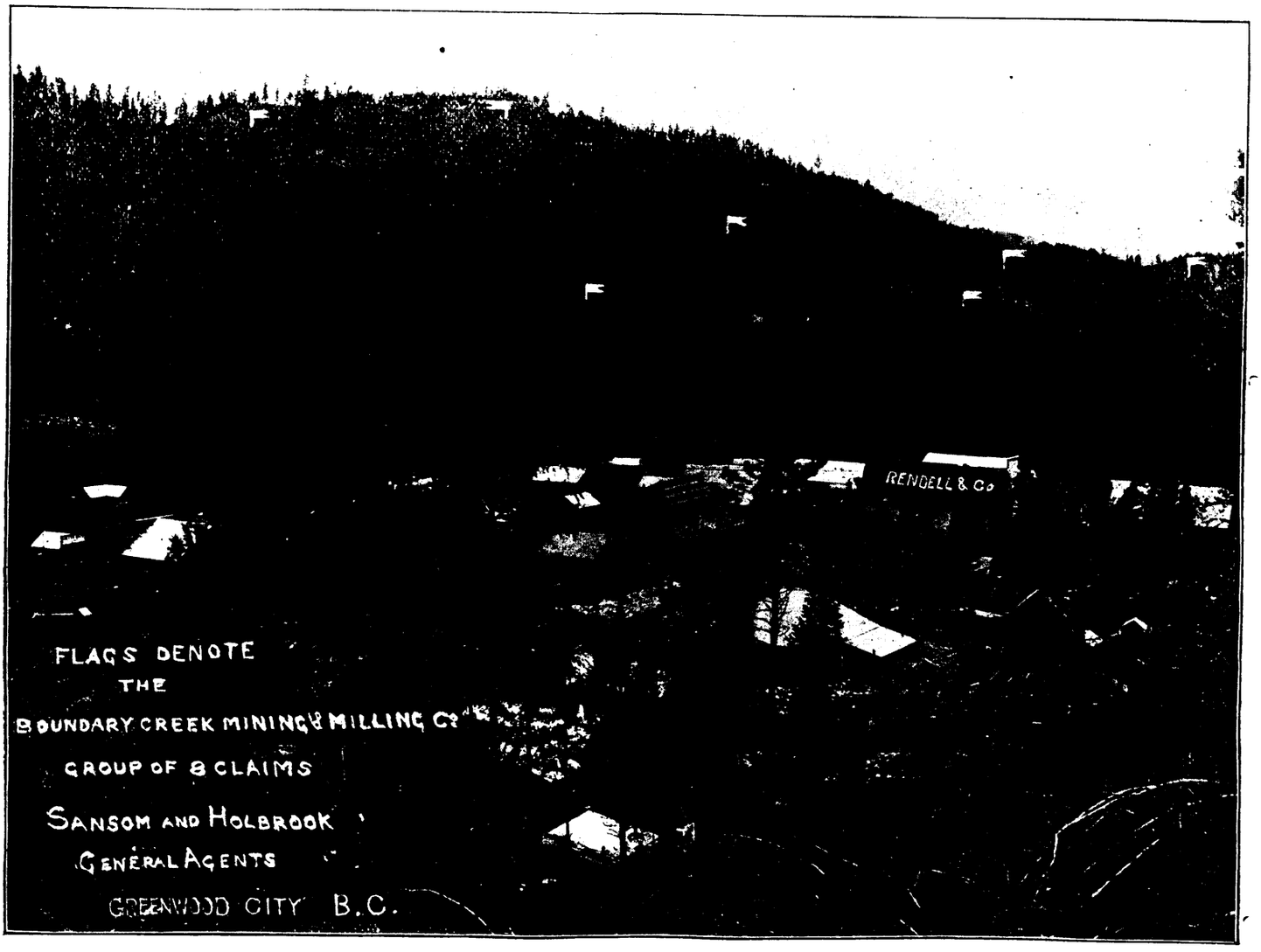
INCORPORATED OCTOBER 21st, 1896.

CAPITAL, $1,500,000. **1,500,000 SHARES AT $1.00 PER SHARE.**

700,000 Shares in the Treasury for Development.

This Company owns and operates a group of the highest grade in Gold, Silver and Copper properties in Boundry Creek.

CLAIMS—The G. A. R., D.A., O. B., S. H. B., J. A. C., FRED D., S. F., C.S. & H., D.H. and BIG LEDGE, constitute the group, which is the most compact and advantageously situated of any under one ownership in Boundary Creek. The proposed Columbia and Western R.R. being surveyed to pass right through Greenwood City and along the base of the hill.



From the above photograph it will be readily seen that, lying as they do on a steep sloping hill, the properties offer unusually good facilities for drainage and rapid and economical development, by main working tunnels driven in from the base of the hill.

The veins lie in the Granite Area—which occupies the upper part of Boundary Creek basin—along the line of contact with the more basic eruptures, and are among the oldest locations in the camp.

A small shipment of 8,653 lbs. was made to the Everett smelter in 1894, yielding per ton, Gold, $103.15; Silver, 74-7-10 ozs.; Lead, two per cent., and a considerable amount of shipping ore is at present on the dumps of the different claims.

Careful investigation is earnestly invited by the Company, as their properties are being developed with a view to making mines and not to booming stock.

Attention is drawn to the large amount of stock (700,000 shares) put into the Treasury, and to the fact that the properties are all fully paid for.

150,000 Treasury shares fully paid up and non-assessable, have been put on the market at 10 cents, and most of the stock so far sold has been taken up locally. A large proportion of the miners now working are also taking stock in payment. For further particulars address

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SECOND ANNUAL

INTERPOVINCIAL CONFERENCE OF CANADIAN MINE OWNERS, MINE MANAGERS AND MINING ENGINEERS

TO BE HELD UNDER THE AUSPICES OF

THE FEDERATED CANADIAN MINING INSTITUTE

IN THE CLUB ROOM

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On Wednesday, Thursday and Friday, 2nd, 3rd, and 4th March, 1898.

SYLLABUS OF PAPERS.

The following among others, will contribute papers for discussion:—

MR. HENRY S. POOLE, M.A., A.R.S.M., General Manager, Acadia Coal Co., Stellarton, N.S.
MR. CHARLES FERGIE, M.E., General Manager, Intercolonial Coal Co., Westville, N.S.
MR F. H. MASON, F.C.S., Halifax.
MR. C. A. MEISSMER, General Manager, Londonderry Iron Co, Londonderry, N S.
MR. JOHN E. HARDMAN, S.B., M.E., Montreal.
MR. GEORGE E. DRUMMOND, Canada Iron Furnace Co., Montreal.
MR. E. A. SJOSTEDT, Metallurgist, Montreal.
MR MILTON HERSEY, Ba.Sc., Montreal.
MR. W. A. CARLYLE, M.E., Provincial Metallurgist, to the Government of British Columbia, Vancouver, B.C.
MR. JOHN B. HOBSON, M.E., General Manager, Cariboo Hydraulic Gold Mining Co., Quesnelle Forks, B.C.
MR. A. H. HOLDICH, A.R.S.M., Nelson, B.C.
MR. HOWARD WEST, A.R.S.M., New Denver, B C.
MR. J. C. GWILLIM, Ba.Sc., M.E., Slocan City, B.C.
MR ROBERT HEDLEY, Metallurgist, Hall Mines Ltd., Nelson, B.C.
MR. F. T. SNYDER, Ottawa Gold Milling and Mining Co., Keewatin.
MR. H. H. PRINGLE, M. Inst. of C.E., Regina (Canada) Gold Mine, Rat Portage, Ont.
MR. J. BURLEY-SMITH, Burley Gold Mining Co., Rat Portage, Ont.
MR. R. H. JONES, F.S.A, Mineralogist, London, Eng.
MR. JOHN BIRKINBINE, M.E., Philadelphia, Pa.
MR SPENCER MILLAR, Am Soc. C.E., New York.
PROF. A. B. WILMOTT, McMaster University, Toronto.
DR. W. L. GOODWIN, School of Mining, Kingston.
MR. C. F. ANDREWS, Isaac's Harbor, N.S.
MR JOHN RUTHERFORD, M.E., Ex-Inspector of Mines for Nova Scotia, Windsor.
DR. E. GILPIN, Inspector of Mines for Nova Scotia, Halifax.
MR. C. C. HANSEN, M.E., Rat Portage, Ont.
MR. LIONEL H SHIRLEY, C. and M.E., Montreal, Que.
MR. J. T. DONALD, M.A., Montreal.
MR. FRANK C. LORING, M.E., Rossland, B.C.

STUDENTS' SESSION.

A session for the reading and discussion of Papers presented by students of Mining Engineering, in competition for the prizes offered annually by the General Mining Association of the Province of Quebec, will be held on Tuesday Evening, 1st February. Intending competitors are requested to communicate the subject of their papers to the Secretary before the 31st of December.

ANNUAL BANQUET.

The Second Annual Dinner of the members of the Federated Institute will be held in the Windsor Hotel, Montreal, on Thursday Evening, 3rd February. His Excellency the Governor-General and other notable persons are expected to be present.

REDUCED RATES ON RAILWAYS.

By arrangement with the various companies, specially low rates will be given to members of the Federated Institute and their friends attending these meetings respecting which fuller particulars will be announced later. For further particulars application should be made to

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4—Prospectors' Course.

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5—Extramural Classes for Prospectors and Mining Men.

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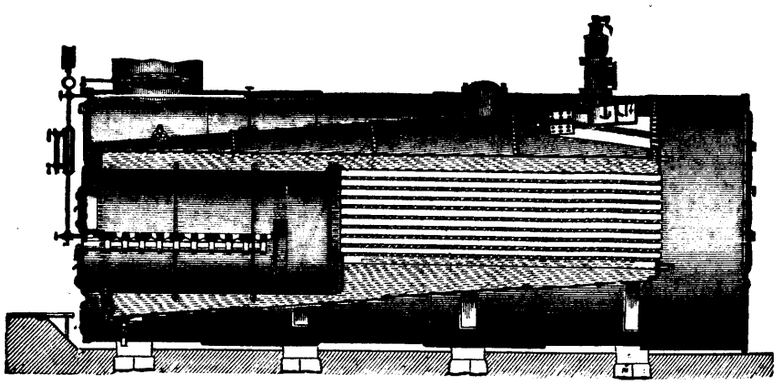

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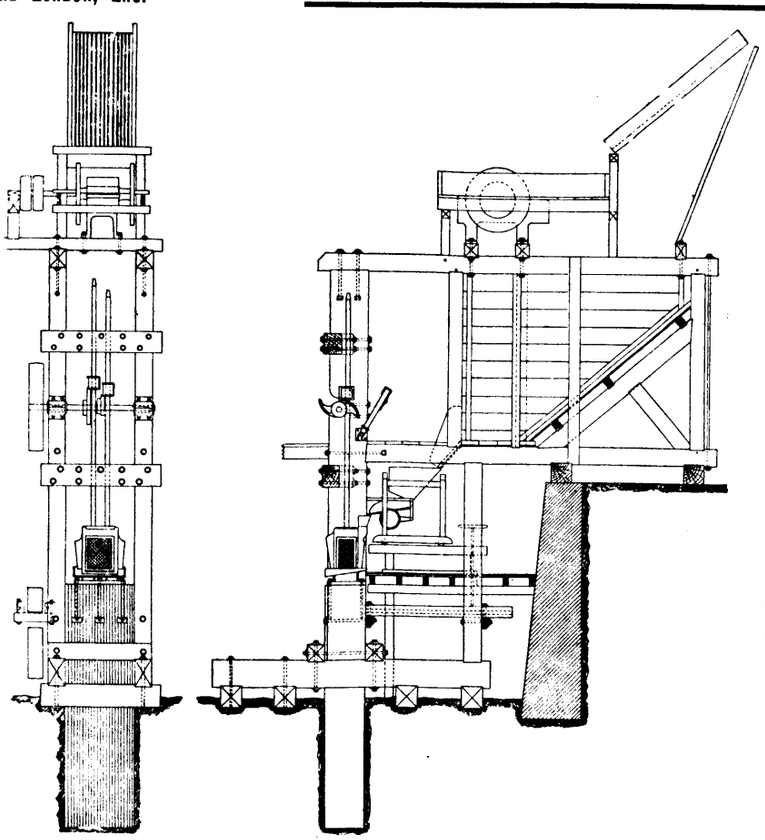

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